



EMBASSY OF THE UNITED STATES ATHENS, GREECE

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ATHENS CHANCERY MAJOR REHABILITATION CHANCERY COLUMN REHABILITATION MOCK-UP SPECIFICATIONS

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US DEPARTMENT OF STATE
BUREAU OF OVERSEAS BUILDINGS OPERATIONS (OBO)
PROJECT NUMBER: S-AQMMA-14-C-0023

Ann Beha Architects

Weidlinger Associates, Inc
Building Conservation Associates, Inc.
Doxiadis Associates

SECTION 000000 – NARRATIVE

OVERVIEW

The intent of the Chancery Rehabilitation Mock-Up is to gather information on the composition and condition of existing elements, determine the best materials and methods for the proposed structural reinforcement and masonry restoration scope, and to better understand the impact on the design and cost of the project.

The Mock-up Contract documents are as follows:

Drawings

G001	TITLE PAGE DRAWING INDEX
G002	DRAWING SYMBOLS ABBREVIATIONS
A101	SITE PLAN & GROUND FLOOR PLAN
A201	EXTERIOR ELEVATIONS
A401	ENLARGED PLAN AND ELEVATIONS
AD501	SELECTIVE REMOVAL & SALVAGE DETAILS
A501	MASONRY RESTORATION DETAILS
A502	MASONRY RESTORATION DETAILS
S001	STRUCTURAL GENERAL NOTES
S100	GROUND FLOOR KEY PLAN & COLUMN ELEVATION
S500	SECTION AND DETAILS

Specifications

SECTION 024193	- SELECTIVE REMOVAL AND SALVAGE
SECTION 039000	- FIBER REINFORCED POLYMER
SECTION 040140	- MASONRY CLEANING TESTS
SECTION 040142	- MASONRY RESTORATION

SCOPE AND SEQUENCE

The mock-up has 4 major phases of work, each which will require submittals, progress reviews, and coordination with other phases. The phases are:

1. Selective Removal and Salvage of Marble Panels
2. Structural Reinforcement of Column
3. Masonry Restoration
4. Masonry Cleaning Tests

1. Selective Removal and Salvage of Marble Panels

The first step in the sequence of work is the selective removal of marble panels at the exterior column K14 where the proposed fiber reinforced polymer (FRP) are to be installed per the structural drawings and specifications.

The Contractor shall take care to remove the marble panels indicated without breaking if at all possible. After removing the marble panels, the Contractor shall remove mortar from the rear face of the marble panels by whatever means are necessary that will not damage the stone. The Contractor shall store marble panels for future reinstallation. If any marble panel(s) break during removal, the Contractor shall retain all pieces of panel(s) for inspections and repair. After the removal of the marble panels, the Contractor shall remove all existing mortar to expose the existing concrete column. The Contractor shall retain samples of mortar for inspection and analysis and remove existing brass support angles and pins and retain for inspection.

At the base of column K14, the contractor shall remove the existing marble paving and divider strips, existing terrazzo paving, existing setting bed, existing slab-on-grade, and existing gravel and earth to facilitate the installation of FRP below-grade at this column per the structural drawings and specifications. The existing marble paving and divider strips and the existing terrazzo paving are to be removed without breaking if at all possible and stored for future reinstallation.

Included as part of selective removal and salvage is the removal of existing pins for selected location, retaining the pins for inspection and noting the location of pins, size, metal type, depth of embedment, and setting material. The Contractor shall also remove two loose ceramic units from a ceramic sun screen and store the units for future reinstallation.

2. Structural Reinforcement of Column

Upon the completion of the selective removal and salvage work, the fiber reinforced polymer (FRP) reinforcement of the exterior column at the intersection of column lines K and 14 can commence.

As shown on the drawings, one column shall be prepared by the contractor for application of FRP, including rounding off sharp and chamfered corners to a radius of 25mm (± 6 mm) by means of grinding or forming with the system's thickened epoxy. The Engineer will hammer concrete to see if there is delamination and to listen for any honeycomb sound. The Contractor shall wrap satisfactory column sections with FRP in accordance with the manufacturer's recommendations with continuous wraps for the length shown on the drawings. The Contractor shall complete report of batch numbers for fabric and epoxy, locations of installation, square footage of fabric and volume of epoxy used each day and submit to engineer-of-record. Engineer will observe the reinforcement of the column and support of the stone. Existing marble panel anchorages to remain that are exposed during the column mock-up will be assessed.

If the alternate for the structural material testing is to be performed at the column (drilled concrete core samples, reinforcing steel tension tests, and concrete carbonation depth tests), these tests should be performed prior to installing the FRP wraps.

3. Masonry Restoration

Upon completion of the fiber reinforced polymer (FRP) reinforcement of the exterior column, the masonry restoration work to reinstall the existing finishes salvaged and stored during selective removal and salvage work may commence.

This work also includes: reinstallation of salvaged panels; providing new stone panels with new anchors; securing hollow sounding panels by grouting through joints and through panels, and patching portholes; securing stone panels by anchoring stone to substrate with helical ties and patching holes for ties; providing new anchors across cracks; reinstalling salvaged ceramic blocks into existing sun screens; providing dutchman repairs in stone units where cores are removed.

Where marble panels have been removed for the installation of fiber reinforced polymer (FRP) reinforcement of the exterior columns the salvaged and/or new marble panels shall be installed by means of mechanical anchors (stainless steel band clamps, stainless steel bent plates, stainless steel drop pins) installed over the FRP and connected to new marble liner blocks and bonded to the column with full bed of mortar.

4. Masonry Cleaning Tests

The masonry cleaning testing are intended to determine the best materials and methods for cleaning various existing exterior finishes. These tests are independent of the selective removal and salvage, fiber reinforced polymer, and masonry restoration work and therefore may occur at any time over the duration of the mock-up. Coordination will be required to insure that the cleaning tests do not impede the other work and vice versa.

The exterior finishes to be tested include marble (Pentelic, Santa Marina, and black St. Peter/Vytina), ceramic sun screens, painted concrete, and painted stucco.

Cleaning methods tested will attempt to remove general soiling, remove dark stains, remove water stains and salt deposits, and strip paint and coatings.

REVIEW MILESTONES

It is intended that representatives from OBO, Post, and the A/E will be present for each portion of the work noted above and that the representatives would be present at the onset of the work to answer any questions and to provide guidance when needed and at the conclusion of the work to review for compliance with the drawings and specifications.

Submittal review milestones for mock-up selective removal and salvage work:

1. Qualification Data: Submit qualification data for firm and personnel specified in "Quality Assurance"
2. Work Description for Selective Removal and Salvage:
 - a. Sequence for performing work
 - b. Procedures to ensure that selective removal and salvage operations do not transfer unacceptable impacts, vibrations, or stresses to historic building fabric.
 - c. Procedures for controlling noise and dust.
 - d. Procedures for releasing or freeing materials and elements from existing construction.
 - e. Protection for elements to be removed and salvaged and for elements to remain.
 - f. Handling and transporting materials and elements removed.
 - g. Provisions for handling and storing elements to be removed and salvaged for reinstallation.
 - h. Disposal locations for elements to be selectively removed and disposed of offsite.
3. Designs for Shoring and Bracing

Submittal review milestones for mock-up FRP work:

1. An approved ICC Evaluation Report. Also, any submittals required as stated in the approved ICC Evaluation Report.
2. A material list, including MSDS for each material component.

3. Manufacturer's product data for both the proposed fiber and epoxy to be supplied, and recommended application procedures, including procedures to properly mix the individual components of the proposed product as well as the proper mix ratios.
4. Certification from the manufacturer of the system's material properties including previously completed ASTM D3039 test results of the proposed system.
5. Complete shop drawings containing details of the number and thickness of layers, joint and end details and locations to satisfy project requirements.
6. Blast Test Reports: Fiber Reinforced Polymers shall be subjected to explosive testing to demonstrate the behavior in response to blast loads. Test results for a project specific floor or column system are not required.
7. Design Calculations: For approval of any product, lay-up or number of plies other than those specified below, submit product design analysis and calculations verifying compliance with required increase of 111-kN in column shear capacity in both the major and minor axis directions.
8. Document a minimum of at least three years of experience for applicator or fifteen similar field applications with acceptable reference letters from respective Owners.
9. Written certification of at least three personnel who have been certified and trained by the FRP system manufacturer who will be on the jobsite during all phases of the installation.
10. Production of an on-site sample of FRP for future review and testing.
11. A list of at least two different qualified testing laboratories who can perform ASTM D3039 tests.

Submittal review milestones for mock-up masonry restoration:

1. Qualification Data: Qualification data for firm and personnel specified in "Quality Assurance"
2. Work Description:
 - a. Materials and Procedures: Materials, methods, tools, and equipment proposed for use.
 - b. Protection: Description.
3. Alternate Methods and Materials (If any)
4. Designs for Temporary Shoring and Bracing
5. Product Data
6. Shop Drawings
 - a. Providing New Stone Panels
 - b. Pinning Stone Panels with Helical Pins
 - c. Dutchman Repairs
7. Samples
 - a. Marble to Match Existing Marble
 - b. Anchors, Fasteners, Pins, and Accessories
 - c. Mortar for Pointing Joints
 - d. Sand for Pointing Mortar
 - e. Custom Patching Mortar for Patching Holes in Marble
 - f. Mortar for Installing Dutchmen
 - g. Sand for Mortar for Installing Dutchmen

Submittal review Milestones for Masonry Cleaning Testing:

1. Qualification Data: Qualification data for firm and personnel specified in "Quality Assurance"
2. Work Description:
 - a. Cleaning: Materials, methods, tools, and equipment proposed for use.
 - b. Protection Description

3. Product Data
4. Waste Disposal Program

END OF SECTION 000000

SECTION 024193 - SELECTIVE REMOVAL AND SALVAGE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 DESCRIPTION

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of selective removal and salvage as shown on the Drawings, as specified herein, and as may be required by conditions and authorities having jurisdiction, including, but not limited to, the following:
1. Providing temporary shoring and bracing as required to ensure stability of building components and fabric to remain.
 2. Providing protection as necessary to protect elements and materials to remain from damage and deterioration
 3. Removing and salvaging the following elements for restoration and reinstallation:
 - a. Stone panels indicated to be removed.
 - b. Existing marble paving and divider strips.
 - c. Existing terrazzo.
 - d. Two loose ceramic units from a ceramic sun screen.
 - e. Existing brass support angles, following inspection by Architect.
 - f. Other elements as indicated on Drawings.
 4. Selectively removing and disposing of the following elements:
 - a. Mortar from joints between stone panels to be removed.
 - b. Mortar behind stone panels.
 - c. Deteriorated concrete behind stone panels to be replaced, following inspection by Architect.
 - d. Corroding metal elements and anchors being replaced, following inspection by Architect.
 - e. Existing pins, following inspection by Architect.
 - f. Existing temporary panel.
 - g. Other elements as indicated on Drawings.
 5. Exposing pins previously installed through the face of the marble panels for review by Architect, to determine their size, metal type, depth of embedment, and setting material.
 6. Delivering items to be reinstalled to locations indicated or designated for storage.
 7. Disposing of elements and materials not to be reinstalled or returned to Owner offsite in a

legal manner.

B. Related Work Specified Elsewhere

1. Fiber Reinforced Polymer – Section 039000
2. Masonry Restoration – Section 040143

1.3 PERFORMANCE REQUIREMENTS

A. Protection for Elements and Materials To Be Removed and Salvaged: Protection for elements and materials to be removed and salvaged shall comply with the following requirements:

1. Prevent damage and deterioration from abrasion, impact, vibration, water (precipitation, condensation, and humidity level), forces caused by handling and transportation, and other exterior forces.
2. Prevent soiling, staining, and marking.
3. Allow application and removal without damaging, deteriorating, or altering existing surfaces and finishes.
4. Provide optimum support to all portions of all elements to prevent cracking, breakage, chipping, and application of undue stress during removal, handling, packing, transportation, and storage.

B. Protection for Elements and Materials To Remain in Place: Completely protect in-place elements and materials to remain from damage and from deterioration that might result from work of this Section—including, but not limited to, dust, dirt, vibration, water, water vapor, condensation, chemicals, chemical vapors, impact, abrasion, excessive stress, temperature extremes, repeated temperature variations, and changes in humidity—without damaging, deteriorating, or otherwise adversely affecting the elements being protected during preparation, application of protection, duration of protection, and removal of protection. All work required to achieve this intent shall be included as work of this Section.

C. Removal: Removal of elements and materials to be removed and salvaged shall be accomplished without damaging, deteriorating, or altering elements and materials to be removed and without damaging, deteriorating, or altering elements, materials, and finishes to remain in place.

D. Storage: Storage shall comply with the following conditions:

1. Provide security from theft, loss, vandalism, damage, and deterioration.
2. Prevent exposure to abrasion, impact, water (precipitation, condensation, and high humidity), excessive heat and cold, substances that might cause soiling or staining, and other deleterious forces.
3. Provide for inspection of components and materials at Architect's request.

1.4 QUALITY ASSURANCE

A. Removal and Salvage Specialist: Award the selective removal and salvage work to a firm or firms regularly engaged in dismantling and salvaging components and materials of historic buildings similar to those required to be removed and salvaged as work of this Section that can

demonstrate to Owner's satisfaction that, within previous five years, the firm has successfully performed and completed in a timely manner at least three projects similar in scope and type to work required on this Project involving historic buildings under the direction of preservation authorities.

1. Foreman: Selective removal and salvage shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Removal and Salvage Specialist. Foreman shall be on site daily for duration of work of this Section. Same foreman shall remain on Project throughout work unless Owner deems foreman's performance unacceptable.
 2. Mechanics: Selective removal and salvage shall be carried out by skilled mechanics who are thoroughly experienced in the removal and salvage of materials from historic buildings and have a minimum of three years' experience with work on historic buildings similar to that required by this Section. In acceptance or rejection of work of this Section, no allowance will be made for workers' inattention or lack of skill.
 3. Mechanics for Removing Mortar from Joints in Stonework: Technicians proposed for cutting joints in stone cladding shall be skilled masons experienced in removing mortar and sealant from joints in stone cladding. Technicians shall be required to successfully complete six linear feet of raking of joints without damaging stone arrises or surfaces. Mechanics who do not complete raking of six linear feet of joint without damaging stone arrises or surfaces shall not be used for work of selective removal and salvage of stone panels on this Project.
- B. Laws, Codes, and Regulations: Work of this Section shall comply with applicable laws, codes, and regulations.
- C. Referenced Standards: Comply with applicable requirements and recommendations of the latest editions of the referenced standards listed herein, except as modified by more stringent requirements of the Contract Documents and of applicable laws, codes, and regulations. In each case in which there is a conflict between requirements of referenced standards; requirements of laws, codes, and regulations; and requirements of this Section, the most stringent or restrictive requirement shall govern.
1. American National Standards Institute (ANSI) A10.6 – *Safety Requirements for Demolition Operations*.
 2. National Fire Protection Association (NFPA) Standard No. 241, *Safeguarding Building Construction and Demolition Operations*.
- D. Shoring and Bracing: Contractor shall retain and pay for the services of a Professional Engineer experienced in the design of shoring and bracing to stabilize objects during construction to design all temporary shoring, bracing, and other support that may be required to ensure that building elements and materials to remain are not damaged, deteriorated, displaced, subjected to stresses that might adversely affect them, or otherwise adversely affected as a result of selective removal and salvage work.
1. Drawings and calculations prepared by the Professional Engineer shall bear an original signature and seal indicating the engineer's Professional Registration. Duplicate copies of drawings and calculations shall be forwarded to the Owner prior to commencing the temporary Work represented in those documents.

2. The Professional Engineer shall furnish additional details, calculations, and other information that may be required by authorities having jurisdiction.
- E. Knowledge of Site and Project Conditions: Before submitting bid, Bidders shall make themselves thoroughly familiar with the Drawings and Specifications, with the scope of this Project, and with conditions at the Project site relating to requirements of this Section and limitations under which the work will be performed and shall determine or verify dimensions and quantities. Submission of a bid shall be considered conclusive evidence that Contractor is thoroughly familiar with Project requirements and site conditions and limitations.
- F. Responsibility for Damage to Historic Material Resulting from Selective Removal and Salvage Work: Restore and/or replace in kind all building components, materials, and finishes damaged or deteriorated as a result of work of this Section.

1.5 SUBMITTALS

- A. General: Submit the following in compliance with the requirements of the Contract Documents. Revise and resubmit each item as required to obtain Architect's approval.
- B. Qualification Data: Submit qualification data for firm and personnel specified in "Quality Assurance" Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least three completed projects similar in size and scope to work required on this Project. For each project list project name, address, architect, supervising preservation agency, scope of contractor's work, and other relevant information. Submit this information with the bid.
- C. Work Description for Selective Removal and Salvage: Detailed description of methods and procedures, equipment, tools, and materials proposed for use in selective removal and salvage operations for each component and material to be removed, including, but not limited to, the following:
1. Sequence for performing work of this Section.
 2. Procedures to ensure that selective removal and salvage operations do not transfer unacceptable impacts, vibrations, or stresses to historic building fabric.
 3. Procedures for controlling noise and dust.
 4. Procedures for releasing or freeing materials and elements from existing construction.
 5. Protection for elements to be removed and salvaged and for elements to remain.
 6. Handling and transporting materials and elements removed.
 7. Provisions for handling and storing elements to be removed and salvaged for reinstallation.
 8. Disposal locations for elements to be selectively removed and disposed of offsite.
- D. Designs for Shoring and Bracing: Drawings and calculations by Professional Engineer retained by Contractor indicating design of temporary shoring, bracing, and other work necessary to ensure support and stability of existing construction and support and stability of materials and elements being removed as part of selective removal and salvage work as required by "Quality Assurance" Article, above.

1.6 MOCK-UPS

A. General:

1. Locate mock-ups as directed by Architect.
2. Architect will monitor mock-ups.

B. Prepare the Following Mock-Ups

1. Removal and Salvage of Stone Panels: At locations indicated on drawings.
2. Removal and Salvage of Marble Pavers: At locations indicated on drawings.
3. Removal and Salvage of Marble Divider Strips: At locations indicated on drawings.
4. Removal and Salvage of Terrazzo Pavers: At locations indicated on drawings.
5. Removal and Salvage of Ceramic Units from a Ceramic Sun Screen: At locations indicated on drawings.
6. Exposing Representative Sample of Pins Previously Installed Through the Face of the Panels to Determine their Size, Metal Type, Depth of Embedment, and Setting Material: At locations indicated on drawings.

1.7 PROJECT CONDITIONS

A. Safety: Protect all persons, whether or not involved in work of this Section, from harm caused by or resulting from work of this Section.

1. Protection from Hazardous Materials: Protect workers and other persons from contact with hazardous materials resulting from work of this Section.
 - a. Silica: Overexposure to respirable crystalline silica may lead to silicosis, which is a disabling, nonreversible, and sometimes fatal lung disease. Provide protections necessary to prevent workers from exposure to respirable crystalline silica. Comply with applicable federal, state, and local laws, codes, and regulations.
 - b. Lead-Containing Material: Perform work with materials containing lead in compliance with applicable OSHA regulations, including but not limited to, Lead in Construction and Hazard Communication Standard (Title 29, Sections 1926.62 and 1910.1200, respectively, Code of Federal Regulations, OSHA, US Department of Labor) and with other applicable federal, state, and local laws, codes, and regulations.
 - c. Asbestos-Containing Material: Comply with applicable federal, state, and local laws, codes, and regulations for handling asbestos-containing materials including, but not limited to, regulations for removing, handling, transporting, and disposing of asbestos-containing materials.
2. Protection from Noise: Limit noise generated by work of this Section to an absolute minimum. Prevent all persons, whether or not involved with the work of this Section, from noise that might adversely affect them.

B. Protection of Building and Property: Provide protection and procedures necessary to protect adjacent elements and materials from damage and from deterioration during work of this Section.

1. Protection from Rain and Other Precipitation: Protect building components and finishes from damage and from deterioration caused by precipitation and other weather-related causes resulting from work of this Section.
 2. Protection from Fire: Take all precautions necessary to prevent fire and spread of fire.
 3. Protection from Water and Other Products Used in the Work: Provide protection necessary to prevent damage and deterioration of building elements and materials to remain caused or resulting from products and procedures used in executing work of this Section.
 4. Protection from Dust: Limit dust resulting from work of this Section to an absolute minimum.
 5. Shoring and Bracing: Provide temporary shoring and bracing as necessary to ensure stability of all components of the work.
- C. Debris Removal
1. Do not drop or throw materials from any height. Lower materials and debris using suitable hoists and containers. Remove debris from site using suitable containers and conveyances.
 2. Keep premises clean by removing accumulation of waste materials, rubbish, and debris from site daily. Dispose of waste, rubbish, and debris in a proper manner in accordance with all applicable laws, codes, and regulations, to the satisfaction of authorities having jurisdiction, and to the satisfaction of the Architect. Keep site and public rights of way clear.
- D. Security: Secure components and materials to be removed and salvaged from theft, loss, defacement, damage, and deterioration.
- E. Condition of Site: Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical. Owner assumes no responsibility for condition of elements to be selectively removed.
- F. Disposal: Dispose of removed materials offsite in a legal manner. Storage or sale of removed items or materials onsite is not permitted.

PART 2 - PRODUCTS

2.1 MATERIALS FOR PROTECTION AND SUPPORT OF INPLACE ELEMENTS, MATERIALS, AND FINISHES

- A. General: Provide materials to protect and support existing elements, materials, and finishes to remain in place during selective removal and salvage work on adjacent elements suitable for use intended and approved by Architect.
1. Separate materials and elements to be protected from contact with materials used for protection that might stain or discolor them.
- B. Resilient Materials: Natural or synthetic batting, non-out-gassing foam boards, bubble wrap, and other approved materials.

- C. Rigid Materials: Plywood and other approved materials. Reinforce sheet materials using dimensioned lumber as required to resist deflection and impact damage using sound wood members.
- D. Anchors and Fasteners: Of suitable size and design for use intended and approved by Architect.

2.2 MATERIALS FOR PROTECTION OF REMOVED AND SALVAGED STONE PANELS

- A. General: Provide materials for protection of removed and salvaged stone panels suitable for use intended and approved by Architect.

2.3 TOOLS AND EQUIPMENT

- A. General: Provide tools suitable for use intended that will do the least amount of damage to elements and materials to remain. Use only tools described in approved Work Description for Removal and Salvage.
 - 1. Hand Tools: Use small, sharp hand tools designed for cutting and sawing, small pry bars, and other appropriate tools.
 - a. Protect surfaces of elements and materials to remain in place from contact with metal tools used for removal by protecting with wood or other appropriate material.
 - 2. Power Tools: Small power tools with rotating blades or small vibrating blades with fine teeth to minimize vibration and width of kerf. Do not use reciprocating saws.
 - 3. Drills: Small rotary power drills with sharp bits or core bits as appropriate for use intended. Do not use hammer drills.
- B. Tools for Removing Mortar from Joints in Stone Cladding
 - 1. Hand Tools: Chisels, hammers, and mallets.
 - a. Thickness of Chisels: Maximum thickness of 5/8 times joint width extending from tip at least three times depth at which chisel will be inserted into joint.
 - 2. Power Tools: Standard tools and equipment, modified tools and equipment, and custom designed and fabricated tools and equipment as necessary to remove mortar from narrow joints without damaging masonry units.
 - a. Electric Grinders: Small, hand-held electric grinders with blades no greater than 2 millimeters (1/16 inch) thick and a maximum of 115 millimeters (4-1/2-inch) diameter.
 - b. Pneumatic Grinders: Specially modified pneumatic die grinders with thin diamond abrasive blades. Subject to compliance with requirements, provide wafer blades as manufactured by CDP Diamond Products, Inc., 11919 Globe, Livonia, MI 48150 (00-1-800-521-0638), or approved equal.
 - c. Hand-Held Multipurpose Oscillating Tool with Diamond Blade: Multipurpose oscillating tool with thin diamond blade not exceeding 3/4 times width of joints

designed for removal of grout and mortar. Provide Fein MultiMaster, manufactured by Fein Power Tools, Inc., 1030 Alcon Street, Pittsburgh, PA 15220 (00-1-877-771-0088), or approved equal, with appropriate diamond blades.

- C. Tools For Removing Mortar From Behind Stone Panels With Panels In Place
 - 1. Hydraulic Concrete Chain Saw with 635 mm (25 inch) guide bar. Provide 890F4 Hydraulic-Powered Concrete Chain Saw, manufactured by ICS, Blount Europe SA, Rue Emile Francqui 5, 1435 Mont-Saint-Guibert, Belgium, Phone: +32 10 301 251.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Engage a Professional Engineer to survey condition of building to determine whether removing any component might result in structural deficiency or unplanned collapse of any other component during selective removal and salvage operations.
- B. Perform surveys as the Work progresses to detect hazards resulting from selective removal activities.

3.2 PREPARATION FOR SELECTIVE REMOVAL AND SALVAGE

- A. Site Access and Temporary Controls: Conduct selective removal work and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Shoring and Bracing: Provide and maintain shoring, bracing, reinforcement, structural supports, and enclosures as necessary to maintain existing construction to remain safely and securely in position without displacement and without damage or deterioration during selective removal and salvage work and to prevent unexpected or uncontrolled movement or collapse of construction being removed.
- C. Protection: Provide protection against damage by water and fire, and injury to the public, workers, occupants and contents of existing building, damage to adjacent property, and damage to portions of existing building not being selectively removed.
 - 1. General: Install protections before beginning general selective removal and salvage work. Protect building, utilities, and equipment, including temporary supports, dust and other enclosures, barricades, and other elements from damage and from deterioration.
 - 2. Protection of Adjacent Components, Materials, and Finishes: Protect components from damage caused by or resulting from selective removal and salvage operations.
 - a. Resilient Cover: Provide resilient, non-abrasive material adjacent to materials and elements to be protected.
 - b. Rigid Protective Cover: Provide rigid cover to prevent impact damage and hold

materials and elements in place should they become dislodged by vibrations or other effects of construction work.

- c. Waterproof Cover: Protect materials and elements from water, water vapor, and condensation that might damage or deteriorate them.

3.3 SELECTIVE REMOVAL AND SALVAGE, GENERAL

- A. Support: Provide shoring, bracing, reinforcement, and enclosures necessary to prevent damage and to prevent deterioration prior to beginning selective removal and salvage work.
- B. Protection: Provide protection from dust, noise, and other conditions to be generated by work of this Section.
- C. Hoisting: Use appropriately sized hoisting devices and cribbing for removal, lifting, and lowering.
- D. Selective Removal: Perform selective removal work systematically in a careful, workmanlike manner using methods required to complete the Work within limitations of governing regulations and as specified herein. Dispose of elements and materials indicated to be selectively removed offsite in a legal manner.
 - 1. Proceed with selective removal systematically. Complete operations in one location before proceeding to other locations.
 - 2. Use hand tools or small power tools designed for sawing or grinding to minimize disturbance of adjacent surfaces.
 - 3. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage both construction to remain and adjoining construction. Temporarily cover openings to remain.
 - 4. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 5. Locate selective removal equipment and remove debris and materials so as not to impose excessive loads on building components.
 - 6. Do not use cutting torches and other devices, including but not limited to heat guns, generating heat.
- E. Removed and Salvaged Items To Be Reinstalled
 - 1. Salvaging Components: Salvage elements as indicated. Protect stone panels from damage during handling and storage. Store stone on pallets with non-staining wood strips between units. Protect from damage and deterioration.
 - 2. Cleaning: Clean panels free of mortar, grout, and other contaminants as specified in appropriate specification sections.
 - 3. Reinstallation: Reinstall items in original locations indicated. Comply with installation instructions in Section 040143 – “Masonry Restoration.”
- F. Removed Items To Be Disposed of Offsite: Except for items and materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner’s property, transport materials removed during work of this Section from Project site and legally dispose of them.

3.4 REMOVAL AND SALVAGE OF STONE PANELS

- A. General: Handle and treat stone units to be removed and salvaged as part of work of this Section in accordance with requirements of this Section and with requirements of Section 040143 – “Stone Cladding Restoration.” Repair or replace all stones broken and all stones deteriorated during removal, handling, and storage as directed by Architect at no additional cost to Owner. Repair procedures shall comply with requirements of Section 040143 – “Masonry Restoration.”
- B. Preparing for Removal: Before attempting to remove stone panels, remove mortar from joints around the entire perimeter of the stone.
 - 1. Use methods for removing mortar that avoid damage to surfaces and arrises of stone blocks.
 - 2. Use plastic or non-staining wood wedges to temporarily support stone units in place during mortar removal.
 - 3. Cut anchors and ties encountered in clearing the joints.
- C. Removing Stone Panels: Carefully remove panels. Where panels are not free after removal of mortar in joints and cutting of anchors, gently use vibrating instrument to free panel from setting mortar. Label stone panels using approved identification system in location that will be hidden after units are reinstalled. Clean off remains of mortars and grouts using care to avoid damage to stone surfaces and arrises. Use mallet and chisels, abrasive stones, stiff fiber bristle brushes, and other approved methods.
- D. Handling Stone: Handle stone to prevent chipping, breakage, soiling, or other damage. Do not use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials that will not mar stone. Lift with wide belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances that might cause staining. Use wood rollers and provide cushion at end of wood slides as necessary to avoid damaging stone units.
- E. Storing: Store stone panels in locations as designated by Owner. Store stone on wood skids or pallets. Place blocks on skids to distribute weight evenly and to prevent breakage and cracking of stones. Do not stack skids. Protect stored stone from weather with waterproof, nonstaining covers or enclosures, but allow air to circulate around stones.
- F. Protecting Stone Units: Protect stone against moisture, soiling, staining, physical damage, vandalism, and theft.
- G. Disposal: Dispose of mortar and anchors and accessories not to be reinstalled legally off site.

3.5 CLEANING AND ADJUSTMENT

- A. Cleaning during Progress of Work: Remove debris as work progresses. Maintain premises in neat and clean condition.
- B. Cleaning at Completion of Selective Removal and Salvage: Clean areas from which elements and materials have been selectively removed of dust, dirt, and debris caused by selective removal operations. Return adjacent areas to condition existing before selective removal and salvage operations began.

- C. Replacing Excess Removal: Repair or replace selective removal work performed in excess of that required. Return structures and surfaces to remain to conditions existing prior to commencement of selective removal and salvage work.
- D. Restoration of Adjacent Surfaces: Repair or replace adjacent construction or surfaces soiled or damaged by selective removal and salvage work to condition existing before beginning work to Architect's satisfaction at no additional cost to Owner.

END OF SECTION 024193

SECTION 039000 – FIBER REINFORCED POLYMER

PART 1 - GENERAL

1.1 GENERAL

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 DESCRIPTION

- A. Work of this Section includes all submittals, materials, tools, equipment, transportation, necessary storage, labor, and supervision required for the application of fiber reinforced polymer systems for reinforced concrete strengthening.

1.3 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.
2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Standard for Testing and Materials (ASTM)

1. ASTM D 3039/D 3039M (2014), Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials.
2. ASTM D 7522/D 7522M (2015) Standard Test Method for Pull-Off Strength for FRP Laminate Systems Bonded to Concrete Substrate.
3. ASTM D 7565/D 7565M (2010), Standard Test Method for Determining Tensile Properties of Fiber Reinforced Polymer Matrix Composites Used for Strengthening of Civil Structures.

C. International Concrete Repair Institute (ICRI)

1. ICRI Guideline 210.3R-2013, Guideline for Using In-Situ Tensile Pull-Off Tests to Evaluate Bond of Concrete Surface Materials.

D. International Code Council (ICC)

1. ICC AC125 (2013), Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems.
2. ICC AC178 (2013), Acceptance Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber Reinforced Polymer (FRP) Composite Systems.

E. American Concrete Institute (ACI)

1. ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures.
2. ACI 503R-93 Use of Epoxy Compounds with Concrete.

1.4 SUBMITTALS

A. The following items must be submitted by the contractor or sub-contractor for the proposed fiber reinforced polymer system:

1. An approved ICC Evaluation Report, compliant with the 2009 IBC, in the name of the proposed system and the system's manufacturer. Also, any submittals required as stated in the approved ICC Evaluation Report, such as manufacturer design manuals and quality documentation.
2. A material list of items proposed to be provided under this section, including MSDS for each material component.
3. Manufacturer's product data for both the proposed fiber and epoxy to be supplied, specifications, and recommended application procedures showing compliance with the specified requirements, including procedures to properly mix the individual components of the proposed product as well as the proper mix ratios.
4. Certification from the manufacturer of the system's material properties including previously completed ASTM D 3039/D 3039M test results of the proposed system.
5. Complete shop drawings containing details of the number and thickness of layers, joint and end details and locations to satisfy project requirements.
6. Blast Test Reports: Fiber Reinforced Polymers shall be subjected to explosive testing to demonstrate the behavior in response to blast loads. Test results for a project specific floor or column system are not required. Submit certified test reports performed by a recognized testing laboratory for a system with the submitted material properties and thickness, bonded to a reinforced concrete slab or column. Application procedure shall be similar to that used for this Project.
7. Design Calculations: For approval of any product, lay-up or number of plies other than those specified below, submit product design analysis and calculations verifying compliance with required increase of 111-kN in column shear capacity in both the major and minor axis directions. All calculations shall be performed by a Registered Professional Engineer, having formal training in structural dynamics, and 5 years demonstrated experience with accepted design practices for blast resistant design.

8. Document a minimum of at least three (3) years of experience for applicator or fifteen (15) similar field applications with acceptable reference letters from respective Owners.
9. Written certification from the composite system manufacturer showing the names of at least three personnel who have been certified and trained by the FRP system manufacturer who will be on the jobsite during all phases of the installation (see Section 3.1 of this specification).
10. A list of at least two different qualified testing laboratories who can perform the required ASTM D 3039/D 3039M tests as per section 3.7 of this specification.

1.5 QUALITY ASSURANCE

- A. Testing and Inspections Agency Qualifications: Independent agency, acceptable to Project Director/COR, qualified according to ASTM C 1077 and ASTM E 329 (or similar Greek or European Standard) for testing indicated.
 1. Personnel conducting field tests shall be qualified as demonstrated by experience and appropriate certification such as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or equivalent certification program.
 2. Personnel performing laboratory tests shall be qualified as demonstrated by experience and appropriate certification such as ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I or equivalent certification program. Testing Agency laboratory supervisor shall be qualified as demonstrated by experience and appropriate certification such as ACI-certified Concrete Laboratory Testing Technician - Grade II.
- B. Testing and Inspections Service: Engage a special inspector and a qualified testing and inspecting to perform material evaluation tests and required special inspections for FRP installation.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver epoxy materials in factory-sealed containers with the manufacturer's labels intact and legible with verification of date of manufacture and shelf life.
- B. Store materials in a protected area at a temperature between 4° and 38° C.
- C. Products shall be stored according the manufacturer's requirements and shall avoid contact with moisture.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND PRODUCTS

- A. Fyfe, 51 Ithakis Street & Kordeliou, Glyfada, 16561, Athens, Greece. Tel: +30.210.995.9595, Fax: +30.210.995.9965, email: info@fyfe-europe.gr.
1. Fabric – Tyfo® SEH-51A
 2. Epoxy Resin – Tyfo® S epoxy
- B. Structural Technologies, 10150 Old Columbia Road, Columbia, MD 21046, United States. Tel: 1.410.850.7000, Fax: 1.410.850.4111
1. Fabric – V-Wrap™ EG50
 2. Epoxy Resin – V-Wrap™ 700 epoxy
- C. Sika, Protomagias 15, Kryoneri Attikis 145 68, Athens, Greece. Tel: +30 21 0816 0600 Fax:+30 21 0816 0606
1. Fabric – SikaWrap®-100G or -430G
 2. Epoxy Resin – Sikadur®-300, 301 or 330 epoxy
- D. Engineer-of-record approved equal that satisfies all of the requirements of Section 1.4 and shows equality to materials defined in Section 2.2. Proposed alternate composite system must be approved in an addendum to these specifications by the engineer of record two-weeks prior to the project bid date.

2.2 COMPOSITE STRENGTHENING SYSTEM

- A. The table below shows the minimum mechanical properties of the cured composite system used for the project design.

PROPERTY	Unidirectional Composite System Requirement	ASTM TEST METHOD
Ultimate Tensile Strength in primary fiber direction, min.	460 MPa	D 3039/D 3039M
Elongation (%): Minimum Maximum	1.5 4.0	D 3039/D 3039M
Tensile Modulus, min.	20.9 GPa	D 3039/D 3039M

Corresponding Thickness per layer	1.3mm	N/A
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- B. Provide a minimum of two plies of FRP consisting of the above required material properties, wrapping the applicable reinforced concrete column(s) for the applicable height, as shown in the Construction Drawings.

2.3 OTHER MATERIALS

- A. Provide other materials as needed for the proper installation of the complete composite system, as selected by the contractor in conformance with these specifications.

PART 3 - EXECUTION

3.1 The work specified under this specification shall be performed by an applicator with proven past experience applying the approved composite system for a minimum of three (3) years or 15 similar field applications with acceptable reference letters from respective Owners. The applicator must supply the names of at least three individuals who have been certified and trained by the FRP system manufacturer and who will be on site during all phases of the project. The engineer of record shall have the right to approve or reject the personnel qualifications as submitted. The engineer may suspend the work if the contractor substitutes unauthorized personnel for authorized personnel during construction.

3.2 The applicator company must be certified by the manufacturer/supplier and provide a quality control procedure in accordance with section 3.7 of this specification.

3.3 The supply and installation of the composite system is to meet the performance criteria of this specification and as stated on the contract drawings.

3.4 Surface Preparation

A. Substrate:

1. The surface to receive the composite shall be free from fins, sharp edges and protrusions that will cause voids behind the installed casing or that, in the opinion of the Engineer, will damage the fibers. Existing uneven surfaces to receive composite shall be filled with the system epoxy filler or other material approved by the Engineer of record. Filling of large voids and cracks in surfaces to receive composite shall be performed prior to the installation of the composite system (small pinholes or micro-bubbles in the concrete surface or resin do not require special detailing). The contact surfaces shall have no free moisture on them at the time of application. If moisture is present, use the manufacturer suggested wet prime epoxy, if available.

2. Repair all damaged concrete, spalls, and irregular surfaces to create a flat, or slightly convex, surface. Sack, or fill with thickened epoxy, surfaces as necessary to eliminate large air surface voids, greater than 13mm diameter. Well-adhered paint and concrete do not require removal.
3. Round off sharp and chamfered corners to a radius of 25mm (± 6 mm) by means of grinding or forming with the system's thickened epoxy. Variations in the radius along the vertical edge shall not exceed 13mm for each 300mm of column height.
4. Surfaces shall be prepared for bonding by means of abrasive blasting or grinding to remove existing laitance and expose aggregate (minimum ICRI CSP-2 concrete surface profile). All contact surfaces shall then be cleaned by hand or compressed air. One prime coat of the manufacturer's epoxy shall be applied and allowed to cure for a minimum of one hour. Prior to the application of the saturated composite fabric, fill any uneven surfaces with the manufacturer's thickened epoxy. Provide anchorage as detailed on construction drawings.

3.5 Procedures for Application

- A. Preparation work for project: Visit site to ensure that all patch work is complete and cured. Review project specifications in detail.
- B. Verify ambient and concrete temperatures. No work shall proceed if the temperature of the concrete surface being repaired is less than 4° C or greater than 38° C. The temperature of the epoxy components shall be between 4° and 38° C at the time of mixing or as specified on the component labels. When air temperature is outside the prescribed range, other measures must be employed to ensure components' temperature is maintained within this range.
- C. Prepare the epoxy matrix by combining components at a ratio specified by the system manufacturer, with an allowable tolerance of $\pm 10\%$. The components of epoxy resin shall be mixed with a mechanical mixer until uniformly mixed, typically 5 minutes at 400-600 rpm. Components that have exceeded their shelf life (as designated on the material label) shall not be used.
- D. Both epoxy resin and fabric shall be measured accurately, combined, and deposited uniformly at the rates shown on the approved working drawings and per manufacturer's recommendations. The composite system shall be comprised of fibers completely saturated with epoxy resin per proper ratio.
- E. Quality control procedures: Record batch numbers for fabric and epoxy used each day, and note locations of installation. Measure square footage of fabric and volume of epoxy used each day. Complete report and submit to engineer-of-record, Special Inspector and system manufacturer. See section 3.7 of this specification.
- F. Fabric sampling procedure: On a smooth, flat, level surface covered with polyethylene sheeting, or 0.4mm plastic film, prime with epoxy saturant, then prepare sample by placing two layers of saturated fabric oriented in the same direction and allow to cure. Apply additional topping of epoxy as required to ensure complete saturation. Samples shall be stored in a sample

box and not moved for a minimum 48 hours after casting. The prepared, identified samples shall be provided to the testing and inspection agency.

G. Installation Procedures:

1. Prepare surface as required, including corner preparation.
2. Remove dust and debris by hand or with compressed air in a manner satisfactory to the Owner's representative.
3. Clean up and protect area adjacent to element.
4. Using a roller or trowel, apply one prime coat of thickened epoxy resin to the concrete surface (0.05mm min.). Allow primer to become tacky to the touch.
5. Fill any uneven surfaces or recesses with thickened epoxy.
6. Saturate fabric with epoxy matrix as per manufacturers specifications.
7. Apply saturated fabric to concrete surface by hand lay-up, using methods that produce a uniform, constant tensile force that is distributed across the entire width of fabric. Under certain application conditions, the system may be placed entirely by hand methods assuring a uniform, even final appearance. Gaps between composite bands may not exceed 13mm width in the fabric's transverse joint unless otherwise noted on project drawings. A lap length of at least 150mm is required at all necessary overlaps in the primary fiber direction of the fabric.
8. Apply subsequent layers, continuously or spliced, until designed number of layers is achieved, per project drawings.
9. Using a roller or hand pressure, ensure proper orientation of fibers, release or roll out entrapped air, and ensure that each individual layer is firmly bedded and adhered to the preceding layer or substrate.
10. Detail all fabric edges, including butt splice, termination points, and jacket edges, with thickened epoxy.
11. Finish: All edges and seams must be feathered with thickened epoxy. Use system as directed by manufacturer. Apply protective coatings as specified between 24 and 72 hours after final application of epoxy. If after 72 hours the epoxy is cured, the surface must be roughened by sanding or brush blasting.
12. System may incorporate structural fasteners but limitations and detailing must be verified with composite system manufacturer.

3.6 Procedure Modifications

- A. Installation procedures may be modified to achieve maximum results, subject to approval of the engineer-of-record. Procedure modifications shall be discussed with the engineer-of-record prior to implementing the modifications.

3.7 Field Quality Control

- A. General: The field quality control procedures shall be in accordance with the following details in addition to ICC AC178, "Acceptance Criteria for Inspection and Verification of Concrete and

Reinforced and Unreinforced Masonry Strengthening Using Fiber Reinforced Polymer Composite Systems.”

- B. Installers: Record batch numbers for fabric and epoxy used each day, and note locations of installation. Measure square footage of fabric and volume of epoxy used each day. Complete report and submit to engineer-of-record and system manufacturer.
- C. Testing and Inspections: Engage a special inspector and a qualified testing and inspecting agency to perform tests and inspections, and to submit test and inspection reports.
- D. Inspection: Certified Special Inspector shall periodically observe all aspects of preparation, mixing, and application of materials in accordance with the applicable requirements in AC178 and Sections 1704 through 1707 of the IBC, including the following:
 - 1. Material container labels
 - 2. Surface Preparation
 - 3. Mixing of epoxy
 - 4. Application of epoxy to the fiber
 - 5. Application of composite system
 - 6. Curing of composite material
 - 7. Preparation and labeling of test samples
 - 8. The composite casing shall be completely inspected by the Special Inspector during and immediately following application of the composite. The contractor shall monitor the mixing of all epoxy components for proper ratio and adherence to manufacturer’s recommendations.
- E. Field Tests:
 - 1. In-Situ Tensile Pull-Off Test: Tensile pull-off testing of concrete substrate shall be conducted in accordance with ICRI Guideline 210.3R-2013. A minimum of two tests shall be performed for each day of production or for each 90m² of FRP application, whichever is less. Adhesion tests shall be performed on a representative adjacent area to the area being strengthened whenever possible. Tests shall be performed on each type of substrate. The locations of the tests shall be representative and on flat surfaces. If no adjacent areas exist, the tests shall be conducted on areas of the FRP system subjected to relatively low stress during service. The minimum acceptable value for any single pull-off test is 1.2 MPa. The average of the tests at each location shall not be less than 1.4 MPa. Additional tests may be performed to qualify the work. Test locations shall be filled with thickened epoxy after the values have been recorded and verified by the special inspector and the test dollies have been removed.
 - 2. In-Situ Adhesion Tests: Direct tension adhesion testing shall be conducted using the method described by ASTM D 7522/D 7522M. A minimum of two tests shall be performed for each day of production or for each 90m² of FRP application, whichever is less. Adhesion tests shall be performed on a representative adjacent area to the area being strengthened whenever possible. Tests shall be performed on each type of substrate or for each surface preparation technique used. The prepared surface of the bonded FRP system shall be allowed to cure a minimum of 72 hours before execution of the adhesion test.

The locations of the tests shall be representative and on flat surfaces. If no adjacent areas exist, the tests shall be conducted on areas of the FRP system subjected to relatively low stress during service. The minimum acceptable value for any single adhesion test is 1.2 MPa. The average of the tests at each location shall not be less than 1.4 MPa. Additional tests may be performed to qualify the work. Each adhesion test is to exhibit a failure mode in the substrate and not the epoxy-to-substrate bond plane. Test locations shall be filled with thickened epoxy after the values have been recorded and verified by the special inspector and the test dollies have been removed.

F. Laboratory Testing:

1. Tensile Tests: Tensile testing of RFP samples shall be completed in accordance with ASTM D 3039/D 3039M. Record lot number of fabric and resin used, and location of installation. A "sample batch" shall consist of two 300mm x 300mm samples of cured composite made of two composite layers, with the major reinforcement in the same direction for both layers. A minimum of two sample batches shall be made daily. The two sample batches will be taken at appropriate times during the day so as to ensure the maximum material deviance in the components of the composite. Testing laboratory shall pre-condition samples at 60° C for 48 hours before testing. The 300mm x 300mm panel shall have 5 coupons, 19mm x 230mm, removed and tested for their material properties in the longitudinal (primary fiber) direction. Tests shall conform to ASTM procedures and manufacturer's published testing methods. Testing results shall be made available within 3 weeks of sample submission. The testing shall provide average values of the following
 - a. Ultimate tensile strength
 - b. Tensile modulus
 - c. Percent elongation

G. Repairs: All defects, including bubbles, delaminations, and fabric tears, spanning more than 5% of the surface area, or as specified by the owner or engineer, shall be repaired. Two types of repairs shall be performed:

1. Small defects (on the order of 75mm diameter) shall be injected or back filled with epoxy.
2. Large defects shall be repaired as required by the consulting engineer's specifications and manufacturer's specifications.
3. The cured laminate shall exhibit a void content no greater than 0.5% by volume in order to avoid moisture intrusion. Small entrapped air pockets and voids naturally occur in mixed resin systems and do not require repair or treatment. Defect repair shall be provided by the manufacturer and be submitted to the structural engineer of record for approval.

H. Remedial Measures: In the event that material testing, per section 3.7.C, determines a sample batch to possess insufficient material properties, remedial measures shall be taken. If the tested composite system has material properties determined to be below the minimum specified values, additional layers shall be installed until the final composite thickness is increased by the

same percentage as the deficiency of the material's elastic modulus. Any required additional material and labor for remedial repairs would not be paid for as an extra to the contracted work.

END OF SECTION 039000

SECTION 040140 - MASONRY CLEANING TESTS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 DESCRIPTION

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of masonry cleaning tests, as specified herein, and as may be required by conditions and authorities having jurisdiction, including, but not limited to, the following:
1. Cleaning test to remove general soiling from Pentelic and Santa Marina marble using water misting and medium pressure water rinsing.
 2. Cleaning test to remove general soiling from Pentelic and Santa Marina marble using micro-abrasive cleaning system
 3. Cleaning test to remove general soiling from Pentelic and Santa Marina using medium pressure hot water (steam) cleaning. Including testing program.
 4. Cleaning test to remove general soiling from masonry at marble podium using poultice cleaners, chemical cleaners, and water rinsing.
 5. Cleaning test to remove dark stains from masonry using poultice cleaners.
 6. Cleaning test to remove water stains and salt deposits from marble fascia panels using poultices and mechanical methods.
 7. Cleaning test to remove general soiling from ceramic sun screens using chemical cleaner and pressurized water rinsing.
 8. Stripping paint and coatings from concrete overhang soffit and fascia.
 9. Stripping paint and coatings from stucco fascia.
 10. Stripping paint and coatings from concrete stairs at interior stairwell.
 11. Protecting window openings, door openings, and other openings in building exterior from water entry and protecting adjacent materials during cleaning tests.
- B. Related Work Specified Elsewhere
1. Selective Removal and Salvage – Section 024193
 2. Masonry Restoration – Section 040143

1.3 QUALITY ASSURANCE

- A. Masonry Cleaning Specialist: Award masonry cleaning work to a firm regularly engaged in cleaning stonework on historic buildings that can demonstrate to Owner's satisfaction that, within previous ten years, the firm has successfully completed at least five projects similar in

scope and type to work required on this Project involving historic buildings under the direction of preservation authorities.

1. Foreman: Masonry cleaning shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Mechanic. Foreman shall read and speak English fluently. Foreman shall be on site daily for duration of work of this Section.
 2. Mechanics: Masonry cleaning shall be carried out by a steady crew of skilled mechanics who are thoroughly experienced with materials and methods specified and have a minimum of three years' experience cleaning stone masonry on historic buildings similar to the work required by this Section. In acceptance or rejection of work of this Section, no allowance will be made for workers' inattention or lack of skill.
- B. Laws, Codes, and Regulations: Work of this Section shall comply with applicable laws, codes, and regulations.
- C. Access for Observation and Approvals: Provide Architect access on a continuing basis to locations on which tests are being carried out, on which work is ongoing, and where work has been completed to allow for observation and approvals. Provide pipe scaffolding and manpower to move and reconfigure scaffolding and planking, personnel lift and manpower to operate lift, or other means of access complying with applicable laws and regulations regarding safety and acceptable to Architect. Provide manpower and equipment to facilitate observation and approvals.
- D. Prohibited Materials and Methods: The following methods are strictly prohibited and shall not under any circumstances be used for work of this Contract: sandblasting and use of acids, alkalis, and other products not specified or specifically approved in writing by the Architect.
- E. Knowledge of Site and Project Conditions: Before submitting bid, Bidders shall make themselves thoroughly familiar with the Drawings and Specifications, with the scope of this Project, and with conditions at the Project site relating to requirements of this Section and limitations under which the work will be performed and shall determine or verify dimensions and quantities. Submission of a bid shall be considered conclusive evidence that Contractor is thoroughly familiar with Project requirements and site conditions and limitations.

1.4 SUBMITTALS

- A. General: Submit the following in compliance with the requirements of the Contract Documents. Revise and resubmit each item as required to obtain Architect's approval.
- B. Qualification Data: Qualification data for firm and personnel specified in "Quality Assurance" Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least five completed projects similar in size, scope, and character to the work required on this Project. For each project list project name, address, architect, conservator, supervising preservation agency, scope of contractor's work, and other relevant information. Submit this information with the bid.
- C. Work Description: Prior to any masonry cleaning work on site, submit detailed description of proposed materials and procedures for masonry cleaning. Submit new written descriptive

information. Photocopies of Contract Documents, excerpts from Contract Documents, and/or duplication of text in Contract Documents will not be accepted for Work Description. Do not begin work on site until work description has been approved in writing. Description shall include, but not be limited to:

1. Cleaning: Materials, methods, tools, and equipment proposed for use.
 2. Protection: Description, including drawings, of proposed materials and methods of protection for preventing harm, damage, or deterioration caused by work of this Section to all persons (whether involved in the Work or not); building elements, materials, and finishes; surrounding plants, landscape, and site; and the environment (including air and water).
- D. Product Data: Submit manufacturer's published technical data for each product to be used in work of this Section including material description, chemical composition (ingredients and proportions), physical properties, recommendations for application and use, test reports and certificates verifying that product complies with specified requirements, and Material Safety Data Sheets (MSDS).
- E. Waste Disposal Program: Prior to commencing masonry cleaning operations, submit a written description of proposed materials and methods for collection, treatment, and disposal of wastes resulting from masonry cleaning operations.

1.5 TESTING

- A. General: Test cleaning methods on sample areas under the direction of the Architect to determine most effective procedure for cleaning.
1. Locate mock-ups as directed by Architect.
 2. Architect will monitor mock-ups.
 3. All materials, dilutions, dwell times, and procedures are subject to modification by Architect during testing process. Architect will choose products and procedures to be used for cleaning masonry and for removing soiling and coatings based on results of test panels. Modifications of sequence, chemical dilution, substitute reagents, and equivalent procedures shall be executed at no additional cost.
 - a. Do not apply products to masonry surfaces without verifying dilution with Architect.
- B. Provide the Following Test Panels
1. Cleaning General Soiling from Pentelic and Santa Marina Marble Using Water Mist and Medium Pressure Water Rinsing: Prepare at least one 1-sq.-meter test panel for each type of marble. Prepare additional test panels using different misting periods, rinse pressures, and other variations as directed.
 2. Cleaning General Soiling from Pentelic and Santa Marina Marble Masonry Using Micro-Abrasive Cleaning System: Prepare at least one 1-sq.-meter test panel for each type of marble. Prepare additional test panels using different abrasives, pressures, and distances between nozzle and masonry surface as directed.

3. Cleaning General Soiling from Pentelic and Santa Marina Using Medium Pressure Hot Water (Steam) Cleaning: Prepare at least one 1-sq.-meter test panel for each type of marble. Prepare additional test panels using different procedures as directed.
4. Cleaning General Soiling from Masonry at Podium Walls Using Poultice Cleaners, Chemical Cleaners, and Water Rinsing: Prepare at least one 1-sq.-meter test panel for each combination of type of stone and chemical cleaner specified for testing. Provide additional test panels using different products, application methods, dwell times, and removal methods as directed.
5. Cleaning Dark Stains from Masonry Using Poultices Methods: Prepare at least one 1-sq.-meter test panel using each poultice cleaner specified for testing. Provide additional test panels using different products, application methods, dwell times, and removal methods as directed.
6. Cleaning Water stains and Salt Deposits from Marble Fascia Panels Using Poultices and Mechanical Methods: Prepare at least one 1-sq.-meter test panel using each poultice cleaner specified for testing. Provide additional test panels using different products, application methods, dwell times, and removal methods as directed.
7. Cleaning General Soiling from Ceramic Sun Screens Using Chemical Cleaners and Pressurized Water Rinsing: Prepare at least one 1-sq.-meter test panel for each product specified for testing. Prepare additional test panels using different products, application procedures, dwell times, and removal procedures as directed.
8. Stripping Paint and Coatings from Concrete Overhang Soffit and Fascia: Prepare at least one 1-sq.-meter test panel for each product specified for testing. Prepare additional test panels using different products, application procedures, dwell times, and removal procedures as directed.
9. Stripping Paint and Coatings from Stucco Fascia: Prepare at least one 1-sq.-meter test panel for each product specified for testing. Prepare additional test panels using different products, application procedures, dwell times, and removal procedures as directed.
10. Stripping Paint and Coatings from Concrete Stairs at Interior Stairwell: Prepare at least one 1-sq.-meter test panel for each product specified for testing. Prepare additional test panels using different products, application procedures, dwell times, and removal procedures as directed.

1.6 PROJECT CONDITIONS

- A. Safety: Protect persons, whether involved with work of this Section or not, from harm caused by work of this Section.
 1. Provide protection to prevent persons, except properly protected masonry cleaning personnel, from coming in contact with masonry cleaning materials and waste from masonry cleaning process.
 2. Provide workers personal protective equipment and take other measures to ensure that workers are not harmed as a result of work of this Section.
- B. Protection of Building: Protect building elements and finishes from damage and from deterioration caused by masonry cleaning work. Repair damage to materials and to finishes resulting from work of this Section to Architect's satisfaction at no additional cost to Owner.
 1. Adjacent Materials: Protect adjacent materials, including but not limited to stone, metals,

- glass, paint, and sealants, from masonry cleaning work that might adversely affect such materials.
2. Spread of Masonry Cleaning Solutions: Do not clean masonry during winds of sufficient force to spread materials used to unprotected surfaces. Cease masonry-cleaning operations when winds may carry water or run-off from stone cleaning to unprotected areas.
 3. Window and Door Openings and Other Penetrations in Building Skin: Prevent water and waste products from entering behind masonry surface at penetrations in skin. Provide reversible temporary seals that will prevent water and waste from entering openings and that will not damage or deteriorate substrate. Remove temporary seals following masonry cleaning. Restore substrates to condition before installation of temporary seals.
 - a. Infiltration: If Contractor notices that water or other product used in work of this Section is penetrating building skin or if Contractor is told that water or other product is penetrating building skin, Contractor shall cease cleaning operations immediately. Cleaning operations shall not proceed until cause of infiltration has been eliminated.
 4. Monitoring for Water Entry: When water is being applied to the exterior masonry, Contractor shall designate one trained person to examine interior spaces and surfaces for evidence of water infiltration. If water infiltration is detected, masonry cleaning operations shall cease immediately. Cleaning operations shall not proceed until cause of infiltration has been eliminated.
- C. Protection of Surroundings: Protect adjacent buildings, site, landscape features, public rights of way, motor vehicles, and other surrounding elements from damage and from deterioration resulting from masonry cleaning work.
1. Collect and dispose of runoff and residue from masonry cleaning operations by legal means and in manner that prevents soil erosion, undermining of paving and foundations, damage to sidewalks, water penetration into building interiors, and harm to buildings, landscape elements, and natural bodies of water and water table.

1.7 COLLECTION AND DISPOSAL OF WASTE PRODUCTS

- A. General: Collect, contain, test, and dispose of liquid and solid wastes in accordance with applicable laws, codes, and regulations.
- B. Collection: Provide gutters and troughs to collect runoff from masonry cleaning operations. Do not allow waste materials from masonry cleaning operations to flow or drop onto sidewalks; trees, shrubs, plants, grass, and other plantings; soil; or structures.
- C. Disposal: Dispose of masonry cleaning run-off by legal means that prevent: erosion, undermining, damage to plant material, and water penetration into building.
 1. Install protection and waste collection systems before beginning masonry cleaning work.
 2. Test drains and other water removal systems to ensure that they are functioning properly before cleaning operations begin. Notify Architect at once if drains or systems are stopped or blocked. Do not begin work of this Section until drains are in good working order.
 3. Filter masonry cleaning runoff to prevent suspended solids such as masonry residue from

- entering drains and drain lines. Contractor at his own expense shall clean out drains and drain lines that become blocked or filled with sand or other solids as a result of work performed under this Section.
4. Dispose of waste products at regular intervals. Do not allow waste products to accumulate on site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND SUPPLIERS

- A. General: Provide products by the following manufacturers or approved equals.
- B. Bellinzoni, Elta Engineering, Str. Misko Mihalovski no. 3a/local 2, 1000 Skopje, Macedonia (+389 2 238 2784).
- C. IntaChem/Remmers: Gebetec S.A., 57009 Kalochori/ Thessaloniki, Greece (+30 2310 700820).
- D. KEIMFARBEN GmbH, Keimstraße 16, D-86420 Diedorf, Germany (+49 821 4802-109).
- E. LTP, Lapidica, C/ Es Colomer, Local 7, Pol. Son Bugadelles, Santa Ponsa, 07180, Palma de Mallorca, Spain (+34 971 690 326).
- F. Panreac Química S.L.U., C/ Garraf, 2, Polígono Pla de la Bruguera, E-08211 Castellar del Vallès, Spain (+34 902 438 439).
- G. ProSoCo, Inc., Tensid UK Ltd., Unit 1 Craven Court, Canada Road, Byfleet, Surrey, KT14 7JL, United Kingdom (+44 1932 564 133).
- H. Sinopia Restauro, Via Poliziano, 56/A, Dora Colletta, 10153 Torino, Italy (+39 11 815 93 62).

2.2 CLEANING MATERIALS

- A. General: Provide the following products for use in testing for cleaning substrates and conditions indicated. Test using dilutions as specified by Architect.
- B. Water for Water Misting and Pressure Rinsing: Clean, potable, free of oils, acids, alkalis, salts, organic matter, soluble and insoluble iron, and other substances detrimental to surfaces being cleaned and non-staining.
 1. Source: Subject to requirements specified, water may be obtained from city water supply.
 2. Distribution: Pump water to locations where work of this Section is being performed at pressure and flow rate necessary for optimum cleaning using each process.
- C. Low-Pressure, Micro-Abrasive Cleaning: Test each of the materials described in Articles "Equipment and Materials for Low-Pressure, Micro-Abrasive Cleaning" below.
- D. Medium Pressure Hot Water (Steam) Cleaning for Testing Removal of General Soiling from

Pentelic and Santa Marina Marble.

- E. Cleaners for Testing Removal of General Soiling From Marble Podium. Test each of the following or approved equal:
1. Enviro Klean 2010 All Surface Cleaner, manufactured by ProSoCo, Inc.
 2. Sure Klean 942 Limestone and Marble Cleaner, manufactured by ProSoCo, Inc.
 3. Sure Klean Marble Poultice, as manufactured by ProSoCo, Inc., mixed with distilled water.
 4. Detergent Lem-3, manufactured by Bellinzoni.
 5. IntaChem Neutral Soap, manufactured by IntaChem/Remmers.
 6. Keim Steinreiniger, manufactured by KEIMFARBEN.
 7. BRIJ 35, manufactured by Sinopia Restauro.
- F. Cleaners for Testing Removal of Dark Stains from Masonry. Test each of the following or approved equal:
1. Fullers Earth, available from LTP, mixed with distilled water.
 2. Sure Klean Marble Poultice, as manufactured by ProSoCo, Inc., mixed with distilled water.
 3. AB 57, manufactured by Sinopia Restauro.
 4. Viscor Gel, manufactured by Sinopia Restauro.
- G. Cleaners for Testing Removal of Water Stains and Salt Deposits from Marble Fascia Panels. Test each of the following or approved equal:
1. Fullers Earth, available from LTP, mixed with distilled water.
 2. Sure Klean Marble Poultice, as manufactured by ProSoCo, Inc., mixed with distilled water.
 3. EDTA Paste, manufactured by Sinopia Restauro.
 4. Viscor Gel, manufactured by Sinopia Restauro.
- H. Cleaners for Testing Removal of General Soiling from Ceramic Sun Screens. Test each of the following or approved equal:
1. Enviro Klean 2010 All Surface Cleaner, manufactured by ProSoCo, Inc.
 2. Sure Klean Light Duty Restoration Cleaner, manufactured by ProSoCo, Inc.
 3. Tween 2000, manufactured by Sinopia Restauro.
 4. Derquim LM 02, manufactured by Panreac
- I. Stripper for Removing Coatings from Concrete and Stucco Surfaces:
1. Sinopia Restauro (Italy) - Pulitore Alcalino - Benzyl Alcohol based gel
 2. Sinopia Restauro (Italy) - Eco Sverniciatore Extra Forte - "Eco" paint stripper neutral
- 2.3 EQUIPMENT AND MATERIALS FOR LOW-PRESSURE, MICRO-ABRASIVE CLEANING TESTS
- A. Complete Low-Pressure, Micro-Abrasive Cleaning Systems: Complete, low-pressure, micro-

abrasive cleaning systems that clean using swirling air, water, and inert fine mineral powder. Provide manufacturer's complete systems including all equipment and accessories required to provide appropriate air pressure and flow rate, water pressure and flow rate, media flow rate, angle of incidence, and other system requirements. Provide IBIX equipment as supplied by IBIX Northeast, 19 Leonberg Road, Cranberry TWP., PA 16066 (724-776-4801), or approved equal.

- B. Abrasive Media Application Gun: Helix Helical Vortex Gun with tangential-rotating abrasive action, or approved equal, available from IBIX Northeast, 19 Leonberg Road, Cranberry TWP., PA 16066 (724-776-4801).
- C. Abrasive Media for Cleaning Marble: For testing, furnish range of natural and manufactured abrasive media, including crushed glass, calcium carbonate and other mineral powders, and other media as requested by the Architect. Test each of the following calcium carbonate media, or approved equal. Abrasive media for testing and use in project can be obtained from IBIX Northeast, 19 Leonberg Road, Cranberry TWP., PA 16066 (724-776-4801).

2.4 EQUIPMENT FOR WATER AND CHEMICAL CLEANING TESTS

- A. General: Provide all equipment and accessories to distribute water at pressures and flow rates required for masonry cleaning.
- B. Pressure Pumps: Pressure pumps capable of producing water flow at a rate of 6 gallons per minute at a pressure of 5.5 Megapascal (800 psi) at nozzle on end of hose. Pumps, or a combination of pumps plus pressure reducing valves, shall have capability of providing water at a steady pressure and flow rate at all pressures from 0.7 Megapascal (100 psi) to 5.5 Megapascal (800 psi). Pumps shall have working pressure gauges. Pumps found to be without working pressure gauges shall be removed from site, and work shall cease until pumps have been replaced with pumps having working pressure gauges. Pumps shall have no ferrous elements in contact with liquid stream.
- C. Particulate Filter: Provide a 5-micron particulate filter in line with water supply. All water used for masonry cleaning shall be filtered.
 - 1. Replace particulate filter as required to provide filtered water with no particles greater than 5 microns at pressure and flow rate specified.
- D. In-line Pressure Gauges: Each water line used for pressure rinsing shall have a working pressure gauge within 15 feet of nozzle used for rinsing.
- E. Spray Nozzles for Pressure Rinsing: Nozzles shall be of nonferrous metal and shall have a minimum 15-degree fan tip.
- F. Misting Equipment: Custom designed and constructed apparatus that provides gentle, uniform, even misting of masonry surfaces without dry spots or locations of excessive rundown.
 - 1. System: Provide manifolds complete with a variety of adjustable spray nozzles, fan and cone type spray heads, hoses, pumps, pressure reducers, pressure regulators, timers, valves, adjustable support systems, and all necessary connections and accessories.

- a. Customize equipment as necessary to provide even, uniform, misting of all surfaces to be cleaned by water misting and pressure rinsing, including all profiled surfaces and all ornament.
 - b. Design system to achieve even wetting using minimum amount of water.
2. Materials: Manifold piping for misting equipment shall be polyvinyl chloride (PVC) tubing and fittings. All hoses, fittings, pumps, valves, and other equipment shall be of materials with no ferrous components and shall be completely nonstaining.
 3. Supports: Provide solid, firm support systems that ensure misting systems remain secure, steady, and at their desired position during entire misting period in each location.
 4. Winds and Air Currents: During periods in which winds or air currents disrupt water flow from spray heads or otherwise prevent misting apparatus from providing even, uniform misting of surfaces, including ornament, enclose misting apparatus, adjust water pressure, reposition spray heads, supply additional spray heads, and/or provide other methods as required to ensure even misting of masonry surfaces.
 5. Rundown: Alter system (including, but not limited to, water pressure and/or flow rate, nozzle size and distance from surface, and time on and time off) as required during course of water misting to ensure continuously damp surface without significant rundown at bottom of area being water misted.
- G. Equipment for Low Pressure Hot Water (Steam) Cleaning: Apparatus consisting of boiler, valves, filters, pressure gauges, hoses, nozzles, and all accessories to provide steam at steady pressure at nozzle and approved by Architect. System shall have no ferrous parts or other parts that might induce metal ions into the steam in contact with the water or steam.
- H. Brushes: Natural fiber bristle or synthetic fiber bristle only. No metal bristle brushes are permitted.
- I. pH Indicator
1. Electronic pH Indicator Pen: Suitable for use intended and approved by Architect.
 2. pH Strips or Paper: Nonstaining litmus paper with appropriate range approved by Architect.

2.5 MISCELLANEOUS MATERIALS

- A. Sealant: Manufacturer's standard one part acrylic latex sealant. Use exclusively for temporary sealing of cracks and joints around penetrations during masonry cleaning work.
1. Do not use sealant containing silicone or other elastomeric product.
- B. Backer Rod: Closed cell expanded polyethylene rod, sized 25 percent greater than joint to be sealed.
- C. Protection Materials: Provide materials suitable for use intended as approved by Architect.
1. Plastic Sheeting: Polyethylene sheeting shall be a minimum of 6 mils thick.

2.6 MIXING CHEMICAL CLEANING SOLUTIONS

- A. General: Dilute chemical cleaning materials as determined following results obtained through test panels. Manufacturer's recommended dilutions may be modified to reflect results of test panels.
 - 1. Supply all dilutions of chemical cleaners at no additional cost.
- B. Create test panels using a minimum of two dilutions for each product where dilution is recommended by manufacturer or requested by Architect.

PART 3 - EXECUTION

3.1 GENERAL MASONRY CLEANING TEST REQUIREMENTS

- A. General: These requirements apply to all work of this Section.
- B. Water Pressure and Flow Rate: Limit water pressure and flow rates to maximum pressures specified herein and to lower pressures as required to avoid damaging masonry, metals, sealants, and other materials and finishes.
 - 1. Pressure: 2.75 Megapascals (400 psi) or less as required to avoid damage to stone panels being cleaned.
 - 2. Flow Rate: 1.36 cubic meters per hour (6 gallons per minute).
 - 3. Distance from Masonry Surface: Hold nozzle at a uniform distance from masonry surface as determined by testing to provide optimum cleaning without damaging masonry surface but at least 30 cm (12 inches) from stone surface.
 - 4. Adjustments: If any building material is damaged or deteriorated by water rinsing, immediately cease work. Do not begin pressure rinsing again until water pressure and flow rate have been adjusted to avoid damage to building materials.

3.2 TEST FOR CLEANING GENERAL SOILING FROM STONE PANELS USING WATER MISTING AND PRESSURIZED WATER RINSING

- A. General: Test cleaning stone panels free of general soiling using water misting and pressurized water rinsing.
- B. Misting: Mist surfaces for period determined during testing. Carefully control misting procedures and misting time so that surfaces are uniformly misted.
- C. Rinsing: Carefully rinse stones surface using water at a pressure of 2.75 Megapascals (400 psi) and flow rate of 1.36 cubic meters per hour (6 gallons per minute). Hold nozzle a consistent distance from stone surface as determined during testing. Overlap passes slightly to ensure surfaces are thoroughly rinsed. Rinse surfaces at least twice, first with vertical passes and then with horizontal passes to ensure complete coverage.
- D. Additional Cleaning: Repeat above procedure as necessary to achieve uniformly clean stone

panels.

3.3 TEST FOR CLEANING GENERAL SOILING FROM MASONRY USING LOW-PRESSURE, MICRO ABRASIVE CLEANING SYSTEM

- A. General: Test cleaning stone panels free of general soiling using micro abrasive cleaning system.
- B. Cleaning: Carefully clean stone surfaces using minimum pressure to achieve desired cleaning without damage to stone. Hold nozzle a consistent distance from masonry surface as determined in testing. Overlap passes slightly to ensure all areas of surface are thoroughly cleaned.
- C. Rinsing: Rinse all surfaces thoroughly using water at a pressure of 5.17 Megapascals (750 psi) and flow rate of 22.71 liters/min , overlapping passes slightly.
- D. Additional Cleaning: Repeat above procedure as necessary to achieve uniformly clean stone panels.

3.4 TEST FOR CLEANING SOILING FROM MARBLE PODIUM AND CERAMIC TILE USING CHEMICAL REMOVER AND PRESSURIZED WATER RINSING

- A. General: Test cleaning stone panels and ceramic tile free of soiling using cleaning chemical followed by pressurized water rinsing.
- B. Cleaner Application and Removal: Apply and remove each cleaner following method of application and dwell times recommended by the product manufacturer. Scrub surface gently with fiber bristle brushes. Rinse surface thoroughly using water at a pressure of 5.17 Megapascals (750 psi) and flow rate of 22.71 liters/min .
- C. Additional Cleaning: Repeat above procedure as necessary to achieve uniformly clean stone panels.

3.5 TEST FOR CLEANING SOILING AND DARK STAINS FROM MASONRY USING POULTICE CLEANERS

- A. General: Test cleaning stone panels free of soiling and stains using poultices followed by pressurized water rinsing.
- B. Poultice Application and Removal: Apply and remove each poultice following method of application and dwell times recommended by the product manufacturer. Scrub surface gently with fiber-bristle brushes. Rinse surface thoroughly using water at a pressure of 5.17 Megapascals (750 psi) and flow rate of 0.02271 m³/min.
- C. Additional Cleaning: Repeat above procedure as necessary to achieve uniformly clean stone panels.

3.6 TEST FOR CLEANING WATER STAINS AND SALT DEPOSITS USING POULTICES AND MECHANICAL METHODS

- A. General: Test cleaning stone panels free of stains and salt deposits using mechanical methods followed by poultices and pressurized water rinsing.
- B. Removal of Heavy Salt Deposits: Mechanically remove salt deposits from marble surfaces using plastic scrapers with rounded edges. Carefully scrape away protruding deposits without gouging or scratching the masonry surfaces to achieve clean, even marble surfaces free of salt deposits.
- C. Poultice Application and Removal: Apply and remove each poultice following method of application and dwell times recommended by the product manufacturer. Scrub surface gently with fiber-bristle brushes. Rinse surface thoroughly using water at a pressure of 5.17 Megapascals (750 psi) and flow rate of 22.71 liters/min.
- D. Additional Cleaning: Repeat above procedure as necessary to achieve uniformly clean masonry.

3.7 CHEMICALLY STRIPPING PAINT FROM CONCRETE AND STUCCO

- A. General: Test Removal of paint from concrete and stucco using chemical paint strippers followed by pressurized water rinsing.
 - 1. Assume three applications of stripper.
- B. Removing Loose Dust and Dirt: Before beginning coating removal, remove loose dust and dirt.
- C. Sealing Cracks: Seal wide cracks using backer rod to prevent water entry.
- D. Stripper Application: Apply paint stripper to painted surfaces following manufacturer's instructions.
- E. Dwell Time: Allow stripper to remain on surface for a minimum of four hours and up to maximum duration recommended by manufacturer. Do not allow stripper to dry on surface. Apply additional stripper to ensure that material remains moist.
- F. Removal: Scrape stripper and coating from surface using plastic scrapers with rounded corners. Remove remaining coating using stiff, fiber bristle scrub brushes, sponges, and water. Rinse surface thoroughly using water at a pressure of 5.17 Megapascals (750 psi) and flow rate of 0.02271 m³/min.
- G. Repeating Removal: Repeat above procedure as necessary to paint to achieve uniformly clean surfaces.

END OF SECTION 040140

SECTION 040143 - MASONRY RESTORATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 DESCRIPTION

- A. The Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of masonry restoration probes and mock-ups as shown on the Drawings and/or as specified herein and as may be required by conditions and authorities having jurisdiction, including, but not necessarily limited to, the following:
1. Reinstalling salvaged panels.
 2. Providing new stone panels with new anchors.
 3. Securing hollow sounding panels by grouting through joints and through panels, and patching portholes.
 4. Securing stone panels by anchoring stone to substrate with helical ties and patching holes for ties.
 5. Providing new anchors across cracks.
 6. Reinstalling salvaged ceramic blocks into existing sun screens.
 7. Providing dutchman repairs in stone units where cores are removed.
- B. Related Work Specified Elsewhere
1. Selective Removal and Salvage – Section 024193
 2. Fiber Reinforced Polymer – Section 039000
 3. Masonry Cleaning – Section 040140

1.3 DEFINITIONS

- A. “Dutchman” as used herein refers to a portion of new or salvaged stone fitted into an existing stone to produce an intact contiguous surface.
- B. “Plug” as used here refers to a circular dutchman cored out of stone matching stone to be repaired.
- C. “Epoxy” as used herein refers to a structural epoxy adhesive or to another structural adhesive as specifically identified.
- D. “Cold Weather Masonry Restoration” as used herein refers to work of this Section when

temperature is below 4 deg C (40 deg F) or predicted to go below 4 deg C (40 deg F) within 48 hours of use of mortar.

- E. “Hot Weather Masonry Restoration” as used herein refers to work of this Section when temperature is above 37 deg C (100 deg F) or when temperature is above 32 deg C (90 deg F) and wind is above 13 kilometers per hour (8 mph) or when either of these conditions is predicted within 48 hours of use of mortar.

1.4 QUALITY ASSURANCE

- A. Masonry Restoration Specialist: Award masonry restoration to a firm regularly engaged in restoration of stone masonry on historic buildings that can demonstrate to Owner’s satisfaction that, within previous ten years, it has successfully completed at least five projects similar in scope and type to work required on this Project under the direction of preservation authorities.
1. Foreman: Masonry restoration shall be directly supervised by a full-time foreman with experience equal to or greater than that required of Masonry Restoration Specialist. Foreman shall be on site daily for duration of work of this Section. Same foreman shall remain on Project throughout work unless his performance is deemed unacceptable.
 2. Mechanics: Masonry restoration shall be carried out by a steady crew of skilled mechanics who are thoroughly experienced with restoration of historic stonework using materials and methods specified and have a minimum of three years’ experience with work on historic buildings similar to that required by this Section. In acceptance or rejection of work of this Section, no allowance will be made for workers’ inattention or lack of skill.
- B. Laws, Codes, and Regulations: Work of this Section shall comply with applicable laws, codes, and regulations.
- C. Referenced Standards: Comply with applicable requirements and recommendations of the latest editions of the referenced standards listed herein, except as modified by more stringent requirements of the Contract Documents and of applicable laws, codes, and regulations. In each case in which there is conflict between requirements of referenced standards; requirements of laws, codes, and regulations; and requirements of this Section, the most stringent or restrictive requirement shall govern.
1. ASTM International (ASTM)
 - a. ASTM A 276, *Standard Specification for Stainless Steel Bars and Shapes.*
 - b. ASTM A 580, *Standard Specification for Stainless Steel Wire.*
 - c. ASTM A 666, *Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.*
 - d. ASTM C 144, *Standard Specification for Aggregate for Masonry Mortar.*
 - e. ASTM C 150, *Standard Specification for Portland Cement.*
 - f. ASTM C 207, *Standard Specification for Hydrated Lime for Masonry Purposes.*
 - g. ASTM C 270, *Standard Specification for Mortar for Unit Masonry.*
 - h. ASTM C 503, *Standard Specification for Marble Dimension Stone*
 - i. ASTM C 881, *Standard Specification for Epoxy-Resin-Base Bonding Systems for*

- Concrete.*
- j. ASTM C 1713, *Standard Specification for Mortars for the Repair of Historic Masonry.*
2. Brick Industry Association (BIA) Technical Notes 1, *Cold and Hot Weather Construction*, June, 2006.
3. International Organization for Standardization (ISO), ISO 13007, *Ceramic Tiles – Grouts and Adhesives.*
- D. Temporary Shoring and Bracing: Contractor shall be solely responsible for the provision of temporary shoring, bracing, and other supports necessary to ensure that no persons are harmed during work of this Section, that no stone panels to remain are damaged or deteriorated during work of this Section, and that no other building elements and materials to remain are damaged, deteriorated, displaced, subjected to undue stress, or otherwise adversely affected as a result of the work of this Section. Contractor shall employ or engage at his own expense a licensed professional engineer to design temporary shoring, bracing, and other supports.
1. Install temporary shoring, bracing, and other supports; alter temporary shoring, bracing, and other supports; and remove temporary shoring, bracing, and other supports as necessary to provide protection without impeding the progress of the work.
- E. Sources of Materials: Obtain each type of material for masonry restoration from a single source to ensure a match in quality, performance, and appearance.
- F. Access for Observation and Approvals: Provide Architect access on a continuing basis to locations on which work is being carried out, and where work has been completed to allow for observation and approvals. Provide pipe scaffolding and manpower to move and reconfigure scaffolding and planking, personnel lift and manpower to operate lift, or other means of access complying with applicable laws and regulations regarding safety and acceptable to Architect. Provide manpower and equipment to facilitate observation and approvals.
- G. Knowledge of Site and Project Conditions: Before submitting bid, Bidders shall make themselves thoroughly familiar with the Drawings and Specifications, with the scope of this Project, and with conditions at the Project site relating to requirements of this Section and limitations under which the work will be performed and shall determine or verify dimensions and quantities. Submission of a bid shall be considered conclusive evidence that Contractor is thoroughly familiar with Project requirements and site conditions and limitations.
- H. Restoration of Damaged Masonry: Repair or replace broken, lost, and damaged masonry resulting from work of this Section to configuration and condition existing before work began to Architect's satisfaction at no additional cost to Owner.
- I. Grout Injection: Grout injection must be done in a careful and controlled manner to ensure that grout is fully injected into the intended area and not injected beyond the area intended. Skilled foremen must oversee this work and track the grouting process for quality assurance. Foreman must have had previous experience with grout injection and must be competent in all skills of the grouting operation. The foreman will direct wall preparation, equipment setup, injection, and cleaning operations. The foreman will record the details of the grout injection in a log to be

submitted to the Architect per the “Grout Injection Logs” Paragraph in “Submittals” Article, below.

1.5 SUBMITTALS

- A. General: Submit the following in compliance with the requirements of the Contract Documents. Revise and resubmit each item as required to obtain Architect’s approval.
- B. Qualification Data: Qualification data for firm and personnel specified in “Quality Assurance” Article that demonstrates that both firm and personnel have capabilities and experience complying with requirements specified. For firm and foreman, provide a list of at least three completed projects similar in size and scope to the work required on this Project. For each project list project name, address, architect, conservator, supervising preservation agency, scope of contractor’s work, and other relevant information. Submit this information with the bid.
- C. Work Description: Detailed description for each type of masonry restoration work to be performed. Do not begin work on site until Architect has approved Work Description in writing. Submit new written descriptive information. Photocopies of Contract Documents, excerpts from Contract Documents, and/or duplication of text in Contract Documents will not be accepted for Work Description. Description for each phase and task of masonry restoration work shall include, but not be limited to:
 - 1. Materials and Procedures: Materials, methods, tools, and equipment proposed for use.
 - 2. Protection: Description, including drawings and diagrams, of proposed materials and methods of protection for preventing harm, damage, and deterioration caused by work of this Section to persons (whether involved in the Work or not); building elements, materials, and finishes; surrounding landscape and site; and the environment (including air and water).
 - a. Include procedures for controlling noise and dust.
 - 3. Alternate Methods and Materials (If Any): Proposed alternate methods and materials (if any) to those specified for masonry restoration work. Provide evidence of successful use on comparable projects and demonstrate effectiveness for use on this Project.
- D. Designs for Temporary Shoring and Bracing: Drawings and calculations by licensed professional engineer retained by Contractor indicating design of temporary bracing, shoring, and other provisions necessary to ensure support and stability for existing construction and support and stability for elements being removed as specified in “Quality Assurance” Article, above.
- E. Product Data: Manufacturer’s published technical data for each product to be used in work of this Section including material description, chemical composition (ingredients and proportions), physical properties, recommendations for application and use, test reports and certificates verifying that product complies with specified requirements, and Material Safety Data Sheets (MSDS).
- F. Shop Drawings: Dimensioned detailed scale drawings at appropriate scales to clearly describe masonry restoration; details of anchors and fasteners, 1:1 (full-size) scale. Submit newly

prepared drawings showing site-verified conditions and materials. Photocopies of Contract Documents and/or electronic scans of Contract Documents will not be accepted for Shop Drawing submittals. If any changes are proposed to anchors and/or embedment depths the Shop Drawings shall bear the stamp of a qualified Eur-Ing Engineer.

1. Providing New Stone Panels: Each type of stone panel and anchoring system. Show locations and type of anchors.
2. Pinning Stone Panels with Helical Pins: Each type of stone panel to be pinned. Show locations and type of pins and type of crack repair.
3. Dutchman Repairs: Each type of dutchman. Show anchors.

G. Samples

1. Marble to Match Existing Marble: 300 mm (12-inch) x 300 mm (12-inch) x 25 mm (1-inch) pieces, finished to match existing.
2. Anchors, Fasteners, Pins, and Accessories: Each configuration and size specified and/or proposed for use.
3. Mortar for Pointing Joints: Cured mortar samples set in 12 mm (1/2-inch) wide by 150 mm (6-inch) long plastic or aluminum channels for approval of color and texture. Samples shall match existing mortar.
4. Sand for Pointing Mortar: Five hundred gram (one-pound) sample of sand proposed for use in pointing mortar. Include sieve analysis (ASTM C 144).
5. Custom Patching Mortar for Patching Holes in Marble: 100-mm (4 inches) square x 25-mm- (1-inch-) thick cured samples for approval of color and texture. Samples shall match existing marble in color, texture, surface reflectance, and other properties.
6. Mortar for Installing Dutchmen: Cured mortar samples set in 12 mm (1/2-inch) wide by 150 mm (6-inch) long plastic or aluminum channels for approval of color and texture. Samples shall match color of stone to receive dutchmen.
7. Sand for Mortar for Installing Dutchmen: Five hundred gram (one-pound) sample of sand proposed for use in installing dutchmen. Include sieve analysis (ASTM C 144).

1.6 MOCK-UPS

A. General: Perform the following mock-ups and probes to determine existing conditions and effective restoration treatments.

1. Locate mock-ups as directed by Architect.
2. Architect will monitor mock-ups.

B. Prepare the Following Mock-Ups

1. Reinstalling Panels: At locations indicated on drawings.
2. Providing New Stone Panels with New Anchors: At locations indicated on drawings.
3. Securing Hollow Sounding Panels by Grouting through Joints and Through Panels, and Patching Portholes: At locations indicated on drawings.
4. Securing Stone Panels by Anchoring Stone to Substrate with Helical Ties and Patching Holes for Ties: At locations indicated on drawings.
5. Providing Dutchman Repairs in Stone Panels: At locations indicated on drawings.

6. Reinstalling Salvaged Ceramic Blocks into Existing Sun Screens: At locations indicated on drawings.
7. Providing new anchors across cracks.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products and materials to prevent damage, deterioration, degradation, and intrusion of foreign material.
- B. Discard and remove from site deteriorated materials, contaminated materials, and products that have exceeded their expiration dates. Replace with fresh materials.
- C. Handling Stone: Handle stone to prevent chipping, breakage, soiling, and other damage.
 1. Handle cut stone using competent craftspeople and methods that guard against damage and deterioration.
 2. Do not use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials.
 3. Lifting and Placing
 - a. Slings: Lift with wide belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances that might cause staining.
 - b. Lifting Clamps: Obtain lifting clamps from stone fabricator or use clamps recommended by stone fabricator for handling stone units weighing over 100 pounds.
 4. Use wood rollers and provide cushion at end of wood slides as necessary to avoid damaging stone units.
 5. Keep surfaces free from dirt, soot, grime, grease, and other discoloring matter.
 6. Furnishing Cut Stone: Furnish stone promptly as ordered and in proper sequence for setting.
 - a. Before shipping stone, coordinate shipping, delivery and storage requirements with the Construction Manager.
 - b. Carefully load cut stone on cars or trucks and protected from damage during shipment.
 - c. Carefully unload cut stone at destination and store cut stone units at the building site in proper sequence for setting. Store units on dry cured white pine or similar non-staining planking set so as to be entirely clear of the ground and arranged so that there shall be no stick marks on exposed faces. Protect arrises from damage.

1.8 PROJECT CONDITIONS

- A. Safety: Protect all persons, whether or not involved in work of this Section, from harm caused by or resulting from work of this Section.
 1. Protection from Hazardous Materials: Protect workers and other persons from contact with hazardous materials resulting from work of this Section.

- a. Silica: Overexposure to respirable crystalline silica may lead to silicosis, which is a disabling, nonreversible, and sometimes fatal lung disease. Provide protections necessary to prevent workers from exposure to respirable crystalline silica. Comply with applicable laws, codes, and regulations.
2. Protection from Noise: Limit noise generated by work of this Section to an absolute minimum. Prevent all persons, whether or not involved with the work of this Section, from noise that might adversely affect them.
- B. Protection of Building: Protect building elements and finishes from damage and from deterioration caused by work of this Section. Repair materials and finishes damaged as a result of work of this Section to Architect's satisfaction at no additional cost to Owner.
 1. Exclusion of Water: Cover open joints and areas from which stone panels and portions of stone panels have been removed during periods when work is suspended to ensure materials and finishes are not damaged by water penetration.
 2. Prevention of Staining: Prevent mortar and adhesives from staining face of masonry to be left exposed. Protect sills, ledges, and projections from mortar droppings. Immediately remove mortar and adhesive in contact with masonry. Protect base of walls from rain splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
 3. Protection from Fire: Take precautions necessary to prevent fire and spread of fire.
- C. Support: Provide shoring, bracing, reinforcement, and enclosures necessary to prevent damage or deterioration prior to removing stone panels.
- D. Hoisting and Lowering: Use appropriately sized hoisting devices and cribbing, to accomplish lifting and lowering to ensure that items being moved are under control at all times.
- E. Responsibility for Dimensions: Dimensions of existing elements and conditions in Contract Documents, whether numerical, tabular, or graphic, are provided for bidding purposes and for Contractor's information and are not guaranteed. Contractor shall measure existing elements and conditions in field before preparing shop drawings, ordering materials, or starting construction and shall certify on shop drawings that dimensions have been field verified. Contractor is responsible for verifying dimensions of existing construction and for preparation of new work and replacement work fitting into and aligning with existing construction.
- F. Dust: Use procedures necessary to generate as little dust as possible in the execution of work of this Section and to minimize dissemination of dust generated during work of this Section to greatest extent possible.
 1. Contractor shall hold Owner, Architect, and their consultants harmless from claims relating to dust resulting from work of this Section.
- G. Debris Removal
 1. Do not drop or throw materials from any height. Remove debris using suitable containers or conveyances. Lower materials to ground in containers. Use methods that keep dust and impact to absolute minimum.
 2. Keep premises clean by removing accumulation of waste materials, rubbish, and debris

- from site daily. Dispose of waste, rubbish, and debris in a proper manner in accordance with applicable laws and regulations, to the satisfaction of authorities having jurisdiction, and to the satisfaction of the Architect. Keep site and public rights of way clear.
3. Do not store or permit excess debris to accumulate on site.

H. Coordination: Coordinate work of this Section with work of other sections as necessary to ensure optimum performance of work of this Contract.

1. Clean stonework as specified in Section 040140 – “Masonry Cleaning” after completing masonry restoration.

1.9 ENVIRONMENTAL REQUIREMENTS

A. General

1. Manufacturer’s Recommendations: Perform work only when temperature of products being used, temperatures of existing and new materials and surfaces, and temperature and humidity of air at Project site comply with manufacturer’s requirements and recommendations.
2. Requirements of Referenced Standard: Perform work of this Section in compliance with the requirements and recommendations of Brick Industry Association Technical Notes 1, *Cold and Hot Weather Construction*, June, 2006.
3. Conflicting Requirements: In each case in which there is a conflict between manufacturer’s recommendations, recommendations of referenced standards, and other requirements specified in this Section, the most stringent and restrictive requirement shall govern.

B. Cold Weather Masonry Restoration: Cold weather masonry restoration shall adhere to following requirements for work, performed in ambient temperatures indicated. Work shall not be permitted when temperature of air or wall is below 4 deg C (40 deg F) or when temperature of air or wall is predicted to be below 4 deg C (40 deg F) in Project location within 48 hours of work without Architect’s prior written approval. No work shall begin when any part of wall or materials in use are frozen or subject to freezing temperatures.

1. Temperature Range 4 deg C (40 deg F) to 0 deg C (32 deg F): Heat mixing water or sand to produce mortar between 4 deg C (40 deg F) and 48 deg C (120 deg F) and maintain above 4 deg C (40 deg F) until placed at that temperature.
2. Temperature Range 0 deg C (32 deg F) to -6 deg C (20 deg F): Heat mixing water and sand to produce mortar between 4 deg C (40 deg F) and 48 deg C (120 deg F). Maintain mortar above freezing until used in masonry.
3. Temperature -6 deg C (20 deg F) and Below: Heat mixing water and sand to produce mortar between 4 deg C (40 deg F) and 48 deg C (120 deg F). Maintain mortar above freezing until used in masonry. Heat masonry units to 4 deg C (40 deg F). Provide enclosure to heat and maintain temperatures above freezing within enclosure.

C. Cold Weather Protection of Completed Masonry Restoration Work: Protect completed stone masonry in the following manner. Temperature ranges indicated apply to anticipated minimum night temperatures.

1. Temperature Range 4 deg C (40 deg F) to 0 deg C (32 deg F): Protect masonry from rain and snow for at least 24 hours by covering with weather-resistive membrane.
 2. Temperature Range 0 deg C (32 deg F) to 6 deg C (20 deg F): Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours.
 3. Temperature -6 deg C (20 deg F) and Below: Except as otherwise indicated, maintain masonry temperature above 0 deg C (32 deg F) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps, or other methods proven to be satisfactory.
- D. Hot Weather Masonry Restoration: Protect fresh mortar from premature drying when temperature, humidity, and wind conditions result in rapid drying of mortar. Provide and maintain tarps against wind and direct sun. Protect masonry for 72 hours after using mortar by one of the following procedures:
1. Water-Soaked Cover: Provide and maintain damp burlap or other damp cloths over cladding to protect mortars from pre-mature drying. Install, maintain, and remove coverings using materials and methods that do not damage or alter masonry.
 2. Fog Spray: Fog spray newly pointed cladding until damp at least three times a day using water without iron or other contaminants that might adversely affect stone or mortar. Do not use water stream or pressure that might wash binder from surface of mortar or cause rundown on cladding.
- E. Proprietary Mortars and Epoxy and Other Structural Adhesives and Fillers: Perform work of this Section requiring proprietary cementitious patching materials and epoxy and other structural adhesives and fillers only when surface and air temperatures are between 10 deg C (50 deg F) and 30 deg C (85 deg F).
- F. Damage from Work in Cold Weather or in Hot Weather: Remove work of this Section damaged by freezing during cold weather work and/or damaged by premature or too-rapid drying during hot weather work and replace with new cladding work complying with the requirements of this Section at no additional cost to Owner.
- G. Use of Proprietary Cementitious Mortars and Grouts: Whenever cementitious mortars and grouts are used, measure and record temperatures of substrates, temperature of mortar or grout, and ambient temperature in the vicinity of the masonry being repaired with the mortar or grout. Measure and record temperatures before beginning work.

PART 2 - PRODUCTS

2.1 STONE

- A. Marble: New sound Pentelikon marble complying with ASTM C 503 and matching existing clean marble in physical and chemical properties and in color, texture, and other surface characteristics.

2.2 MORTAR AND PATCHING MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, nonstaining. Do not use masonry cement.
- B. White Portland Cement: ASTM C 150, Type I. Nonstaining.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Sand: Clean sharp sand, free of loam, silt, soluble salts, organic matter, and other substances that might adversely affect mortar, masonry units, or embedded elements. Provide 00 sand of color to provide mortar matching color of existing original mortar (with minimal addition of pigment). Sieve and mix sand and aggregates from individual sources and from more than one source to provide mortar matching original mortar.
- E. Water: Clean and free of substances that might adversely affect mortar, masonry, and embedded elements.
- F. Pigments: Stable, light-fast, alkali-resistant, water-soluble mineral oxide pigments without fillers or extenders complying with ASTM C 979. Provide one of the following:
 - 1. SGS Concentrated Mortar Colors by Solomon Color, Inc., 4050 Color Plant Road, Springfield, IL 62702 (00-1-217-522-3112).
 - 2. Lanxess Bayferrox Iron Oxide Pigments by Lanxess Corporation, Business Unit Inorganic Pigments, 111 RIDC Park West Drive, Pittsburgh, PA 15275 (00-1-412-809-1000).
- G. Admixture for Thick-set Mortar for Installing Stone Panels: Laticrete 3701 Mortar Admix for “thick-set” mortars by Laticrete International, Inc., 91 Amity Rd., Bethany, CT 06524 (00-1-203-393-0010), or approved equal.
- H. Admixture for Thin-set Mortar for Installing Stone Panels and Dutchmen: Laticrete 4237 Mortar Admix for “thin-set” mortars by Laticrete International, Inc., 91 Amity Rd., Bethany, CT 06524 (00-1-203-393-0010), or approved equal.

2.3 PREFORMULATED MORTARS

- A. Cementitious Patching Mortar for Holes and Cracks in Marble: Single-component, cementitious, mineral-based mortar specifically manufactured for the restoration of natural stone. Provide Jahn M120 Marble Repair Mortar, available from Jahn International, or approved equal. Provide custom colors to match colors of clean marble being patched.

2.4 ANCHORS AND ADHESIVES

- A. General: Provide anchors, dowels, attachments, and fasteners as shown on Drawings and approved shop drawings and of size and configuration suitable for use intended to ensure sound, secure anchorage.
 - 1. Material: Stainless steel complying with ASTM A 276 or ASTM A 666 Type 302, 303, 304, 304L, 316, or 316L, unless otherwise noted. All stainless steel to be welded shall be

- Type 316L.
2. Prohibited Types of Anchors and Fasteners: Expansion bolts, cinch bolts, and plugs are not acceptable.
- B. Bent Plate Stainless Steel Stone Anchors for Attaching New Stone Panels to Concrete: Bent plate anchors with fixed pins or draw pins inserted into masonry and secured to back-up hollow masonry of concrete with grouted sock anchors.
1. Stone Anchors: Stainless steel bent plate stone anchors 3 mm thick x 40 mm wide with fixed pins or draw pins (10 mm diameter x 40 mm long) as indicated on Drawings for each condition.
 2. Grouted Sock Anchors: M14x2 threaded stainless steel anchor bolt in mesh sock with plastic grout tube for installation of grout. Stone anchors shall be secured to grouted sock anchors with stainless steel washer and nut. Provided grouted sock anchors by Cintec International Limited, 11 Gold Tops, Newport, South Wales NP20 4PH, United Kingdom (044 (0) 1633 246614) [www.cintec.com/worldwide/home].
- C. Helical Ties for Securing Stone Panels: Helical ties specifically designed for stabilizing masonry fabricated from ASTM A 276 or ASTM A 666 Type 304 stainless steel. Provide Helifix helical wall ties, 8-millimeter (3/8-inch) diameter, of length as indicated on Drawings, as manufactured by Helifix North America Corporation, 110 Maplecrete Rd., Concord, ON, Canada L4K 1A4 (00-1-888-992-9989), or approved equal.
1. Tools for Installation: Furnish tools recommended by helical tie manufacturer for preparation, installation, and testing of helical anchors to ensure optimum performance.
- D. Structural Adhesive: Structural adhesive specifically designed for anchoring to masonry substrates. Provide HIT HY 200 Hybrid Adhesive by Hilti Hellas SA. Av. Kimi 132 | 15123 Maroussi, Athens, Greece, (+30 210 2880600), or approved equal.
- E. Anchors for Stone Dutchmen: M6 x 1 (1/4-inch-diameter) threaded Type 316 stainless steel rod.
- F. Stainless Steel Banding Clamps: System consisting of stainless steel bands and buckles installed to hold metal elements in place vertically. Provide Type 201 Stainless Steel 19mm, 1.12mm thick bands with heavy duty buckles of the same alloy.
1. Tools for Installation: Furnish tools recommended by band manufacturer for preparation, installation, and testing of band clamps to ensure optimum performance.
- 2.5 EQUIPMENT AND TOOLS FOR CLEANING ANCHOR HOLES
- A. Air Compressor and Related Equipment: Air compressor, hoses, nozzles, valves, oil and water filters, storage tank, and accessories as necessary to provide clean, oil- and water-free, filtered compressed air at a pressure of 0.70 Megapascal (100 psi) and a flow rate of 170 liters per minute (6 cfm). Maintain equipment in optimum condition to ensure that clean, dry, oil-free air is consistently available at required pressure and flow rate.
- B. Brushes for Cleaning Anchor Holes: Stiff wire bristle or nylon bristle brushes of diameter to ensure full cleaning of dust and debris from masonry substrate at sides and bottom of hole.

Furnish brushes specifically manufactured for cleaning anchor holes in masonry substrates as available from Hilti Hellas SA. Av. Kimi 132 | 15123 Maroussi, Athens, Greece, (+30 210 2880600), or approved equal. Brushes shall be sized appropriately for holes in which they are to be used so that they firmly contact entire circumference of hole at the same time. Use sizes recommended by anchor manufacturer and approved by Architect. For small diameter holes use custom fabricated brushes or other methods of removing contaminants from sides of holes.

- C. Air Nozzle for Cleaning Anchor Holes: Nozzle specifically manufactured and sold for use in removing dirt and debris loosened by use of brushes in anchor holes and of length capable of reaching bottom of deepest anchor holes so that debris is blown free from bottom of holes outward. Provide 24-inch-long air nozzle by Hilti Hellas SA. Av. Kimi 132 | 15123 Maroussi, Athens, Greece, (+30 210 2880600), or approved equal. For small diameter holes use special thin nozzles as necessary to reach bottom of hole and remove dust and dirt.

2.6 TOOLS FOR CUTTING JOINTS TO SPECIFIED WIDTH

- A. General: Standard tools and equipment, modified tools and equipment, and custom designed and fabricated tools and equipment as necessary to cut joints between stone panels to dimensions indicated on Drawings without damaging masonry units. Furnish and install jigs and use other methods approved by Architect to ensure that joints are cut straight and true and the stone at sides of joints and at ends of joints is not chipped, cut, or otherwise damaged. Joints shall be of uniform width throughout.
 - 1. Electric Grinders: Small, hand-held electric grinders with blades of thickness of joints to be cut thick and a maximum diameter of 115 millimeters (4-1/2 inches).

2.7 MISCELLANEOUS MATERIALS AND EQUIPMENT

- A. Detergent: Non-ionic detergent. Provide one of the following, or approved equal:
 - 1. Fila Concentrated Natural Detergent, manufactured by Fila Industria Chimica Spa. Via Garibaldi | 58-35018 San Martino di Lupari (Padova) Italy, (049 946 73 00).
 - 2. Karcher RM 55 ASF, Active Cleaner, Neutral, available from Karcher International.
 - 3. Karcher RM 623, Stone and Façade Cleaners, available from Karcher International.
- B. Solvent for Removing Adhesives: Acetone or other solvent approved by Architect.
- C. Tape for Protecting Stone Surfaces: Masking tape or other approved tape that will protect masonry surface from contact with repair materials being used and that can be applied to and removed completely from stone surface without damaging, deteriorating, or altering the appearance of the surface.
- D. Pointing Trowels: Long, thin pointing trowels narrower than joints being pointed. Custom fabricate special trowels for masonry pointing as necessary to ensure proper insertion of mortar to rear of joints and optimum compaction of mortar.
- E. Air Compressor and Equipment for Cleaning Debris from Joints: Air compressor together with hoses, nozzles, valves, pressure gauges, oil filters, water filters, and other accessories as

necessary to provide a complete system capable of producing clean, filtered compressed air without contaminants at a pressure of 0.70 Megapascal (100 psi) and a flow rate of 170 liters per minute (6 cfm).

- F. Drills and Bits for Drilling Stone and Concrete: Rotary drills with diamond bits and diamond core bits as appropriate for drilling out existing anchors and providing holes for new anchors. Do not use hammer drills or other percussive tools.
- G. Scrapers for Removing Mortar: Wood scrapers with rounded corners.
- H. Brushes for Removing Dirt and Debris from Joints: Stiff natural bristle or fiber bristle brushes. No metal bristle brushes are permitted.
- I. Sand for Removing Mortar: Clean, washed fine sand.
- J. Cloths for Removing Mortar: Clean, white terry cloth or similar rough-textured cloth.
- K. Natural Rubber Sponges: Sponges for cleaning the perimeter of patches.

2.8 STONE FABRICATION

- A. Cut stone accurately to shape and dimension to comply with Drawings and approved shop drawings. Exposed surfaces shall be true, and arrises shall be sharp and continuous with adjoining arrises. Exposed surfaces shall replicate textures of adjacent existing stone panels.
- B. Dress bed and head joints full thickness of unit and at right angles to face, unless otherwise shown or necessary for installation.
- C. Cut holes to receive anchoring devices indicated on Drawings and as shown on approved shop drawings. Use care to avoid damaging or weakening stone.

2.9 MORTAR MIXES

- A. General
 - 1. Mortars specified hereinafter shall comply with ASTM C 1713, *Standard Specification for Mortars for the Repair of Historic Masonry*.
 - 2. Mix mortars using proportions specified herein as adjusted, if necessary, by the amount of moisture in the ingredients. The proportions specified are for dry cements and limes and damp, loose (saturated, surface-dry) sand. If ingredients with different moisture contents are used (for example, lime putty is used in place of lime or dry sand is used in place of damp, loose sand), adjust quantities so that the proportions of ingredients in the mixes equal the proportions specified as approved by Architect.
- B. "Thick Set" Mortar for Setting Stone Panels and Dutchmen: Complying with ISO 13007, C.2, with tensile bond strength of more than 2 mPa at 28 days.
 - 1. 1 part by volume white Portland cement (Type I)

2. 3 parts by volume fine “00” sand (selected to match color of existing clean stone)
 3. Temper to a workable consistency with Laticrete 3701 polymer admixture, or approved equal, mixed in accordance with manufacturer's recommendations for high strength, “thick set” mortar.
- C. “Thin Set” Mortar for Setting Stone Panels and Installing Dutchmen: Complying with ISO 13007, C.2, with tensile bond strength of more than 2 mPa at 28 days.
1. 1 part by volume white Portland cement (Type I)
 2. 3 parts by volume fine “00” sand (selected to match color of existing clean stone)
 3. Temper to workable consistency with Laticrete 4237 polymer admixture, or approved equal, mixed in accordance with manufacturer’s recommendations for high strength, “thin set” mortar.
- D. Mortar for Pointing Joints in Masonry: Cement, lime, sand mortar. Proportion mortar by volume as follows to achieve a mortar with a minimum compressive strength of 2.86 Megapascals (415 psi) at 7 days and 3.72 Megapascals (540 psi) at 28 days.
1. 1 part by volume white Portland cement
 2. 2 parts by volume hydrated lime
 3. 7 parts by volume fine “00” sand (selected to match color of existing clean mortar)
 4. Oxide pigments as necessary to adjust color of mortar mixed to as close a match to adjacent stone surface as possible using appropriate aggregates to match color of adjacent stone surface but not to exceed 7 percent of the weight of the cement.

2.10 PREFORMULATED GROUTS

- A. Cementitious Injection Grout for Filling Voids Behind Panels: Provide the following or approved equal.
1. Jahn M30 Micro Injection Grout Formulation #32, available from Jahn International.
- B. Water for Mixing Preformulated Grouts: Clean, potable, and free of substances that might adversely affect mortar, masonry, and embedded elements.

2.11 MIXING MORTARS AND GROUTS

- A. Measuring: Measure mortar and grout ingredients carefully using containers with fixed volumes so that proportions are controlled and maintained throughout the work of this Section.
- B. Mixing: Mix mortars and grouts in an approved type of power-operated batch mixer. Mix for time necessary to produce a homogeneous plastic mortar but not be less than five minutes: approximately two minutes for mixing dry materials and not less than three minutes for mixing after water has been added.
- C. Water: Use minimum amount of water to produce a workable consistency for mortar’s intended purpose.
1. Mortar for Pointing: As dry a consistency as will produce a mortar sufficiently plastic to

- be worked into joints.
2. Grout for Injection: Consistency that can be injected to fill voids and losses.
- D. Small Batches: Where mortar or grout is required in small batches of less than one cubic yard and Architect specifically approves, mortar may be mixed by hand in clean wooden or metal boxes prepared for that purpose provided that Architect approves mixing boxes and methods of mixing and transferring Portland cement and lime mortars.
- E. Installation: After mixing, mortars for pointing or setting shall sit for 20 minutes prior to use to allow for initial shrinkage. Mortar shall be placed in final position within two hours of mixing. Retempering of partially hardened material is not permitted.
- F. Custom Patching Mortars and Injection Grouts: Mix and use in strict accordance with manufacturer's written instructions. Mortars and grouts shall be placed in final position within period recommended by product manufacturer. Retempering of partially hardened material is not permitted.

2.12 PRODUCTS AND EQUIPMENT FOR GROUT INJECTION

- A. Injection Ports: Surface-mounted injection ports with caps designed for injecting epoxy adhesives and cementitious grouts into masonry. Provide Quick Lock Surface Ports with Quick Lock Caps and Quick Lock Braces as manufactured by Mar-Flex Waterproofing and Basement Products, 6866 Chrisman Lane, Middletown, OH 45042 (800-498-1411), or approved equal.
- B. Temporary Crack Sealer: Two-component, non-sag, polyurea paste designed for sealing surfaces of cracks and delaminations in masonry and adhering injection ports to enable pressure injection of adhesives and grouts and to allow for removal without damaging or staining masonry surface. Provide "StripSEAL" manufactured by ChemCo Systems, 2800 Bay Road, Redwood City, CA 94063 (800-757-6773), or approved equal. Test crack sealer to ensure that it can be removed without damaging or staining stone.
- C. Equipment for Injection of Cementitious Grouts: Equipment approved by grout manufacturer and by Architect for application of cementitious grouts to cracks in masonry units and to joints between units. Equipment may be for gravity flow, hand pump operation, or power-operated pump operation as necessary to inject grout throughout depths of cracks and joints to be grouted. Equipment shall include accessories, including but not limited to, hoses, nozzles, valves, traps, and pressure gauges, necessary for optimum installation of cementitious grout under each condition in which cementitious grout is to be installed.

PART 3 - EXECUTION

3.1 REMOVALS

- A. General: Remove all stone panels indicated to be removed and replaced with new or salvaged panels. Store salvaged panels for future reinstallation. If marble panel(s) break during removal, retain all pieces of panel(s) for inspections and repair or for use in dutchmen repairs. Comply with requirements of Section 024193 – "Selective Removal and Salvage."

3.2 SUBSTRATE RESTORATION

- A. General: Repair reinforced concrete to comply with requirements of Section 039000 – “Fiber Reinforced Polymer.”

3.3 CORING OUT ANCHORS

- A. General: Drill out existing pins to show type, size and embedment depth of pins. Provide new stone plug to fill hole.
- B. Preparation: Drill out existing pins using core drill. Clean hole thoroughly to remove contaminants.
- C. Installing Stone Plug: Install mortar and install stone plug to match adjacent surface with minimum joint between plug and mother stone. Comply with requirements of Paragraph “Providing Dutchman Repairs in Stone Panels,” below.
- D. Clean-up: Remove mortar from faces of plug and mother stone.

3.4 INSTALLING MASONRY PANELS

- A. General: Ensure clean, sound substrates free of mortar and contaminants and provide masonry using salvaged or new stone panels as indicated on Drawings. Do not damage stone panels. Repair and replace stone panels damaged during work of this Section as directed by Architect and to Architect’s satisfaction at no additional cost to Owner.
- B. Drilling for Anchors: Drill stone panels for pins to attach stone liners.
- C. Cleaning Stone: Clean stone before setting. Remove old mortar from salvaged stone and scrub stone with detergent and water using natural or synthetic fiber bristle brushes. Thoroughly rinse salvaged stone and new stone with clean water.
- D. Preparation for Anchors
 - 1. Prepare concrete substrate to receive salvaged and new stone panels.
 - 2. At columns, clean fiber reinforced polymer after resin has cured.
- E. Installing Stone Panels with Stone Liners on columns: Install stainless steel bent plates fastened with stainless steel band clamps around the columns. Tension the straps to hold the bent plates in place under a total load of 400kg, (100 kg on each bent plate). Drill holes into marble panel below or above to receive draw or drop pins. Apply “thick-set” mortar. Insert pins into holes. Apply panel to ensure that it is plumb, level, and true to line with adjacent panels. Draw pins through steel bent plate into marble panel. Ensure even joint widths. Use nylon wedges to ensure proper location of stone panels.
- F. Installing Stone Fascia Panels with Stone Liners : Install stainless steel angles fastened with structural adhesive into anchor holes. Drill holes into marble panel below or above to receive draw or drop pins. Apply “thick-set” mortar. Insert pins into holes. Apply panel to ensure that it

is plumb, level, and true to line with adjacent panels. Draw pins through steel angle into marble panel. Ensure even joint widths. Use nylon wedges to ensure proper location of stone panels.

- G. Defects: Patching of defects in stone blocks shall not be permitted. Chips and stains on faces shall be redressed or cleaned. No acid-leaching agent shall be permitted.
- H. Pointing Joints: Comply with Article "Preparing and Pointing Joints," below.

3.5 SECURING PANELS TO SUBSTRATE USING HELICAL TIES

- A. General: Install helical wall ties in locations indicated on Drawings in strict accordance with helical tie Manufacturer's written instructions for "Dryfix Masonry Repair." Plug holes in exposed stone surfaces with patching mortar to match adjacent surface.
- B. Manufacturer's Testing and Instruction: Before installation of helical wall ties, a representative of the helical tie Manufacturer shall visit Project site to test pullout strength of anchors and to instruct the workers in installation procedures to obtain optimum performance of wall ties.
- C. Installation: Drill holes in stonework and install ties using only tools and procedures recommended by Manufacturer. Set face of tie below stone surface to depth indicated on Drawings.
- D. Patching Holes: Patch holes for anchors and cracks in stone panels using cementitious patching mortar following requirements of Article "Patching Stone with Cementitious Patching Mortar," below, to match color, texture, and surface of adjacent stone

3.6 PATCHING STONE WITH CEMENTITIOUS PATCHING MORTAR

- A. General: Clean out holes for anchors and grouting and fill holes and cracks with cementitious patching mortar with surface matching profile, color, and texture of adjacent stone.
- B. Preparation
 1. Cleaning: Clean surfaces of holes to be filled so that they are free from dust, dirt, oils, grease, and other substances and coatings that might adversely affect adhesion of filling and patching material. Brush surfaces with stiff fiber-bristle brushes and blow clean with clean, oil-free compressed air. Wash surfaces of prepared stone with clean water and specified detergent. Rinse thoroughly with clean, clear water and soft, natural fiber bristle brushes.
 2. Protection: Protect surrounding surfaces as necessary to prevent contact with patching materials.
 3. Wetting: Wet surface of prepared stone with clean water and soft fiber-bristle brushes to ensure that at time of patching vertical surfaces are glistening wet and horizontal surfaces are dampened without pooling water. If surfaces dry out before applying cementitious patching mortar, repeat the wetting process.
- D. Application of Patching Mortar: Prepare and apply patching mortar in strict accordance with manufacturer's directions.

1. Application of Bond Coat: Apply a thin coat of patching mortar mixed with water to the consistency of wet putty to the wet substrate. Do not allow bond coat to dry out before applying patching mortar of standard consistency with water content as recommended by manufacturer.
 2. Application of Patching Material: Apply patching mortar to fill voids. Trowel mortar onto wet bond coat. Fill entire void in one steady lift, building material up slightly beyond the plane of the adjacent surfaces. Compress material as it is installed to ensure entire void is filled without gaps.
- E. Finishing: After initial set scrape away excess mortar to provide the appropriate profile matching adjacent planes and profiles. Finish surface to match adjacent surface.
- F. Cleaning: Remove uncured patching mortar from the perimeter of the repair area before it dries using methods that provide uniformly clean surfaces without streaks or stains and without damage or deterioration to stone surfaces or to cementitious patching mortar patches.
- G. Curing: Periodically mist cementitious patching mortar gently using clean water at intervals determined in accordance with the manufacturer's written instructions but at least several times a day for a period of at least 72 hours following installation. Begin misting at appropriate time depending on temperature, humidity, and wind conditions as recommended by manufacturer.
- H. Corrective Measures: Patches exhibiting cracks in patch surface, separation at sides of crack, and/or debonded areas (hollow to sounding test) are unacceptable. Remove unacceptable patches, properly prepare substrates, and provide new patches to comply with the requirements of this Section as directed by and to the satisfaction of the Architect at no additional cost to Owner.
- 3.7 PROVIDING DUTCHMAN REPAIRS IN STONE PANELS
- A. General: Prepare core holes and provide stone dutchmen matching adjacent stone to restore unit to original configuration and appearance.
1. Fabricate dutchman plugs from salvaged stone, where possible.
- B. Dutchman Preparation: Cut stone dutchman plugs with a core drill and carefully fit to opening in stone, with an allowance of not more than 1.5-millimeter- (1/16-inch-) wide buttered joints at face. Dress surface of dutchman to match appearance, tooling, and texture of adjacent stone using an approved method. Complete surface dressing of dutchman before installing dutchman. Drill holes for anchors.
- C. Cleaning Anchor Holes and Substrate: Use stiff bristle brushes and filtered, oil-free compressed air to thoroughly remove dust and other contaminants from anchor holes and from stone surfaces to receive mortar.
- D. Wetting Stone Surfaces: Wet surfaces to receive mortar to ensure that surfaces are damp but free of standing water at time of mortar application (saturated, surface dry) unless specifically instructed otherwise by mortar admixture manufacturer.
- E. Installation: Install anchors with specified adhesive, and install dutchman using specified mortar

matching adjacent stone.

- F. Joint Surfaces: Finish joints between new and old work to match color and texture of stone.
- G. Protection: Protect adjacent surfaces during dutchman repair. Wipe and rinse mortar accidentally splashed onto adjacent surfaces immediately. Remove uncured structural adhesive immediately with solvent recommended by adhesive manufacturer.
 - 1. Repair damage to stone and damage to other materials to remain resulting from adhesive and mortar spills to Architect's satisfaction at no additional cost to Owner.
- H. Cleaning: Clean faces of patched stone units following completion of dutchman installation. Clean mortar splashes, smears, etc. with wood scrapers or by vigorously brushing with stiff fiber bristle brushes and clean, potable water. If necessary to remove mortar, add clean white sand to water.

3.8 SECURING HOLLOW SOUNDING PANELS BY GROUTING THROUGH JOINTS AND THROUGH PANELS

- A. General: Remove deteriorated mortar, point entire perimeter of panel, and inject grout through joints to fill cavity behind panel. If cavity cannot be filled with this method, drill through panel and inject grout directly into void.
- B. Seal Perimeter Joints: Provide temporary crack sealer over existing joints.
- C. Preparation for Grouting Joints: Drill 1/4-inch-diameter injection ports through new pointing mortar or panel approximately 300 millimeters on center. Remove dust, dirt, loose particles, and other contaminants that might adversely affect adhesion of grout or durability of grout from holes using mechanical means followed by clean, oil-free compressed air. Install injection ports over holes. Seal surface of joint and adhere injection ports to stone with temporary crack sealer. Protect adjacent masonry surfaces from contact with grout using approved methods.
- D. Prewetting Substrates: Immediately before injecting grout, flush joint with clean water. If grout is not installed immediately, flush joint again with water to ensure that stone surfaces in area to be grouted are wet at time of grout injection.
- E. Grout Injection: Inject cementitious grout using gravity flow or other approved equipment and methods to ensure that void behind pointing mortar is filled as approved by Architect.
- F. Preparation for Patching Injection Ports: Remove temporary sealer and injection ports and clean stone surface. Remove grout from sides of injection ports. Clean stone at injection ports thoroughly using fine, stiff, fiber-bristle brush followed by clean, oil-free compressed air to remove particles and dust. Thoroughly rinse surfaces to ensure that substrate will not rapidly absorb water from mortar.
- G. Remove temporary crack sealer.
- H. Filling Injection Ports with Patching Mortar: Fill holes with patching mortar matching color and texture of adjacent pointing to comply with requirements of Article "Patching Stone with

Cementitious Patching Mortar,” above.

- I. Finishing: Strike surface flush with adjacent joint surface.
- J. Curing: Protect grout and mortar from too rapid drying and from contact with water that might wash binder from surface.

3.9 SETTING CERAMIC BLOCKS

A. Preparation

- 1. Remove mortar from surfaces of salvaged blocks and from the surfaces on which the blocks are to be set.
- 2. Clean all dust, debris and residue by scrubbing with fiber (non-metallic) bristle brushes and pressurized water from all surfaces to receive mortar.

B. Installation

- 1. Wet all surfaces to receive mortar to be saturated, surface dry. Remove any ponding water.
- 2. Scrub in a slurry coat of thickset mortar on block surfaces.
- 3. Set blocks in thickset mortar and tamp so the blocks are in line with adjacent units and are level and plumb.
- 4. When mortar is leather hard, rake out the joints to a depth of 20 mm and install pointing mortar matching the color and texture of adjacent clean mortar. Install the mortar in accordance with the provisions of the Article, PREPARING AND POINTING JOINTS.

3.10 PREPARING AND POINTING JOINTS

A. Preparing Joints

- 1. Cleaning: Remove loose mortar and foreign material from joints using a fine, stiff natural- or synthetic-fiber bristle brush. Remove remaining particles, dust, and dirt using clean, filtered, oil-free compressed air. Ensure that dust and dirt are not blown back into previously cleaned joints.

B. Pointing Joints

- 1. Wetting: Thoroughly drench masonry with water 24 hours prior to pointing joints to saturate masonry. Thoroughly wet masonry again immediately before pointing joints and allow surfaces to dry slightly. At time of masonry pointing, surfaces shall be damp, so that they do not rapidly absorb moisture, but free of standing water (saturated, surface dry).
 - a. Failure to Properly Wet Substrate: Evidence that masonry to be pointed has not been properly dampened to prevent water in the mortar from being too rapidly absorbed by the masonry will be cause for Architect to reject pointing work. Remove rejected pointing, properly prepare joints for pointing, and provide new mortar to meet requirements of this Section at no additional cost to Owner.

2. Installing Mortar: Install mortar in joints as follows.
 - a. Using a long, thin masonry pointing trowel, tightly pack mortar into joints in layers not exceeding 6 millimeters (1/4-inch) thick to fill joint to match original sound joints.
 - b. Firmly iron each layer to compact mortar and ensure full bond between mortar and stone panels and a firm, solid joint.
 - c. Allow each layer to reach thumbprint hardness before applying succeeding layer. Do not let previous layer dry out before applying succeeding layer. Construct uniform joints.
 - d. Do not spread mortar over edges onto exposed surfaces of stone panels. Do not featheredge mortar.
3. Tooling Joints: After final layer of mortar is “leather hard,” tool joints with a flat rule jointer, or as directed by Architect.
 - a. Profile: Tool joints to match original joint profiles as directed by Architect. Solidly compress mortar so that it adheres well to masonry on both sides and forms a dense surface. Premature or late tooling will result in unacceptable finishes, which will be rejected.
4. Curing
 - a. Keep newly pointed joints damp for at least 72 hours after mortar has been inserted. Do not apply a direct stream of water to joints for at least 7 days after mortar has been placed.
 - b. Ensure masonry temperature remains as required by specifications until mortar is thoroughly cured.

C. Cleaning and Repairing Mortar Joints

1. Water Washing: Wash pointed masonry with clean filtered water and nonabrasive hand tools to remove mortar debris from masonry surfaces. Do not use chemical cleaners.
 - a. Wash within 72 hours following completion of masonry pointing.
 - b. Use blunt-edged wood scrapers, soft natural bristle brushes, and rough towels along with water to remove mortar debris. Do not use wire brushes. Do not scratch or otherwise damage joint surfaces.
2. Repairing Pointed Joints: As cleaning progresses, examine joints to locate cracks, holes, and other defects. Carefully point up and fill such defects with mortar. Where joints are defective in opinion of Architect cut out joints to minimum depth of 19 millimeters (3/4 inch) or two-and-one-half times joint width, whichever is greater, properly prepare joint substrates, and provide new pointing mortar exercising extreme care to ensure that color matches that of adjacent pointing. Exposed joint surfaces shall be free from protruding mortar, holes, pits, depressions, and other defects.

- D. Correcting Unacceptable Joints: Should a crack occur in any joint surface, should mortar separate from a stone panel, or should Architect determine that for another reason masonry pointing work does not equal or exceed the minimum standard established by the approved

mock-up and comply with requirements of this Section, remove mortar to a minimum depth of 19 millimeters (3/4 inch), properly prepare joint substrates, and repoint following requirements of this Section to Architect's satisfaction at no additional cost to Owner.

3.11 ADJUSTMENT AND CLEANING

- A. Adjustment: Correct work of this Section that does not meet requirements of this Specification to Architect's satisfaction at no additional cost to Owner.
- B. Cleaning Restored Masonry: Clean masonry with specified detergent to comply with requirements of Section 040140 – "Masonry Cleaning."
- C. Site Cleaning: At completion of masonry restoration work, remove debris and left over materials from site and leave site broom clean.

END OF SECTION 040143