

## SECTION 04902 - CAST STONE RESTORATION AND CLEANING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary and Division 1 Specifications, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Removing plant growth.
  - 2. Repairing stonework, including replacing damaged units.
  - 3. Cleaning exposed stone surfaces.
  - 4. Repointing mortar joints.
  - 5. Stone consolidation treatment.
  - 6. Related Sections include the following:
    - 7. Division 4 Sections
    - 8. Division 7 Sections
  - 9. Unit Prices: Stone restoration and cleaning to be provided under unit prices are described in Division 1 Section "Unit Prices."

#### 1.3 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm
- B. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.
- C. High-Pressure Spray: 800 to 1200 psi; 4 to 6 gpm.

#### 1.4 SUBMITTALS

- A. Samples for verification, before erecting the mockup, of the following:
  - 1. Each new exposed material to be used for replacing existing materials. Include in each set of samples the full range of colors and textures to be expected in the completed Work.
- B. 12-by-12-inch minimum stone samples.
- C. Each type of mortar for pointing and stone rebuilding and repair in the form of sample mortar strips, 6 inches lon by 1/2 inch wide, set in aluminum or plastic channels.
- D. Each type of repair anchor.
- E. Each type of adhesive.

- F. Each type of chemical cleaner.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- H. Restoration program for each phase of the restoration process, including protection of surrounding materials on the building and Project site during operations. Describe in detail the materials, methods, equipment, and sequence of operations to be used for each phase of the restoration work.
  - 1. If alternative materials and methods to those indicated are proposed for any phase of restoration work, provide a written description, including evidence of successful use on other comparable projects, and a testing program to demonstrate their effectiveness for this Project.
  - 2. Cleaning program indicating cleaning process, including protection of surrounding materials on building and Project site, and control of runoff during operations. Describe in detail the materials, methods, and equipment to be used.
  - 3. If materials and methods other than those indicated are proposed for cleaning work, provide a written description, including evidence of successful use on other comparable projects, and a testing program to demonstrate their effectiveness for this Project.

#### 1.5 QUALITY ASSURANCE

- A. Restoration Specialist: Engage an experienced stone restoration and cleaning firm that has completed work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
  - 1. At Contractor's option, the work may be divided between 2 specialist firms: 1 for cleaning work and 1 for repair work.
  - 2. Field Supervision: Require restoration specialist firms to maintain an experienced full-time supervisor on the Project site during times that stone restoration and cleaning are in progress
  - 3. Chemical Manufacturer Qualifications: A company regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-trained representatives who are available for consultation and Project site inspection and assistance at no additional cost
  - 4. Mockups: Prepare field samples for restoration methods and cleaning procedures to demonstrate aesthetic effects and qualities of materials and execution. Use materials and methods proposed for completed Work and prepare samples under same weather conditions to be expected during remainder of Work.
    - a. Locate mockups on the building where directed by Architect.
    - b. Stonework Repair: Prepare sample panels of size indicated for each type of stone material indicated to be patched, rebuilt, or replaced. Erect sample panels into an existing wall, unless otherwise indicated, to demonstrate the quality of materials and workmanship.
    - c. Cleaning: Prepare sample approximately 25 sq. ft. in area for each type of stone and surface condition.

- 1) Test cleaners and methods on samples of adjacent materials for possible adverse reactions, unless cleaners and methods are known to have a deleterious effect.
  - 2) Allow a waiting period of not less than 7 days after completion of sample cleaning to permit a study of sample panels for negative reactions.
  - 3) Repointing: Prepare 2 separate sample areas approximately 36 inches high by 72 inches wide for each type of repointing required; one for demonstrating methods and quality of workmanship expected in removing mortar from joints and the other for demonstrating quality of materials and workmanship expected in pointing mortar joints.
  - 4) Stone Consolidation Treatment: Demonstrate materials and methods to be used on a sample panel approximately 4 sq. ft. in area.
  - 5) Insert other mockups as required.
  - 6) Notify Architect 7 days in advance of the dates and times when samples will be prepared.
  - 7) Obtain Architect's approval of mockups before starting the remainder of stone restoration and cleaning.
  - 8) Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
5. Preconstruction Testing: Engage an independent testing agency experienced in performing the type of tests indicated and approved by Architect to perform preconstruction tests.
- a. Preconstruction Stone Tests: Test stone according to ASTM C 97 for absorption and bulk specific gravity, ASTM C 99 for modulus of rupture, and ASTM C 170 for compressive strength.
  - b. Test each proposed type of replacement stone.
6. Source of Materials: Obtain materials for stone restoration from a single source for each type of material required (stone, cement, sand, etc.) to ensure a match of quality, color, pattern, and texture.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Carefully pack, handle, and ship stone and accessories strapped together in suitable packs or pallets or in crates or heavy-duty containers.
- B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with type and name of product and manufacturer.
- C. Store cementitious materials off the ground, under cover, and in a dry location.
- D. Store aggregates, covered and in a dry location, where grading and other required characteristics can be maintained and contamination avoided.
- E. Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

## 1.7 PROJECT CONDITIONS

- A. Do not repoint mortar joints or repair stone unless air temperature is between 40 and 80 deg F and will remain so for at least 48 hours after completion of Work.
- B. Cold-Weather Requirements: Comply with the following procedures for stone repair and mortar-joint pointing:
  - 1. When air temperature is below 40 deg F, heat mortar ingredients, stone repair materials, and existing walls to produce temperatures between 40 and 120 deg F.
    - a. When mean daily air temperature is between 25 and 40 deg F, cover completed Work with weather-resistant, insulating blankets for 48 hours after repair and pointing.
    - b. When mean daily air temperature is below 25 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 48 hours after repair and pointing.
- C. Hot-Weather Requirements: Protect restoration work when temperature and humidity conditions produce excessive evaporation of water from mortar and patching materials. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 90 deg F and above.
  - 1. Clean stone surfaces only when air temperature is 40 deg F and above and will remain so for at least 7 days after completion of cleaning.
- D. Apply stone consolidation treatment only when surface and air temperatures are between 50 and 90 deg F and rain is not expected within 24 hours.
- E. Prevent grout or mortar used in repointing and repair work from staining face of surrounding stone and other surfaces. Immediately remove grout and mortar in contact with exposed stone and other surfaces.
  - 1. Protect sills, ledges, and projections from mortar droppings.

## 1.8 SEQUENCING AND SCHEDULING

- A. Order replacement materials at the earliest possible date, to avoid delaying completion of the Work.
- B. Perform stone restoration work in the following sequence:
  - 1. Remove plant growth.
  - 2. Repair existing stonework, including replacing existing stone with new stone materials.
  - 3. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
  - 4. Clean stone surfaces. Remove paint before general cleaning.
  - 5. Rake out existing mortar from joints indicated to be repointed.
  - 6. Point existing mortar joints of stone indicated to be restored.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. Factory-Mixed Patching Mortar:
    - a. Jahn Restoration Mortar; Cathedral Stone Products, Inc.
    - b. Custom System 45; Edison Chemical Systems, Inc.
  2. Non-acidic Gel Cleaner:
    - a. Sure Klean 942 Masonry Cleaner; ProSoCo, Inc.
  3. Non-acidic Liquid Cleaner:
    - a. Bio-Cleanse; Dominion Restoration, Inc.
  4. Mild Acidic Cleaner:
    - a. DR-60 Stone and Masonry Cleaner; Dominion Restoration, Inc.
    - b. Sure Klean Light-Duty Restoration Cleaner; ProSoCo, Inc.
  5. Acidic Cleaner:
    - a. Diedrich 101-G Granite, Terra Cotta, and Brick Cleaner; Diedrich Technologies, Inc.
    - b. Hydroclean Brick, Granite, Sandstone and Terra Cotta Cleaner (HT-626); Hydrochemical Techniques, Inc.
    - c. Sure Klean Heavy-Duty Restoration Cleaner; ProSoCo, Inc.
    - d. Sure Klean Interior Stone Cleaner; ProSoCo, Inc.
    - e. Sure Klean 1028 Restoration Cleaner; ProSoCo, Inc.
    - f. Sure Klean Restoration Cleaner; ProSoCo, Inc.
  6. One-Part Limestone Cleaner:
    - a. Hydroclean Limestone and Marble Cleaner and Brightener (HT-907); Hydrochemical Techniques, Inc.
    - b. Sure Klean Limestone Restorer; ProSoCo, Inc.
  7. Two-Part Limestone Cleaner:
    - a. Diedrich Limestone Cleaner Prerinse (707) and Neutralizer After-Rinse (707N); Diedrich Technologies, Inc.
    - b. Hydroclean Limestone and Marble Precleaner (HT-704) and Hydroclean Limestone and Marble Cleaner and Brightener (HT-907); Hydrochemical Techniques, Inc.
    - c. Sure Klean Limestone Prewash and Afterwash; ProSoCo, Inc.
  8. Alkaline Paint Remover:

- a. Diedrich 404/606/606X Paint Remover; Diedrich Technologies, Inc.
  - b. Hydroclean Heavy Duty Paint Remover (HT-716); Hydrochemical Techniques, Inc.
  - c. Enviro Strip #1; ProSoCo, Inc.
  - d. Enviro Strip #2; ProSoCo, Inc.
  - e. 1217 Poultice/Paint Stripper; ProSoCo, Inc.
  - f. Sure Klean Heavy-Duty Paint Stripper; ProSoCo, Inc.
9. Solvent-Type Paint Remover:
- a. Diedrich 505 Special Coatings Stripper; Diedrich Technologies, Inc.
  - b. Diedrich 505X Dry Strip; Diedrich Technologies, Inc.
  - c. Dominion Multi-Layer Paint & Graffiti Remover; Dominion Restoration, Inc.
  - d. Hydroclean Solvent Paint Remover (HT-300); Hydrochemical Techniques, Inc.
  - e. Non-Methylene Chloride Paint Stripper; ProSoCo, Inc.
  - f. Sure Klean 509 Paint Stripper; ProSoCo, Inc.
  - g. Sure Klean 859 Paint Stripper; ProSoCo, Inc.
  - h. Sure Klean 940 Paint Stripper; ProSoCo, Inc.
10. Low-Odor, Solvent-Type Paint Remover:
- a. Enviro Strip #3; ProSoCo, Inc.
  - b. Enviro Strip #4; ProSoCo, Inc.
11. Liquid Strippable Masking Agent:
- a. Diedrich Acid Guard; Diedrich Technologies, Inc.
  - b. Sure Klean Acid Stop; ProSoCo, Inc.
12. Stone-to-Stone Adhesive:
- a. A-199-T/B-439-T; Bonstone Materials Corp.
  - b. Akemi; Wood and Stone Co.
13. Mortar-to-Stone Adhesive:
- a. Sikadur Hi-Mod Epoxy, Sikastix 370; Sika Corporation.
14. Stone Consolidation Treatment:
- a. Conservare OH Stone Strengthener; ProSoCo, Inc.
15. Stone Consolidation and Water-Repellent Treatment:
16. Conservare H Stone Strengthener; ProSoCo, Inc.

## 2.2 CAST STONE MATERIALS

- A. Cast Stone: Provide cast building stone of variety, color, finish, size, and shape to match existing stone.

## 2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II.
- B. Provide white cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- C. Low-Alkali Cement: Portland cement for use with limestone shall contain not more than 0.60 percent total alkali when tested according to ASTM C 114.
- D. Hydrated Lime: ASTM C 207, Type S.
- E. Aggregate for Mortar: ASTM C 144.
- F. Colored-Mortar Aggregate: Natural or manufactured sand selected to produce mortar color indicated.
  - 1. For pointing mortar, provide sand with rounded edges.
  - 2. Match size, texture, and gradation of existing mortar as closely as possible.
  - 3. If known, indicate source of sand and size and gradation.
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in stone mortars.
- H. Factory-Mixed Patching Mortar: Cement-based vapor-permeable mortar, custom-manufactured for patching stone and formulated to match stone in color and texture.
- I. Water: Potable.

## 2.4 CLEANING MATERIALS

- A. Water for Cleaning: Potable.
  - 1. Warm Water: Heat water to a temperature of 140 to 160 deg F.
- B. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium polyphosphate (TSPP), 1/2 cup of laundry detergent (Tide, All, etc.), 5 quarts of 5 percent sodium hypochlorite (bleach), and 15 quarts of warm water for each 5 gal. of solution required.
- C. Non-acidic Gel Cleaner: Manufacturer's standard Non-acidic gel containing detergents and chelating agents and specifically formulated for cleaning stone surfaces. Cleaner shall have a pH between 6 and 9 and shall not be considered a hazardous waste according to 40 CFR 261.

- D. Non-acidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
- E. Mild Acidic Cleaner: Manufacturer's standard mildly acidic cleaner containing no hydrochloric, hydrofluoric, or sulfuric acid; chlorine bleaches; or caustic soda.
- F. Acidic Cleaner: Manufacturer's standard-strength acidic stone restoration cleaner composed of hydrofluoric acid blended with other acids, including a trace of phosphoric acid, and combined with special wetting systems and inhibitors.
- G. One-Part Limestone Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.
- H. Two-Part Limestone Cleaner: Manufacturer's standard 2-part system consisting of an alkaline cleaner for prewash and an acid neutralizer for afterwash.
- I. Alkaline Paint Remover: Manufacturer's standard alkaline paste formulation for removing paint coatings from masonry.
- J. Solvent-Type Paint Remover: Manufacturer's standard thixotropic, water-rinsable solvent formulation for removing paint coatings from masonry.
- K. Low-Odor, Solvent-Type Paint Remover: Manufacturer's standard low-odor, thixotropic, water-rinsable solvent formulation, containing no methanol or methylene chloride, for removing paint coatings from masonry.
- L. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from the damaging effects of acidic and alkaline masonry cleaners.

## 2.5 MISCELLANEOUS MATERIALS

- A. Stone-to-Stone Adhesive: 2-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg F, in formulation (knife or flowing grade) recommended by adhesive manufacturer for type of stone repair indicated, and matching stone color.
- B. Mortar-to-Stone Adhesive: High-modulus, high-strength, moisture-insensitive epoxy adhesive with a pot life of 30 minutes at 40 deg F.
- C. Stone Consolidation Treatment: Ready-to-use product designed for the consolidation of masonry materials that have deteriorated due to weathering and exposure to pollutants. Treatment shall be composed of silicic-ethyl esters, a neutral catalyst, and solvents.
- D. Stone Consolidation and Water-Repellent Treatment: Ready-to-use product designed for the consolidation and water-repellent treatment of masonry materials that have deteriorated due to weathering and exposure to pollutants. Treatment shall be composed of silicic-ethyl esters, a neutral catalyst, a silane water repellent, and solvents.

- E. Stone Anchors: Type and size indicated or, if not indicated, to match existing anchors in size and type. Fabricate anchors and dowels from Type 304 stainless steel.

## 2.6 MORTAR

- A. Measurement and Mixing: Measure cementitious and aggregate material in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
- B. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 1 to 2 hours. Add remaining water in small portions until reaching mortar of the desired consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.
- C. Colored Mortar: Produce mortar of color required by using selected ingredients. Do not adjust proportions without Architect's approval.
  - 1. Mortar Pigments: Where mortar pigments are indicated, do not exceed a pigment-to-cement ratio of 1:10 by weight.
  - 2. Do not use admixtures of any kind in mortar, unless otherwise indicated.
  - 3. Mortar Proportions: Mix mortar materials in the following proportions:
    - a. Pointing Mortar for Stone: 1 part white portland cement, 1 part lime, and 6 parts colored- or natural-mortar aggregate.
    - b. Pointing Mortar for Stone: 1 part white portland cement, 2 parts lime, and 6 parts colored- or natural-mortar aggregate
    - c. Rebuilding Mortar: 1 part white portland cement, 1 part lime, and 6 parts colored- or natural-mortar aggregate.
    - d. Rebuilding Mortar: Comply with ASTM C 270, Proportion Specification, Type N, unless otherwise indicated, with cementitious material limited to portland cement and lime.
    - e. Patching Mortar for Stone: Provide mix composed of white and gray cement combined with lime and selected aggregates to produce a color matching the color of existing stone. Proportion mix with 2 parts cement, 2 parts lime, and 6 parts aggregate.

## 2.7 CHEMICAL CLEANING

- A. Dilute chemical cleaners with water to produce solutions of concentration recommended by chemical cleaner manufacturer, unless otherwise indicated.
- B. Acidic Cleaner Solution for Unpolished Stone: Unless otherwise indicated, dilute with water to produce a hydrofluoric acid content of 3 percent or less, but not greater than that recommended by chemical cleaner manufacturer.
  - 1. Use only on unpolished granite, unpolished dolomite marbles, and siliceous sandstone.
  - 2. Acidic Cleaner for Polished Stone: Dilute with water to a concentration demonstrated by testing that does not etch or otherwise damage the polished

surface, but not greater than that recommended by chemical cleaner manufacturer.

- a. Use only on polished granites and polished dolomite marbles.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. General: Comply with chemical cleaner manufacturer's written instructions for protecting building surfaces against damage from exposure to their products.
- B. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from injury resulting from stone restoration work.
  1. Prevent chemical cleaning solutions from coming into contact with pedestrians, motor vehicles, landscaping, buildings, and other surfaces that could be injured by such contact.
  2. Do not clean stone during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
  3. Neutralize and collect alkaline and acid wastes for disposal off Owner's property. Dispose of runoff from cleaning operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
  4. Erect temporary protection covers over pedestrian walkways and at points of entrance and exit for persons and vehicles that must remain in operation during course of stone restoration work
  5. Protect adjacent surfaces from contact with chemical cleaners by covering them with a liquid strippable masking agent or polyethylene film and waterproof masking tape. Apply masking agent to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces.

#### 3.2 STONE REMOVAL AND REPLACEMENT

- A. Carefully remove by hand, at locations indicated, stone that has deteriorated, shifted, or is damaged beyond repair.
- B. Support and protect remaining stonework that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.
- C. Remove mortar, loose particles, and soil from salvaged stone and stone surrounding removed units to prepare for resetting.
- D. Replace removed stone with salvaged stone, where possible, or with new stone matching existing stone, including size. Butter vertical joints for full width before setting and set units in full bed of mortar, unless otherwise indicated.
- E. Tool joints after setting to match joints of surrounding stone.

- F. Rake out mortar used for laying stone before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing stone.

### 3.3 STONE REPAIR

- A. Carefully remove loose stone fragments in areas to be repaired. Reuse only pieces of spalled stone that are in sound condition.
- B. Remove soil, loose stone particles, mortar, and other debris or foreign material from the surfaces to be bonded on both the fragment and the building stone from which fragment was removed by cleaning with a stiff-fiber brush.
- C. Apply adhesive to comply with adhesive manufacturer's written instructions. Coat bonding surface of building stone with stone-to-stone adhesive, completely filling all voids and covering all surfaces. Fit stone fragments onto building stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured.
  - 1. After adhesive has fully cured, further anchor stone fragments with 1/4-inch diameter, plain stainless-steel rods set into 1/4-inch diameter holes drilled at a 45-degree downward angle through the face of the stone. Center and space anchor rods between 3 and 5 inches apart and at least 2 inches from any edge. Insert rods at least 2 inches into backing stone and 2 inches into fragment with end countersunk at least 3/4 inch from the exposed face of the stone.
  - 2. Clean residual adhesive from edges. Wet stone, fill chipped areas, and drill holes with patching mortar. Avoid featheredging. Finish patched areas to match texture of and be level with adjacent stone surfaces. Keep patching mortar damp for 72 hours.

### 3.4 STONE PATCHING

- A. Cut out deteriorated stone and adjacent stone that has begun to deteriorate. Remove additional stone so patch will not have feathered edges and will be at least 1/4 inch thick.
- B. Remove loose particles, soil, debris, oil, and other contaminants from existing stone units at locations indicated by cleaning with a stiff-fiber brush.
- C. Brush-coat stone surfaces with mortar-to-stone adhesive complying with manufacturer's written instructions.

-OR-

- D. Brush-coat stone surfaces with a slurry coat of patching mortar complying with manufacturer's written instructions.
- E. Place patching mortar in layers no thicker than 2 inches. Roughen surface of each layer to provide a key for the next layer.
- F. Build patch up 1/4 inch above surrounding stone and carve surface to match adjoining stone after mortar has hardened.

- G. Keep each layer damp for 72 hours or until mortar has set.
- H. Unacceptable patches are those with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture. Remove patches and refill to provide patches free of these defects.

### 3.5 CLEANING STONE, GENERAL

- A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Work from bottom to top of the building for each scaffold drop.
- B. Use only those cleaning methods indicated for each stone material and location.
  - 1. Use natural-fiber brushes only.
- C. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage stonework.
  - 1. Equip units with pressure gages.
- D. For chemical cleaner spray application, use a low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with a cone-shaped spray tip.
- E. For water spray application, use a fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
  - 1. For heated water spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
  - 2. For steam application, use a steam generator capable of delivering live steam at nozzle.
- F. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging stone surfaces
- G. Removing Plant Growth: Completely remove plant, moss, and shrub growth from stone surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing to dry as long as possible before removal. Remove loose soil or debris from open joints to whatever depth they occur.
  - 1. Apply ammonium sulfamate or another acceptable root-killing material to plant roots according to manufacturer's written instructions. Do not apply materials to plants that are to remain.
- H. Water Application Methods: Where water application methods are indicated, comply with the following:
  - 1. Prolonged Spraying: Soak stone surfaces by applying water continuously and uniformly to a limited area for the time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.

- I. Spray Applications: Spray apply water to stone surfaces to comply with requirements indicated for location, purpose, water temperature, pressure, volume, and equipment. Unless otherwise indicated, hold spray nozzle at least 6 inches from surface of stone and apply water from side to side in overlapping bands to produce uniform coverage and an even effect.
- J. Steam Wash: Apply steam to stone surfaces at pressures not exceeding 80 psi. Hold nozzle at least 6 inches from surface of stone and apply steam from side to side or in direction of tooling in overlapping bands to produce uniform coverage and an even effect.
- K. Chemical Cleaner Application Methods: Apply chemical cleaners to stone surfaces to comply with chemical cleaner manufacturer's written instructions; use brush or spray application methods, at Contractor's option, unless otherwise indicated. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.
  - 1. Spray Application: Apply chemical cleaners at pressures not exceeding 50 psi, unless otherwise indicated.
  - 2. Reapplying Chemical Cleaners: Do not apply chemical cleaners to same stone surfaces more than twice. If additional cleaning is required, use a steam wash.
  - 3. Bottom to top rinsing helps ensure a thorough and uniform rinse; rinse water leaving bottom of wall while top is being rinsed will only be clear if entire wall is thoroughly rinsed. Also, entire wall will be wet when rinsing is completed, resulting in more uniform drying and less streaking.
  - 4. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting.

### 3.6 CLEANING STONework

- A. Detergent Cleaning: Clean stonework with a detergent solution applied as follows:
  - 1. Wet stone with water of a temperature recommended by the manufacturer applied by low-pressure spray.
  - 2. Scrub stonework with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that stone surface remains wet.
  - 3. Rinse with cold water to remove detergent solution and soil:
    - a. Apply rinse by low-pressure spray.
    - b. Repeat cleaning procedure above where required to produce the cleaning effect established by mockup.
- B. Mild Acidic Chemical Cleaning: Clean stone with a mild acidic cleaner applied as follows:
  - 1. Wet stone with cold water applied by low-pressure spray.
  - 2. Apply cleaner to stone. Let cleaner remain on surface for period indicated below:
    - a. As recommended by chemical cleaner manufacturer.
  - 3. Rinse with cold water to remove chemicals and soil.
    - a. Apply rinse by low-pressure spray.
  - 4. Repeat cleaning procedure above where required to produce the cleaning effect established by mockup. Do not apply more than twice.

- C. Non-acidic Gel Chemical Cleaning: Clean stonework with a Non-acidic gel cleaner applied as follows:
1. Wet stone with cold water applied by low-pressure spray.
  2. Apply Non-acidic gel cleaner in a 1/8-inch thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively so area will be uniformly covered with fresh cleaner and dwell time will be uniform throughout area being cleaned.
  3. Let cleaner remain on surface for period indicated below:
    - a. As established by mockup.
  4. Remove bulk of Non-acidic gel cleaner by squeegeeing into containers for disposal.
  5. Rinse with cold water to remove chemicals and soil.
    - a. Apply rinse by low-pressure spray.
  6. Repeat cleaning procedure above where required to produce the cleaning effect established by mockup. Do not apply more than twice.
- D. One-Part Limestone Chemical Cleaning: Clean limestone with one-part limestone cleaner applied as follows:
1. Wet stone with cold water applied by low-pressure spray.
  2. Apply one-part limestone cleaner to stone by using a soft-fiber brush or low-pressure spray equipment. Let cleaner remain on surface for period recommended by manufacturer.
  3. Immediately repeat application of one-part limestone cleaner as indicated above over the same area.
  4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
- E. Two-Part Limestone Chemical Cleaning: Clean limestone with 2-part limestone cleaner applied as follows:
1. Wet stone with cold water applied by low-pressure spray.
  2. Apply alkaline prewash cleaner to stone by brush or roller. Let cleaner remain on surface for period recommended by cleaner manufacturer, unless otherwise indicated.
  3. A specific time should be inserted in subparagraph above as determined by preliminary testing. Time will vary depending on temperature and relative humidity.
  4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
  5. Apply an afterwash acid neutralizer to stone, while surface is still wet, using low-pressure spray equipment, a deep-nap roller, or a soft-fiber brush. Let neutralizer remain on surface for period recommended by manufacturer, unless otherwise indicated.
  6. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
  7. Repeat cleaning procedure above where required to produce the cleaning effect established by mockup. Do not apply more than twice.
- F. Paint Removal with Alkaline Paint Remover: Remove paint from stonework as follows:
1. Apply paint remover to dry, painted stonework with brushes.
  2. Allow paint remover to remain on surface for period recommended by manufacturer.

3. Rinse with cold water to remove chemicals and paint residue.
    - a. Apply rinse by low-pressure spray.
  4. Apply an acidic cleaner to stonework, while surface is still wet, using low-pressure spray equipment or a soft-fiber brush. Let cleaner remain on surface for period recommended by chemical cleaner manufacturer, unless otherwise indicated.
  5. Rinse with cold water to remove chemicals and soil.
    - a. Apply rinse by low-pressure spray.
- G. Paint Removal with Solvent-Type Paint Remover: Remove paint from stonework as follows:
1. Apply thick coating of paint remover to painted stonework with natural-fiber cleaning brush, deep-nap roller, or large paint brush.
  2. Allow paint remover to remain on surface for period recommended by manufacturer. Agitate periodically with a stiff-fiber brush.
  3. Rinse with cold water to remove chemicals and paint residue.
  4. Apply rinse by low-pressure spray.

### 3.7 REPOINTING STONEWORK

- A. Rake out joints as follows:
1. Rake out mortar from joints to depths equal to 2-1/2 times their widths, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.
  2. Remove mortar from stonework surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
  3. Do not spall edges of stone units or widen joints. Replace damaged stone units.
  4. Cut out old mortar from vertical joints by hand with a chisel and mallet, unless otherwise indicated. The use of a small-diameter (4") blade power-operated grinder to cut horizontal joints only is permitted based on submission by Contractor of a satisfactory quality-control program and demonstrated ability of operators to use tools without damaging stone. The quality-control program includes provisions for supervising performance and preventing damage due to worker fatigue.
- B. Point joints as follows:
1. Rinse stonework-joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at the time of pointing, excess water has evaporated or run off and joint surfaces are damp but free of standing water.
  2. Apply the first layer of pointing mortar to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Compact each layer thoroughly and allow it to become thumbprint hard before applying the next layer.
  3. After joints have been filled to a uniform depth, place remaining pointing mortar in 3 layers with first and second layers each filling about two-fifths of joint depth; third layer, the remaining one-fifth. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing stone has rounded edges, slightly recess final layer from face. Take care not to spread mortar over edges onto exposed stone surfaces or to featheredge mortar.

4. When mortar is thumbprint hard, tool joints to match original appearance of joints, unless otherwise indicated. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in a damp condition for at least 72 hours.
6. Where repointing work precedes cleaning of existing stone, allow mortar to harden at least 30 days before beginning cleaning work.

### 3.8 STONE CONSOLIDATION TREATMENT

- A. Apply treatment to clean, dry surfaces according to manufacturer's written instructions. Remove areas of blind exfoliation and delamination before applying.
- B. Apply in cycles (repeated applications) to small sections of stonework, not more than 100 sq. ft. in area. Each cycle shall consist of 3 successive saturating applications, applied at 5- to 15-minute intervals, depending on drying conditions.
- C. Apply by low-pressure spray to the point of rejection in each application. Apply from bottom of section to top.
- D. Apply 3 cycles, allowing treated surface to dry for 60 to 90 minutes between cycles.
- E. Protect treated surfaces from rain for 48 hours after treatment.
- F. Allow treated surfaces to dry for at least 21 days before repointing, patching, or applying water repellents or sealants.

### 3.9 FINAL CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed stonework surfaces of excess mortar and foreign matter; use stiff-nylon or -fiber brushes and clean water, spray applied at a low pressure.
- B. Do not use metal scrapers or brushes.
- C. Do not use acidic or alkaline cleaners.

END OF SECTION 04902