SECTION 040140.61 - STONE REPAIR

Revise this Section by deleting and inserting text to meet Project-specific requirements.

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			2. SUMMARY
				1. Section Includes:

Repairing stone masonry.

Removing abandoned anchors.

Painting steel uncovered during the work.

* + - * 1. Related Requirements:
			1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

Pressure spray value in "Low-Pressure Spray" Paragraph below is not standardized; revise pressure to suit Project.

* + - * 1. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

Revise "Rebuilding (Setting) Mortar" Paragraph below to suit local usage and office practice.

* + - * 1. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

Rift may be obscure in igneous rocks such as granite. Often it is obvious as with bedding planes in many sedimentary stones.

* + - * 1. Rift: The most pronounced direction of splitting or cleavage of a stone.
				2. Stone Terminology: ASTM C119.
			1. PREINSTALLATION MEETINGS

Retain "Preinstallation Conference" Paragraph below if Work of this Section is extensive or complex enough to justify a conference.

* + - * 1. Preinstallation Conference: Conduct conference at Project site.

If needed, insert list of conference participants.

Retain subparagraph below if additional requirements are necessary; include information about conference.

Review methods and procedures related to stone repair including, but not limited to, the following:

Verify stone repair specialist's personnel, equipment, and facilities needed to make progress and avoid delays.

Materials, material application, sequencing, tolerances, and required clearances.

Quality-control program.

Coordination with building occupants.

* + - 1. SEQUENCING AND SCHEDULING

Procedure in first paragraph below may be required to ensure consistency of sand and gray portland cement, if any, throughout Project. Coordinate use of gray portland cement with "Mortar Materials" Article. Gray portland cement can vary more than white portland cement from plant to plant and from batch to batch.

* + - * 1. Order sand[ **and gray portland cement**] for colored mortar immediately after approval of [**Samples] [mockups**]. Take delivery of and store at Project site enough quantity to complete Project.

"Work Sequence" Paragraph below is an example only; revise to suit Project or delete if not prescribing a work sequence. This sequence assumes that cleaning, if required, precedes repairs. For this, stone and joints must be sound enough to prevent water and chemicals from penetrating into building.

* + - * 1. Work Sequence: Perform stone repair work in the following sequence, which includes work specified in this and other Sections:

Retain and revise subparagraphs below, and insert others to suit Project. Insert other sequences for different areas of building if needed.

Remove plant growth.

Inspect masonry for open mortar joints and permanently or temporarily point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.

Remove paint.

Clean stone.

Rake out mortar from joints surrounding stone to be replaced and from joints adjacent to stone repairs along joints.

Repair stonework, including replacing existing stone with new stone.

Rake out mortar from joints to be repointed.

Point mortar and sealant joints.

After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.

Retain subparagraph below if water repellents are part of Project; revise if water-repellent, graffiti-resistant coating is required.

Where water repellents are to be used on or near stonework, delay application of these chemicals until after pointing and cleaning.

If windows are to be replaced, insert subparagraph into the above sequence for the timing of window replacement.

Retain paragraph below if scaffolding anchor holes in stonework and patching them are required and acceptable; revise to suit Project.

* + - * 1. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in stone according to "Stone Patching" Article. Patch holes in mortar joints according to Section 040140.62 "Stone Repointing."
			1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

Include recommendations for product application and use.

Include test data substantiating that products comply with requirements.

* + - * 1. Shop Drawings:

Include plans, elevations, sections, and locations of replacement stone units on the structure and their jointing, showing relation of existing and new or relocated units.

Show partial replacement stone units (dutchmen).

Indicate setting number of each new stone unit and its location on the structure in annotated plans and elevations.

Show provisions for expansion joints or other sealant joints.

Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.

Show replacement and repair anchors, including drilled-in pins. Include details of anchors within individual stone units, with locations of anchors and dimensions of holes and recesses in stone required for anchors, including direction and angle of holes for pins.

Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

Retain "Samples for Initial Selection" and "Samples for Verification" paragraphs below for two-stage Samples.

* + - * 1. Samples for Initial Selection: For the following:

Retain and revise subparagraphs below and insert others to suit Project. Stone samples are not included because the existing stone is typically the standard of appearance, but stone samples for selection could be inserted. Revise options in "Colored Mortar" Subparagraph to approximate existing joint widths.

Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches long by [**1/4 inch] [1/2 inch**] wide, set in aluminum or plastic channels.

Have each set contain a close color range of at least [**three] [six] <Insert number**> Samples of different mixes of colored sands and cements that produce a mortar matching the existing, cleaned mortar when cured and dry.

Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.

Sand Types Used for Mortar: Minimum 8 oz. of each in plastic screw-top jars.

Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of stone representative of the range of stone colors on the building.

Have each set contain a close color range of at least [**three] [six] <Insert number**> Samples of different mixes of patching compound that matches the variations in existing stone when cured and dry.

Include similar Samples of accessories involving color selection.

* + - * 1. Samples for Verification: For the following:

Retain and revise four subparagraphs below and insert others to suit Project.

Each type of replacement stone. Include sets of Samples to show full range of color, texture, grain, veining, and finish to be expected. Provide sets of at least [**two] [three] <Insert number**> 12-by-12-inch Samples for each type, but no fewer than necessary to indicate full range and proportion of variations within range.

Samples in first subparagraph below are of limited value because they are not cured under same conditions as patching compound used in actual work. A mockup provides a better sample.

Each type of patching compound in form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.

Each type of adhesive.

Accessories: Each type of anchor, accessory, and miscellaneous support.

Coordinate "Qualification Data" Paragraph below with qualification requirements in "Quality Assurance" Article.

* + - * 1. Qualification Data: For [**stone repair specialist] [including field supervisors and workers] [and] [testing service**].

Retain "Preconstruction Test Reports" Paragraph below if specifying preconstruction testing in "Preconstruction Testing" Article as Contractor's responsibility.

* + - * 1. Preconstruction Test Reports: For [**existing stone and mortar] [and] [replacement stone**].

Retain paragraph below if program is retained in "Quality Assurance" Article.

* + - * 1. Quality-control program.
			1. QUALITY ASSURANCE
				1. Stone Repair Specialist Qualifications: Engage an experienced stone repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing standard unit masonry or new stone masonry is insufficient experience for stone repair work.

Field Supervision: Stone repair specialist firms shall maintain experienced full-time supervisors on Project site during times that stone repair work is in progress.

Retain "Stone Repair Worker Qualifications" Subparagraph below if required; option is an example only.

Stone Repair Worker Qualifications: [**When stone units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products**].

* + - * 1. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging stonework. Include provisions for supervising performance and preventing damage.

Retain required mockups in "Mockups" Paragraph below; insert others to suit Project. Test areas that were prepared or are required as part of a separate contract to evaluate and establish stone repair materials and processes are not mockups.

* + - * 1. Mockups: Prepare mockups of stone repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

Stone Repair: Prepare sample areas for each type of stone indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Director’s Representative unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

Replacement: Four stone units replaced.

Partial Stone Replacement: Two partial stone replacements (dutchman repairs).

Stone Plug Repair: Two stone plug repairs for each type of stone indicated to be plugged.

Crack Injection: Apply crack injection in two separate areas[, **each approximately 36 inches long] [as directed**].

Patching: Three small holes [**at least 1 inch in diameter] [as directed**].

Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Director’s Representative specifically approves such deviations in writing.

Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

* + - 1. PRECONSTRUCTION TESTING

Retain this article for preconstruction testing. Revise this article based on Specifier’s knowledge of the building's materials and experience with similar work. Project-specific preconstruction testing can be expensive but may be the best means of proving that performance requirements are met if existing stone and mortar were not tested before the Contract.

* + - * 1. Preconstruction Testing Service: [**Director’s Representative will engage] [Engage**] a qualified testing agency to perform preconstruction testing on stone units as follows:

Retain applicable subparagraphs below; revise tests and insert others if required.

Provide test specimens as indicated and representative of proposed materials and existing construction.

Replacement Stone: Test each proposed type of replacement stone according to ASTM C170 for compressive strength, ASTM C99 for modulus of rupture, and ASTM C97 for absorption and bulk specific gravity.

Usually test existing stone and mortar before preparing the Specifications, and delete "Existing Stone," "Existing Mortar," and "Temporary Patch" subparagraphs below.

Existing Stone: Test each type of existing stone indicated for replacement according to ASTM C170 for compressive strength, wet and dry, perpendicular and parallel to rift; ASTM C99 for modulus of rupture, wet and dry, perpendicular and parallel to rift; and ASTM C97 for absorption and bulk specific gravity. Carefully remove five existing stones from locations designated by Director’s Representative. Take testing samples from these stones.

Existing Mortar: Test according to ASTM C1324, modified as agreed by testing service and Director’s Representative for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength.

Temporary Patch: As directed by Director’s Representative, provide temporary materials followed by permanent repairs at locations from which existing samples were taken.

* + - 1. DELIVERY, STORAGE, AND HANDLING

Retain paragraphs below that are applicable to products retained in Part 2.

* + - * 1. Deliver stone units to Project site strapped together in suitable packs or pallets or in heavy-duty crates and protected against impact and chipping.
				2. Deliver each piece of stone with code mark or setting number on unexposed face, corresponding to Shop Drawings, using nonstaining paint.
				3. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
				4. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
				5. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
				6. Store sand where grading and other required characteristics can be maintained and contamination avoided.
				7. Handle stone to prevent overstressing, chipping, defacement, and other damage.
			1. FIELD CONDITIONS

Usually retain this article; revise to suit Project.

* + - * 1. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit stone repair work to be performed according to product manufacturers' written instructions and specified requirements.

Retain "Temperature Limits, General" or "Cold-Weather Requirements" Paragraph below. Retain second if cold-weather construction is permitted for repair work.

* + - * 1. Temperature Limits, General: Repair stone units only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.
				2. Cold-Weather Requirements: Comply with the following procedures for stone repair unless otherwise indicated:

When air temperature is below 40 deg F, heat mortar ingredients, repair materials, and existing stone to produce temperatures between 40 and 120 deg F.

When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after repair.

* + - * 1. Hot-Weather Requirements: Protect stone repairs 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 to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.
				2. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.
1. PRODUCTS

See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products.

* + - 1. PERFORMANCE REQUIREMENTS
				1. Source Limitations: Obtain each type of material for repairing stone (stone, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.
				2. Defects: Do not use stone units with chipped arises, cracks, voids, stains, or other defects which will be visible in the finished Work. Do not patch or hide defects. Remove defective stone units from the Site.
			2. STONE MATERIALS

Retain "Stone Matching Existing" Paragraph below. Insert other materials and properties to suit Project.

Retain first option in "Stone Matching Existing" Paragraph below, revising percentage if required, if properties are unknown. Retain second option if required properties are known.

* + - * 1. Stone Matching Existing: Natural building stone of variety, color, texture, grain, veining, finish, size, and shape that match existing stone and with physical properties[ **within 10 percent of those determined from preconstruction testing of selected existing stone.][ as listed below**:]

Retain first subparagraph below if required properties are known. Copy subparagraph and re-edit for different types of stone, if required.

Physical Properties for [**Granite] [Limestone] [Marble] [Sandstone] <Insert stone type**>:

Compressive Strength: <**Insert requirement**> according to ASTM C170.

Modulus of Rupture: <**Insert requirement**> according to ASTM C99.

Absorption: <**Insert requirement**> according to ASTM C97.

Bulk Specific Gravity: <**Insert requirement**> according to ASTM C97.

For existing stone that exhibits a range of colors, texture, grain, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.

Retain "Quarry" Subparagraph below only if a quarry is known to have stone that meets appearance and other requirements. Often, original quarries cannot match original stone due to natural variations in the geologic deposit.

Quarry: Subject to compliance with requirements, provide stone from [**the original quarry] <Insert quarry name, location, and stone designation>**.

Retain "Original Quarry" Subparagraph below only if retaining first option in "Quarry" Subparagraph above.

Original Quarry: <**Insert quarry name, location, and stone designation**>.

Retain "Cutting New Stone" Paragraph below if required.

* + - * 1. Cutting New Stone: Cut each new stone so that, when it is set in final position, the rift or natural bedding planes will match the rift orientation of existing stones.
			1. MORTAR MATERIALS

Retain one or more paragraphs in this article to suit Project. Delete masonry cement and mortar cement if not allowed by "Mortar Mixes" Article. See Evaluations for discussion of masonry cement and mortar cement.

In "Portland Cement" Paragraph below, gray portland cement is sometimes used to help obtain correct mortar color.

* + - * 1. Portland Cement: ASTM C150, Type I or Type II, except Type III may be used for cold-weather construction; white[ **or gray, or both**] where required for color matching of mortar.

Retain subparagraph below if required.

Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

* + - * 1. Hydrated Lime: ASTM C207, Type S.
				2. Masonry Cement: ASTM C91.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Hanson Brick and Tile;Lehigh Hanson.

Holcim US.

QUIKRETE.

Approved equivalent.

* + - * 1. Mortar Cement: ASTM C1329.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Cemex, Inc.

Holcim US.

Approved equivalent.

* + - * 1. Mortar Sand: ASTM C144.

Retain "Exposed Mortar" Subparagraph below if required; revise to suit Project.

Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

Revise "Colored Mortar" Subparagraph below to produce exposed mortar quality and appearance required for Project.

Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

Retain "Mortar Pigments" Paragraph below for pigmented mortar.

* + - * 1. Mortar Pigments: ASTM C979, compounded for use in mortar mixes, and having a record of satisfactory performance in stone mortars.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Davis Colors.

LANXESS Corporation.

Solomon Colors, Inc.

Approved equivalent.

Use formulation that is vapor and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than stone units being repaired, and develops high bond strength to all types of stone.

Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.

Formulate patching compound in colors, textures, and grain to match stone being patched. Provide [**sufficient number of] [no fewer than three**] colors to enable matching of each piece of stone.

* + - * 1. Cementitious Crack Filler: Ultrafine superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all types of stone.
				2. Stone-to-Stone Adhesive: Two-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg F, recommended in writing by adhesive manufacturer for type of stone repair indicated, and matching stone color.
			1. ACCESSORY MATERIALS

Revise "Stone Repair Anchors and Pins" Paragraph below to suit Project.

* + - * 1. Stone Repair Anchors and Pins: Mechanical fasteners and pins of [**Type 304] [Type 316**] stainless steel; designed for stone stabilization and pinning stone pieces; matching shape and size of existing anchors unless otherwise indicated.

Retain "Setting Buttons and Shims" Paragraph below to ensure equal joint spacing.

* + - * 1. Setting Buttons and Shims: Resilient plastic, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units, less the required depth of pointing materials unless removed before pointing.
				2. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

Insert paragraph(s) for other types of masking products, including tapes, sheets, etc., to suit Project.

Retain "Antirust Coating" Paragraph below if retaining requirement in Part 3 for coating existing anchors within wall.

* + - * 1. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

Coordinate surface preparation standard in "Surface Preparation" Subparagraph below with surface preparation standard in "Painting Steel Uncovered during the Work" Article. If known, consider inserting manufacturer's name and product name.

Surface Preparation: Use coating requiring no better than [**SSPC-SP 2, "Hand Tool Cleaning"] [SSPC-SP 3, "Power Tool Cleaning"] [or] [SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning"] <Insert surface preparation standard**> surface preparation according to manufacturer's literature or certified statement.

Limit in "VOC Limit" Subparagraph below is the EPA limit for rust-preventive architectural coatings.

VOC Limit: Use coating with a VOC content of 400 g/L or less.

* + - * 1. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

Previous effectiveness in performing the work involved.

Minimal possibility of damaging exposed surfaces.

Consistency of each application.

Uniformity of the resulting overall appearance.

Do not use products or tools that could leave residue on surfaces.

* + - 1. MORTAR MIXES
				1. Measurement and Mixing: Measure cementitious materials and sand 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.
				2. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Director’s Representative's approval.

Retain "Mortar Pigments" Subparagraph below if using pigments; revise to suit Project.

Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

* + - * 1. Do not use admixtures in mortar unless otherwise indicated.
				2. Mixes: Mix mortar materials in the following proportions:

Retain "Rebuilding (Setting) Mortar by Volume," "Rebuilding (Setting) Mortar by Type," or "Rebuilding (Setting) Mortar by Property" Subparagraph below, or revise to indicate specific requirements for each type of stone indicated. Consider revising portland cement to white portland cement if exposed, light-colored mortar is required.

The volumetric proportion in "Rebuilding (Setting) Mortar by Volume" Subparagraph below is an example only; revise to suit Project.

Rebuilding (Setting) Mortar by Volume: [**1 part portland cement, 1 part lime, and 6 parts sand] <Insert proportions**>.

Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, [**Type N]** unless otherwise indicated, with cementitious material limited to **[portland cement and lime] [masonry cement] [or] [mortar cement**].

Insert additional properties in "Rebuilding (Setting) Mortar by Property" Subparagraph below if required.

Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, [**Type N]** unless otherwise indicated; with cementitious material limited to **[portland cement and lime] [masonry cement] [or] [mortar cement**].

Retain "Pigmented, Colored Mortar" Subparagraph below if adding mortar pigment to setting-mortar mix.

Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

1. EXECUTION
	* + 1. PROTECTION
				1. Prevent mortar from staining face of surrounding stone and other surfaces.

Cover sills, ledges, and other projecting items to protect them from mortar droppings.

Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.

Immediately remove mortar splatters in contact with exposed stone and other surfaces.

Retain paragraph below if applicable; insert other items that may interfere with execution of this work.

* + - * 1. Remove[ **gutters and**] downspouts and associated hardware adjacent to stone and store during stone repair. Reinstall when repairs are complete.

Provide temporary rain drainage during work to direct water away from building.

* + - 1. STONE REPAIR, GENERAL

Retain "Appearance Standard" Paragraph below to control overall appearance from a distance.

* + - * 1. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from [**20 feet] [50 feet**] away by Director’s Representative.
			1. ABANDONED ANCHOR REMOVAL <**Insert drawing designation**>

Copy this article and re-edit for significantly different conditions and anchor types to be removed.

Insert drawing designation. Use these designations on Drawings to identify locations. See "Delineating the Work" Article in the Evaluations for discussion of these designations.

* + - * 1. Remove abandoned anchors, brackets, wood nailers, and other extraneous items [**no longer in use unless indicated to remain] [indicated to be remove**d].

Remove items carefully to avoid spalling or cracking stone.

Notify Director’s Representative before proceeding if an item cannot be removed without damaging surrounding stone. Do the following where directed:

Revise first two subparagraphs below if cutting off an item flush is acceptable. Ferrous items continue to corrode if cut off flush.

Cut or grind off item approximately 3/4 inch beneath surface and core drill a recess of same depth in surrounding stone as close around item as practical.

Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.

[**Patch] [Plug**] hole where each item was removed unless directed to remove and replace stone unit.

* + - 1. STONE REMOVAL AND REPLACEMENT <**Insert drawing designation**>

Copy this article and re-edit for significantly different shapes and sizes of stone to be removed and replaced.

Insert drawing designation. Use these designations on Drawings to identify locations. See "Delineating the Work" Article in the Evaluations for discussion of these designations.

* + - * 1. At locations indicated, remove stone that has deteriorated or is damaged beyond repair[ **or is to be reused**]. Carefully remove entire units from joint to joint, without damaging surrounding stone, in a manner that permits replacement with full-size units.
				2. Support and protect remaining stonework that surrounds removal area.

Retain option in first paragraph below if applicable; revise to suit Project.

* + - * 1. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.[ **Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.**]
				2. Notify Director’s Representative of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.
				3. Remove in an undamaged condition as many whole stone units as possible.

Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.

Remove sealants by cutting close to stone with utility knife and cleaning with solvents.

Store stone for reuse. Store off ground, on skids, and protected from weather.

Deliver cleaned stone not required for reuse to Director’s Representative unless otherwise indicated.

* + - * 1. Clean stone surrounding removal areas by removing mortar, dust, and loose particles in preparation for stone replacement.
				2. Replace removed damaged stone with other removed stone in good condition, where possible, [**or with new stone** ]matching existing stone, including direction of rift or natural bedding planes. Do not use broken units unless they can be cut to usable size.
				3. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.

Maintain joint width for replacement stone to match existing joints.

Retain subparagraph below especially for narrow joints.

Use setting buttons or shims to set stone accurately spaced with uniform joints.

* + - * 1. Set replacement stone with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting, and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors [**of size and type indicated] [matching existing configuration**].

Retain one of first two subparagraphs below. Coordinate with mortar mixes in Part 2. First subparagraph assumes that laying, setting, and repointing are done at same time; second assumes that joints are repointed separately.

Tool exposed mortar joints in repaired areas to match joints of surrounding existing stonework.

Rake out mortar used for laying stone before mortar sets according to Section 040140.62 "Stone Repointing." Point at same time as repointing of surrounding area.

When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

* + - * 1. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

Revise subparagraph below to suit Project.

Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

* + - 1. PAINTING STEEL UNCOVERED DURING THE WORK <**Insert drawing designation**>

Retain this article if steel may be uncovered during the Work. Revise to accommodate another method or methods if required.

Insert drawing designation. Use these designations on Drawings to identify locations. See "Delineating the Work" Article in the Evaluations for discussion of these designations.

* + - * 1. Notify Director’s Representative if steel is exposed during stone removal. Where Director’s Representative determines that steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:

Coordinate "Surface Preparation" Subparagraph below with surface preparation standard for antirust coating in "Accessory Materials" Article.

Surface Preparation: Remove paint, rust, and other contaminants according to [**SSPC-SP 2, "Hand Tool Cleaning"] [SSPC-SP 3, "Power Tool Cleaning"] [or] [SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning**"] <Insert surface preparation standard>, as applicable to comply with paint manufacturer's recommended preparation.

Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).

Consult Project structural Director’s Representative about option in paragraph below; revise to suit Project.

* + - * 1. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch, notify Director’s Representative before proceeding.
			1. PARTIAL STONE REPLACEMENT <**Insert drawing designation**>

Copy this article and re-edit for significantly different shapes and sizes of partial stone replacement (dutchman repair).

Insert drawing designation. Use these designations on Drawings to identify locations. See "Delineating the Work" Article in the Evaluations for discussion of these designations.

If Project involves thin stone cladding, revise first paragraph below to require full-depth removal, and revise remaining paragraphs as necessary.

* + - * 1. Remove defective portion of existing stone unit (backing stone). Carefully remove defective portion of stone by making vertical and horizontal saw cuts at face of backing stone and removing defective material to depth required for fitting partial replacement (dutchman).

Make edges of backing stone at cuts smooth and square to each other and to finished surface; essentially rectangular. Make back of removal area flat and parallel to stone face.

Do not overcut at corners and intersections. Hand trim to produce clean sharp corners with no rounding and no damage to existing work to remain.

If backing stone becomes further damaged, remove damaged area and enlarge partial replacement as required.

* + - * 1. Remove mortar from joints that abut area of stone removal to same depth as stone was removed. Remove loose mortar particles and other debris from surfaces to be bonded and surfaces of adjacent stone units that will receive mortar by cleaning with stiff-fiber brush.

Retain last option in first paragraph below for stone having bedding planes, usually sedimentary stone such as limestone and sandstone, unless this degree of control is considered unnecessary for dutchmen.

* + - * 1. Cut and trim partial replacement to accurately fit area where material was removed from backing stone. Fabricate to size required to produce joints between partial replacement and backing stone of no more than 1/16 inch in width, and to produce joints between partial replacement and other stones that match existing joints between stones.[ **Cut partial replacement so that, when it is set in final position, natural bedding planes will match the orientation of bedding planes of the backing stone unless otherwise indicated.]**

Retain "Exposed Pinning" or "Concealed Pinning" Paragraph below if large partial replacements that can accommodate pinning are required. Method in second paragraph might be required for noticeably patterned stones close to view, but it is more difficult. Revise pin diameter, length, or spacing if required. Consider deleting third option in either paragraph and detailing pin layout on Drawings. If retaining either paragraph, verify that method is appropriate to type of stone.

* + - * 1. Exposed Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- diameter, [**plain] [threaded**] stainless-steel pins set into 1/4-inch- diameter holes drilled at a 45-degree downward angle through face of partial replacement and into backing stone.[ **Center and space pins 3 to 5 inches apart and at least 2 inches from any edge. Insert pins at least 2 inches into backing stone and 2 inches into partial replacement with end countersunk at least 3/4 inch from exposed face of partial replacement**.]
				2. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- diameter, [**plain] [threaded**] stainless-steel pins set into 1/4-inch- diameter holes drilled into backing stone and into, but not through, the partial replacement.[ **Center and space pins 3 to 5 inches apart and at least 2 inches from any edge. Insert pins at least 2 inches into backing stone and 2 inches into partial replacement, but no closer than 3/4 inch from exposed face of partial replacement.]**
				3. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of backing stone and partial replacement, completely filling all crevices and voids.
				4. Apply partial replacement while adhesive is still tacky and hold securely in place until adhesive has cured. Use temporary shims, clamps, wedges, or other devices as necessary to align face of partial replacement with face of backing stone.

Retain option in paragraph below if retaining "Exposed Pinning" Paragraph.

* + - * 1. Clean adhesive residue from exposed surfaces and patch chipped areas[ **and exposed drill holes**] as specified in "Stone Patching" Article.
			1. STONE PLUG REPAIR <**Insert drawing designation**>

Insert drawing designation. Use these designations on Drawings to identify locations. See "Delineating the Work" Article in the Evaluations for discussion of these designations.

Method in this article is particularly suitable for polished stone, where patching would be unacceptable.

* + - * 1. Remove cylindrical piece of damaged stone by core-drilling perpendicular to stone surface.

Retain option in first paragraph below for stone having bedding planes, usually sedimentary stone such as limestone and sandstone, unless this degree of control is considered unnecessary for plugs.

* + - * 1. Prepare a replacement plug by core-drilling replacement stone. Use a drill sized to produce a core that will fit into hole drilled in damaged stone with only minimum gap necessary for adhesive.[ **Cut and install plug so that, when it is set in final position, natural bedding planes will match the orientation of bedding planes of the backing stone unless otherwise indicated**.]
				2. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of existing stone and plug, completely filling all crevices and voids.
				3. Apply plug while adhesive is still tacky and hold securely in place until adhesive has cured.
				4. Clean adhesive residue from exposed surfaces.
			1. STONE-FRAGMENT REPAIR <**Insert drawing designation**>

Insert drawing designation. Use these designations on Drawings to identify locations. See "Delineating the Work" Article in the Evaluations for discussion of these designations.

Method in this article is particularly suitable where a unique, ornamental piece of stone merely needs reattachment and where patching would be costly or unacceptable. Revise method to suit Project.

* + - * 1. Carefully remove cracked or fallen stone fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.
				2. Remove soil, loose particles, mortar, and other debris or foreign material from fragment surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.

Retain "Pinning" or "Concealed Pinning" Paragraph below if fragment is large and can accommodate pinning. Method in second paragraph might be required for noticeably patterned stones close to view, but it is more difficult. Revise pin diameter, length, or spacing if required. Consider deleting third option in either paragraph and detailing pin layout on Drawings. If retaining either paragraph, verify that method is appropriate for type of stone.

* + - * 1. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- diameter, [**plain] [threaded**] stainless-steel pins set into 1/4-inch- diameter holes drilled at a 45-degree downward angle through face of fragment and into parent stone.[ **Center and space pins between 3 and 5 inches apart and at least 2 inches from any edge. Insert pins** **at least 2 inches into parent stone and 2 inches into fragment with end countersunk at least 3/4 inch from exposed face of fragment**.]
				2. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- diameter, [**plain] [threaded**] stainless-steel pins set into 1/4-inch- diameter holes drilled into parent stone and into, but not through, the fragment.[ **Center and space pins between 3 and 5 inches apart and at least 2 inches from any edge. Insert pins at least 2 inches into parent stone and 2 inches into fragment, but no closer than 3/4 inch from exposed face of fragment**.]
				3. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.
				4. Fit stone fragment onto parent stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.

Retain option in paragraph below if retaining "Pinning" Paragraph.

* + - * 1. Clean adhesive residue from exposed surfaces and patch chipped areas[ **and exposed drill holes**] as specified in "Stone Patching" Article.
			1. CRACK INJECTION <**Insert drawing designation**>

Insert drawing designation. Use these designations on Drawings to identify locations. See "Delineating the Work" Article in the Evaluations for discussion of these designations.

* + - * 1. General: Comply with cementitious crack-filler manufacturer's written instructions.
				2. Drill 1/4-inch- diameter injection holes as follows:

Transverse Cracks Less Than 3/8 inch Wide: Drill holes through center of crack at 12 to 18 inches o.c.

Transverse Cracks More Than 3/8 inch Wide: Drill holes through center of crack at 18 to 36 inches o.c.

Delaminations: Drill holes at approximately 18 inches o.c. both vertically and horizontally.

Drill holes 2 inches deep.

* + - * 1. Clean out drill holes and cracks with compressed air and water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.
				2. Place plastic injection ports in drilled holes and seal face of cracks between injection ports with clay or other nonstaining, removable plugging material. Leave openings at upper ends of cracks for air release.
				3. Inject cementitious crack filler through ports sequentially, beginning at one end of area and working to opposite end; where possible, begin at lower end of injection area and work upward. Inject filler until it extrudes from adjacent ports. After port has been injected, plug with clay or other suitable material and begin injecting filler at adjacent port, repeating process until all ports have been injected.
				4. Clean cementitious crack filler from face of stone before it sets by scrubbing with water.
				5. After cementitious crack filler has set, remove injection ports, plugging material, and excess filler. Patch injection holes and surface of cracks as specified in "Stone Patching" Article.
			1. STONE PATCHING <**Insert drawing designation**>

Copy this article and re-edit for significantly different types and sizes of stone patching.

Insert drawing designation. Use these designations on Drawings to identify locations. See "Delineating the Work" Article in the Evaluations for discussion of these designations.

Patching slightly to moderately damaged stone units is usually much less expensive than replacing them.

* + - * 1. Patch the following stone units unless another type of repair or replacement is indicated:

Usually retain first subparagraph below and indicate units that require patching on Drawings.

Units indicated to be patched.

Retain three subparagraphs below, with or without subparagraph above; revise to suit Project.

Units with holes.

Consider retaining option in one or both subparagraphs below to define an acceptable defect size; revise to suit Project.

Units with chipped edges or corners.[ **Patch chipped edges or corners measuring more than 3/4 inch in least dimension**.]

Units with small areas of deep deterioration.[ **Patch deep deteriorations measuring more than 3/4 inch in least dimension and more than 1/4 inch deep**.]

Retain first paragraph below if there are existing patches in unsatisfactory condition. Retain one of two options; retain first if not all existing patches require replacement and their locations are indicated on Drawings; revise to suit Project.

* + - * 1. Remove and replace existing patches [**where indicated] [unless otherwise indicated or approved by Director’s Representative**].
				2. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch thick, but not less than recommended in writing by patching compound manufacturer.
				3. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of stone unit.

Retain first paragraph below for stone that exhibits a color variation.

* + - * 1. Mix patching compound in individual batches to match each stone unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
				2. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer's written instructions.
				3. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.

Retain "Simple Details" Subparagraph below if stone has an essentially smooth surface.

Simple Details: Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, as determined by testing, to best match existing stone.

Retain "Carved Details" Subparagraph below if carving is required.

Carved Details: Build patch up 1/4 inch above surrounding stone, and carve surface to match adjoining stone after patching compound has hardened.

* + - * 1. Keep each layer damp for 72 hours or until patching compound has set.
				2. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.
			1. FINAL CLEANING

Retain this article only if overall cleaning of existing stonework occurs before repair work is completed.

Revise first paragraph below if chemical cleaning of repaired stonework is required; delete if overall cleaning of repaired stonework is included in another Section.

* + - * 1. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

Do not use metal scrapers or brushes.

Do not use acidic or alkaline cleaners.

Paragraphs below are examples only; revise to suit Project.

* + - * 1. Clean adjacent nonstone surfaces. Use detergent and soft brushes or cloths.
				2. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
				3. Remove masking materials, leaving no residues that could trap dirt.
			1. FIELD QUALITY CONTROL
				1. Testing Agency: Director’s Representative will engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.
				2. Notify [**inspectors] [and] [**Director’s Representative] in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until [**inspectors] [and**] [Director’s Representative] have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.
			2. STONE WASTE DISPOSAL
				1. Salvageable Materials: Unless otherwise indicated, excess stone materials are Contractor's property.
				2. Stone Waste: Remove stone waste and legally dispose of off State property.

END OF SECTION 040140.61