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SECTION 321440

STONE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Exterior paving.
 - 2. Exterior stone stairs.
 - 3. Stone curbs.
- B. Related Sections:

1. Division 04 Section "Exterior Granite Cladding" for stone cladding.
2. Division 07 Section "Joint Sealants" for sealing joints in stone.

1.2 REFERENCES

- A. ASTM A 123-02: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM C 97-02: Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
- C. ASTM C 119-04: Terminology Relating to Dimension Stone
- D. ASTM C 170-90 (1999): Test Method for Compressive Strength of Dimension Stone
- E. ASTM C 270-03: Specification for Mortar for Unit Masonry
- F. ASTM C 568-03: Specification for Limestone Dimension Stone
- G. ASTM C 615-03: Specification for Granite Dimension Stone
- H. ASTM C 880-98: Test Method for Flexural Strength of Dimensional Stone

1.3 DEFINITIONS

- A. Definitions contained in ASTM C 119 apply to this Section.
- B. Metric Conversions: The following metric conversions shall apply where English measurements are indicated in the text:
 1. 1/16 inch (1.5 mm)
 2. 1/8 inch (3 mm)
 3. 3/16 inch (5 mm)
 4. 1/4 inch (6 mm)
 5. 5/16 inch (8 mm)
 6. 3/8 inch (10 mm)
 7. 1/2 inch (12 mm)
 8. 5/8 inch (15 mm)
 9. 13/16 inch (20 mm)
 10. 1 inch (25 mm)
 11. 1-3/16 inches (30 mm)
 12. 1-1/4 inches (32 mm)
 13. 1-1/2 inches (40 mm)
 14. 1-5/8 inches (41 mm)
 15. 2 inches (51 mm)
 16. 3 inches (75 mm)
 17. 4 inches (100 mm)
 18. 6 inches (150 mm)
 19. 8 inches (200 mm)
 20. 12 inches (300 mm)

1.4 SUBMITTALS

- A. Product Data: For each stone type and each manufactured product shown on Drawings or specified.
 - 1. For each stone variety used on Project, include physical property data.
- B. Shop Drawings: Show fabrication and installation details for stone:
 - 1. Include dimensions and profiles of stone units.
- C. Samples: Submit samples for each stone type required, exhibiting the full range of color characteristics expected.
 - 1. Submit a minimum of 2 each, 12 inches x 12 inches in size, in each color and finish specified.
 - 2. Submit a minimum of 2 each, 12 inches x 12 inches in size, in each color and finish specified.
 - 3. In the case of more variegated stones, color photos shall be submitted in addition to the number of samples to show the full range of color and markings to be expected.

[[**Mortar Samples**]: Full range of exposed color and texture.

- 5. [**Sealant Samples**]: For each type and color of joint sealant required.
- D. Preliminary Test Reports: Submit test reports for proposed stones prior to final stone selection. Preliminary test reports shall be indicative of the stone to be proposed for the project.
 - 1. Testing of production stone is required in addition to preliminary test reports.
- E. Certification: Submit a letter of certification from the stone fabricator, stating the material being furnished is the specified material and there are sufficient reserves available to supply the project and furnish replacements if needed.
- F. Material Test Reports: From a qualified independent testing agency, as follows:
 - 1. Provide reports for each stone type.
 - 2. For metal components.
- G. Qualification Data: Submit qualification data as specified under Article, "Quality Assurance" for the following:
 - 1. [Installer]
 - 2. [Fabricator]
- H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Stone: Obtain each stone variety from a single quarry.
 - 1. Make quarried blocks available for examination by Architect.
- B. Qualifications:
 - 1. Installer Qualifications: Engage experienced installer that has completed stone installation similar in material, design, and extent to that indicated for the project.

2. Fabricator Qualifications: Engage experienced fabricator that has completed stone fabrication similar in material, design, and extent to that indicated for the project.
- C. Preconstruction Stone Testing: Engage an independent testing agency to perform the following testing for each stone variety:
1. Furnish test specimens that are representative of materials.
 2. Physical Property Tests: ASTM standards specified for stone type.
 3. Flexural Strength Tests: ASTM C 880
- D. Mockups: Build mockup of typical areas as shown on Drawings.
1. Size:
 - a. [48 inches x 48 inches]
 - b. [96 inches x 96 inches]
 - c. [10 feet x 10 feet]
 2. Color consistency: demonstrate color consistency with mockup; color range shall not exceed range of color established by samples.
 3. Include sealant joints installed as required by Division 07 Section "Joint Sealants."
 4. Mockups may become part of the completed Work if approved at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle materials to prevent deterioration or damage.
1. Stone shall be carefully packed and loaded for shipment using reasonable care and customary precautions against damage in transit. Material, which may cause staining or discoloration shall not be used for blocking or packing.
 2. The stone shall be stacked on timber or platforms at least 4 inches above the ground. Care shall be taken to prevent staining or discoloration during storage.
 3. If storage is to be for a prolonged period, polyethylene or other suitable plastic film shall be placed between wood and finished surfaces of completely dry stone.
- B. Properly store cementitious materials. Do not use damp cementitious materials.
- C. PROJECT CONDITIONS
- D. Cold-Weather Requirements for Exterior Stone Paving: ACI 530.1/ASCE 6/TMS 602.
- E. Hot-Weather Requirements for Exterior Stone Paving: ACI 530.1/ASCE 6/TMS 602:

PART 2 - PRODUCTS

2.1 STONE SOURCE

- A. Varieties and Source: Subject to compliance with requirements, provide stone of the following variety and from the following source:
1. Granite Source: Coldspring
 2. Dolomitic Limestone: Kasota Valley Limestone by Coldspring.

2.2 GRANITE MATERIAL

- A. Granite: ASTM C 615.
- B. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- C. Granite Type [**insert Drawing Designation type**]:
 - 1. Stone Variety: [**Insert stone variety**] by Coldspring.
 - 2. Location:
 - a. [Exterior Paving].
 - b. [Exterior Stairs].
 - 3. Finish:
 - a. [Polished]
 - b. [Velvet]
 - c. [Diamond 8]
 - d. [Rub & Sand]
 - e. [Textured]
 - f. [Thermal]
 - g. [Diamond 10]
 - h. [Bush-Hammer]
 - i. [Bush-Hammer & Jet].
 - 4. Nominal Thickness: Not less than the following nominal thickness:
 - a. [13/16 inch (+1/8" -1/16")] [20 mm]
 - b. [1-3/16 inches (+1/8 -1/16")] [30 mm]
 - c. [1-5/8 inches (+1/8" -1/16")] [41 mm]
 - d. [2 inches (+1/8" -1/16")] [51 mm]
 - e. [3-1/8 inches (+1/8" -1/16")] [79 mm]
 - f. [3-7/8 inches (+1/8" -1/16")] [98 mm]

2.3 LIMESTONE MATERIAL

- A. Dolomitic Limestone: ASTM C 568, classification as follows:
 - 1. Medium Density Limestone: ASTM C 568 Class II.
 - a. Density: [**135 - 160 lb/cu. ft.**] [**2160 - 2560 kg/cu. m**]
 - b. Absorption by weight: 5 percent maximum
 - c. Modulus of rupture: **800 psi (5.5 MPa)** minimum
 - 2. High Density Limestone: ASTM C 568 Class III.
 - a. Density: [**Greater than 160 lb/cu. ft.**] [**Greater than 2400 kg/cu. m**]
 - b. Absorption by weight: 5 percent maximum
 - c. Modulus of rupture: **800 psi (5.5 MPa)** minimum
- B. Dolomitic Limestone Type [**insert type designation**]:
 - 1. Location:
 - a. [Exterior Paving].
 - b. [Exterior Stairs].

2. Finish:
 - a. [Honed]
 - b. [Polished]
 - c. [Tapestry]
 - d. [Diamond]
 - e. [Textured]
 - f. [Rock Face]
 - g. [Split Face].
3. Color: Cream.
4. Surface: Unfilled.
5. Paver Thickness: Not less than the following:
 - a. [2 inches (+1/8" -1/16")] [51 mm]
 - b. [3-1/8 inches (+1/8" -1/16")] [79 mm]
 - c. [3-7/8 inches (+1/8" -1/16")] [98 mm]

2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction.
- B. Hydrated Lime: ASTM C 207.
- C. Portland Cement-Lime Mix: ASTM C 150, Type I or Type III, and ASTM C 207.
- D. Colored Portland Cement-Lime Mix: ASTM C 150, Type I or Type III; ASTM C 207; and mortar pigments.
- E. Aggregate: ASTM C 144.
- F. Mortar Pigments: Natural and synthetic iron oxides. Use only pigments with a record of satisfactory performance in mortar and containing no carbon black.
- G. Latex Additive: Acrylic-resin water emulsion recommended by additive manufacturer for use with field-mixed portland cement mortar bed.
- H. Thin-Set Mortar: Latex-Portland Cement Mortar: ANSI A118.4. Provide products by one of the following:
- I. Water: Potable.

2.5 GROUT

- A. Grout Colors:
 1. [Match stone].
 2. [As indicated by manufacturer's designations].
 3. [Match Architect's samples].
 4. [As selected by Architect from manufacturer's full range].
- B. Polymer Modified Cement Grout: ANSI A118.7.

1. Polymer Type: Acrylic resin in liquid-latex form for addition to prepackaged dry-grout mix.

2.6 ACCESSORIES

- A. Cleavage Membrane:
 1. [Polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick].
 2. [Unperforated asphalt felt, ASTM D 226, Type I (No. 15)].
- B. Reinforcing Wire: ASTM A 185 and ASTM A 82 except for minimum wire size.
- C. Cork Joint Filler: Preformed strips, ASTM D 1752, Type II.
- D. Cleaner: As recommended by stone producer.

2.7 STONE FABRICATION

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
- B. Fabricate stone to comply with requirements indicated and with the following references:
 1. Granite: NSI – Dimensional Stone Design Manual
 2. Dolomitic Limestone: MIA's "Dimension Stone - Design Manual."
- C. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and Shop Drawings.
 1. Pattern: **[As indicated on Drawings]**.
 2. Joint Width: **[Insert dimension]**.
- D. Fabricate stone stair treads in sizes and profiles indicated.
- E. Carefully inspect finished stone units at fabrication plant for compliance with requirements. Replace defective units. Clean backs of stones to remove rust stains and iron particles.

2.8 MORTAR AND GROUT MIXES

- A. Mortar: Comply with referenced standards and with manufacturers' written instructions.
 1. Do not use admixtures. Do not use calcium chloride.
 2. Combine mortar materials and mix thoroughly. Discard mortar when it has reached initial set.
- B. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with manufacturer's written instructions.
- C. Mortar-Bed Bond Coat: Mix neat cement and latex additive to a creamy consistency.
- D. Latex-Modified Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and latex additive to comply with manufacturer's written instructions.

- E. Cement-Paste Bond Coat: Mix either neat cement or cement and sand with water to a consistency similar to that of thick cream.
- F. Joint Grout: Comply with mixing requirements in referenced ANSI standards and with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.
- B. Remove substances from concrete substrates that could impair mortar bond.
- C. Clean dirty or stained stone surfaces before setting.
 - 1. Scrub with fiber brushes; drench with clear water.
 - 2. Use mild cleaning compounds.

3.3 INSTALLATION

- A. Do necessary field cutting as stone is set. Cut lines straight and true and finish field-cut edges to match shop-cut edges.
 - 1. Use power saws with diamond blades to cut stone.
- B. Set stone to comply with Drawings and Shop Drawings.
- C. Scribe and field-cut stone as necessary to fit at obstructions. Produce neat joints of size specified or indicated.
- D. Expansion- and Control-Joint Installation: Locate and install according to Drawings and Shop Drawings.

3.4 INSTALLATION TOLERANCES

- A. Variation in Line: Do not exceed **1/8 inch in 96 inches (3 mm in 2400 mm)**, **1/4 inch in 20 feet (6 mm in 6 m)**, or **3/8 inch (10 mm)** maximum.
- B. Variation in Joint Width: Do not vary joint thickness more than **1/16 inch (1.5 mm)** or 1/4 of nominal joint width, whichever is less.
- C. Variation in Surface Plane: Do not exceed **1/8 inch in 10 feet (3 mm in 3 m)**, **1/4 inch in 20 feet (6 mm in 6 m)**, or **3/8 inch (10 mm)** maximum from level or slope indicated.
- D. Variation in Plane between Adjacent Units (Lipping): Do not exceed **1/32-inch (0.8-mm)** difference between planes of adjacent units.

3.5 INSTALLATION OF STONE DIRECTLY OVER CONCRETE

- A. Saturate concrete with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat to damp concrete and broom to provide an even coating that completely covers the concrete. Do not exceed **1/16-inch (1.5-mm)** thickness. Limit area of mortar-bed bond coat to avoid its drying out before placing setting bed.
 1. Place reinforcing wire mesh over concrete, lapped at joints by at least one full mesh and supported so mesh becomes embedded in middle of setting bed. Hold edges back from vertical surfaces about **1/2 inch (13 mm)**.
- C. Apply mortar bed to finished elevations indicated immediately after applying mortar-bed bond coat.
- D. Mix and place only that amount of mortar bed that can be covered with stone before initial set. Cut back, bevel edge, and discard material that has reached initial set before stone can be placed.
- E. Place stone before initial set of mortar occurs. Immediately before placing stone on setting bed, apply uniform **1/16-inch- (1.5-mm-)** thick bond coat to bed or to back of each stone unit.
- F. Tamp and beat stone with a wooden block or rubber mallet.
 1. Set each unit in a single operation before initial set of mortar; do not return to areas already set.
- G. Rake out joints to depth required to receive grout or pointing mortar as units are set.
- H. Point joints after setting.

3.6 INSTALLATION OF STONE OVER MEMBRANE

- A. Place cleavage membrane over substrates, lapped at least **4 inches (100 mm)** at joints.
- B. See Division 7 waterproofing Section for installation of waterproofing.
 1. Carefully place stone and setting materials over waterproofing. Replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with stone.
 2. Provide cork joint filler, where indicated.
- C. Place reinforcing wire fabric over membrane protection board, lapped at least one full mesh at joints and supported so mesh becomes embedded in middle of setting bed. Hold edges back from vertical surfaces about **1/2 inch (13 mm)**.
- D. Place mortar bed over membrane protection board to uniform thickness at elevations required with reinforcing wire fabric fully embedded in middle of mortar bed.
- E. Mix and place only that amount of mortar bed that can be covered with stone before initial set.

- F. Apply uniform **1/16-inch- (1.5-mm-)** thick bond coat to bed or to back of each stone unit then place stone before initial set of mortar occurs.
- G. Tamp and beat stone with a wooden block or rubber mallet. Set each unit in a single operation before initial set of mortar.
- H. Rake out joints to depth required to receive grout as units are set.
- I. Point joints after setting.

3.7 STONE STAIR INSTALLATION

- A. Stone Stair Treads and Risers: "Installation of Stone Directly over Concrete".
- B. Thin-Set, Latex-Portland Cement Mortar: ANSI A108.5.

3.8 GROUTING

- A. Polymer-Modified Cement Grout for Stone Joints: ANSI A108.10 and manufacturer's written instructions.
 - 1. Do not use sanded grout for polished stone.
 - 2. Grout joints as soon as possible after initial set of setting bed. Finish joints by tooling to produce a slightly concave polished joint, free of drying cracks.
 - 3. Maintain grout in damp condition for seven days.

3.9 ADJUSTING

- A. Remove and replace stone not matching final samples and mockups.
- B. Remove and replace stone not complying with requirements.
- C. Replace non-complying stone to match final samples and mockups, comply with specified requirements. Replacement stone shall show no evidence of replacement.
- D. Patching: Minor patching in small areas may be acceptable if the repair does not distract from the overall appearance of the finished project.

3.10 PROTECTION

- A. Prohibit traffic from installed stone for a minimum of 72 hours.
- B. Protect during construction with nonstaining kraft paper, and cover with a layer of untreated plywood where adjoining areas require construction work access.

3.11 CLEANING

- A. Clean stone as work progresses. Remove mortar, sealant, and stains before tooling joints.
- B. Final Cleaning: Clean stone as recommended by fabricator or stone producer.

1. Clean all finished stonework with a mild detergent using a fiber brush.
 2. After cleaning, rinse with clean water.
 3. Do not use acid or other caustic materials.
- C. When cleaning is completed, remove temporary protection.

END OF SECTION