(Specifier Notes:
The purpose of this guide specification is to assist the specifier in correctly specifying limestone paving and its installation. The specifier needs to edit this guide specification to fit the needs of each specific project.
Throughout the guide specification, there are Specifier Notes to assist in the editing of this guide specification. Brackets [ ] have been used to indicate when a selection or a decision is required. References have been made to MasterFormat Division numbers and titles and should be coordinated with other Sections.)

SECTION 32 14 40

LIMESTONE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

(Specifier Note: RETAIN one of bracketed options in paragraph below.)

A. Limestone paving [over compacted subgrade with sand filled joints.][over concrete subbase set in mortar setting beds with grouted joints.]

1.2 SUBMITTALS

A. Product Data: Manufacturer's technical literature for each product indicated, specified, or required.

B. Sieve Analyses: For aggregate setting-bed materials according to ASTM C 136.

C. Samples for Initial Selection: Mortar samples showing full range of colors expected; make samples using same materials to be used on Project; label samples to indicate type and amount of colorant used.

D. Samples for Verification:

1. Limestone: Full-size units of each different limestone unit for each color, finish, and pattern specified, showing full range to be expected.
2. Edge Restraints: 12 inch long with stakes.

1.3 QUALITY ASSURANCE

A. Mockups: Before beginning work of this Section, build as many mockups as required to verify selections made under submittals and to demonstrate aesthetic effects and for work execution. Use materials and installation methods specified.

1. Build 48 inch square for each type of paving.
2. Locate at locations indicated or, if not indicated, as directed by Architect; facing south.
3. Clean exposed faces.
4. Notify Architect 7 days in advance of dates and times when mockup will be constructed.
5. Protect approved mockups from elements with weather-resistant covering.
6. Maintain during construction in an undisturbed condition as a standard for judging completed work.
7. Approval is for following qualities; approval does not constitute approval of deviations from Contract Documents, unless specifically approved by Architect in writing:

a. Color, texture, and blending of limestone units.
b. Other aesthetic qualities as determined by Architect.

8. When directed, demolish and remove mockups from site, including foundations.

1.4 DELIVERY, STORAGE, AND HANDLING

(Specifier Note: RETAIN paragraph below for mortar setting bed applications.)

A. Cementitious Materials: Store on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

(Specifier Note: RETAIN paragraph below for aggregate setting bed applications.)

B. Aggregates: Store where grading and other required characteristics can be maintained and contamination avoided.

C. Limestone and Accessories: Store and handle according to following:

1. To prevent deterioration or damage due to contaminants, breaking, chipping, or other causes.
2. ILI's The Contractors Handbook on Indiana Limestone.

1.5 FIELD CONDITIONS

(Specifier Note: RETAIN this article for mortar setting bed applications.)

A. Cold Weather Requirements:

1. Do no cementitious work when ambient temperature is less than 32 degrees F or when 40 degrees F or less and falling.
2. Provide heat and protection to protect work from freezing for not less than 48 hours after installation.
3. Distribute heat uniformly to prevent concentration of heat near sources; provide deflection or protective screens.

B. Warm Weather Requirements:

1. Protect work against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial.
2. Apply and cure work as required by climatic and job conditions to prevent dryout during cure period.
3. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind from work during cure period.

PART 2 - PRODUCTS

2.1 LIMESTONE

A. Material Quality Standard: ASTM C 568, Classification II or III.

2.2 LIMESTONE PANELS

A. Basis of Design: Contract Documents are based on limestone panels fabricated by Earthworks, Inc. to establish a standard of quality.

(Specifier Note: RETAIN one of bracketed options in subparagraph below.)

1. Selection: [Aux Vases Buff][Aux Vases Blue][EW Gold][Pewter Mist][Chocolate Marble].

(Specifier Note: Typical thicknesses are 1-1/2 and 2-1/4 inches; other thicknesses are available.)

2. Dimensions: [- insert for width, length, height, and depth as required -].

(Specifier Note: RETAIN one of bracketed options in subparagraph below.)

3. Finish: [Smooth][Sandblasted].

2.3 AGGREGATE SETTING BED MATERIALS

(Specifier Note: RETAIN this article for aggregate setting bed applications.)

(Specifier Note: RETAIN one of bracketed options in subparagraph below; if retaining third option, specify as recommended by geotechnical engineer.)

A. Aggregate for Subbase: Sound, crushed stone or gravel complying with [ASTM D 448 for Size No. 57.] [As specified in Division 31 Earthwork Section.] [- insert information - .]

(Specifier Note: RETAIN one of bracketed options in subparagraph below; if retaining third option, specify as recommended by geotechnical engineer.)

B. Aggregate for Base: Sound, crushed stone or gravel complying with [ASTM D 448 for Size No. 8.] [As specified in Division 31 Earthwork Section.] [- insert information - .]

C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

D. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

2.4 MORTAR MATERIALS

(Specifier Note: RETAIN this article for mortar setting bed applications.)

A. Setting Beds:

1. Portland Cement: ASTM C 150, Type I or II.
2. Hydrated Lime: ASTM C 207, Type S.
3. Sand: ASTM C 144.

B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement, unfading mineral pigments and white or colored sand as required to produce required color.

C. Latex Additive: Manufacturer's standard-water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

D. Water: Potable.

2.5 ACCESSORIES

A. Separation Geotextile: AASHTO M 288, woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent.

1. Survivability: Class 2 according to AASHTO M 288.
2. Apparent Opening Size: No. 60 sieve, maximum according to ASTM D 4751.
3. Permittivity: 0.02 per second, minimum according to ASTM D 4491.

4. UV Stability: 50 percent after 500 hours' exposure according to ASTM D 4355.

B. Plastic Edge Restraints: Triangular PVC extrusions 1-3/4 inches high by 3-1/2 inches wide designed to serve as edge restraints for unit pavers; rigid type for straight edges and flexible type for curved edges, with pipe connectors and 3/8 inch diameter by 12 inch long steel spikes.

C. Steel Edge Restraints: Painted steel edging 3/16 inch thick by 4 inches high with loops pressed from or welded to face to receive stakes at 36 inches o.c., and steel stakes 15 inches long for each loop.

D. Herbicide: Commercial chemical for weed control, registered with the EPA, in granular, liquid, or wettable powder form.

2.6 MORTAR MIXES

(Specifier Note: RETAIN this article for mortar setting bed applications.)

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement or cement and sand with latex additive to a creamy consistency.

C. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

D. Latex-Modified, Portland Cement Slurry Bond Coat: Proportion and mix portland cement, sand, and latex additive for slurry bond coat to comply with written instructions of latex-additive manufacturer.

E. Job-Mixed, Polymer-Modified Portland Cement Grout: Add liquid-latex additive to portland cement and sand in proportion and concentration recommended by liquid-latex manufacturer. Proportion cement and sand to comply with written instructions of latex-additive manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions:

1. Examine substrates for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of segmental retaining walls.
2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards specified elsewhere, perform work according to following, unless otherwise specified:

1. ILI's Indiana Limestone Handbook.
2. Respective manufacturer's written instructions.
3. Approved submittals.

B. General Requirements:

1. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
2. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
3. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.

C. Edge Restraints:

1. Install edge restraints before placing unit pavers.
2. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
3. For metal edge restraints with top edge exposed, drive stakes at least 1 inch below top edge.

D. Steps: Install paver steps before installing adjacent pavers.

(Specifier Note: RETAIN one of the following paragraphs; first is for smooth pavers where slopes to drains are critical; second is when nominal control of paving surface is acceptable.)

E. Tolerances: Do not exceed 1/32 inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.

F. Tolerances: Do not exceed 1/16 inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

3.3 AGGREGATE SETTING BED APPLICATIONS

A. Soil Subgrade Preparation:

(Specifier Note: RETAIN one of bracketed options in subparagraph below; if retaining third option, specify as recommended by geotechnical engineer.)

1. [Compact uniformly to at least 95 percent of ASTM D 1557 laboratory density.][As specified in Division 31 Earthwork Section.][- insert information - .]
2. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, and replace with compacted backfill or fill as directed.

B. Separation Geotextile: Place over prepared subgrade, overlapping ends and edges at least 12 inches.

C. Base: Place aggregate base, compact by tamping with plate vibrator to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.

D. Drainage Geotextile: Place over compacted base course, overlapping ends and edges at least 12 inches.

E. Leveling Course: Place and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.

F. Herbicide: Treat leveling course to inhibit growth of grass and weeds.

G. Setting Pavers:

1. Set with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base.
2. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.
3. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500 to 5000 lbf compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under following conditions:

    a. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
    b. Before ending each day's work, fully compact installed concrete pavers to within 36 inches of the laying face.
    c. Cover pavers that have not been compacted, and leveling course on which pavers have not been placed, with non-staining plastic sheets to protect from rain.

H. Filling Joints:

1. Spread dry sand and fill joints immediately after vibrating pavers into leveling course.
2. Vibrate pavers and add sand until joints are completely filled, then remove excess sand.
3. Leave a slight surplus of sand on the surface for joint filling.
4. Do not allow traffic on installed pavers until sand has been vibrated into joints.
5. Repeat joint filling process 30 days later.

3.4 MORTAR SETTING BED APPLICATIONS

A. Subbase Preparation: Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Placing Mortar Setting Bed:

1. Apply mortar bed bond coat over surface of concrete subbase about 15 minutes before placing setting bed.
2. Limit area of bond coat to avoid its drying out before placing setting bed.
3. Do not exceed 1/16 inch thickness for bond coat.
4. Apply mortar bed over bond coat immediately after applying bond coat.
5. Spread and screed setting bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
6. Place mortar bed with reinforcing wire fully embedded in middle of setting bed.
7. Spread and screed setting bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
8. Mix and place only that amount of mortar bed that can be covered with pavers before initial set.
9. Cut back, bevel edge, remove, and discard setting-bed material that has reached initial set before placing pavers.

C. Setting Pavers:

1. Place pavers before initial set of cement occurs.
2. Immediately before placing pavers on setting bed, apply uniform 1/16 inch thick, slurry bond coat to bed or to back of each paver with a flat trowel.
3. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances.

4. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
5. Provide 3/8 inch nominal joint width with variations not exceeding plus or minus 1/16 inch.

D. Grouting Joints:

1. Grout joints as soon as possible after initial set of setting bed.
2. Force grout into joints, taking care not to smear grout on adjoining surfaces.
3. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
4. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
5. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

E. Curing: Cure grout by maintaining in a damp condition for 7 days, unless otherwise recommended by grout or liquid-latex manufacturer.

3.5 ADJUSTING

A. Patching: Repair damaged surfaces according to ILI's Repairing Damage to Indiana Limestone.

3.6 CLEANING

A. Final Cleaning: Clean installed work according to following:

1. ILI's Indiana Limestone Handbook.
2. ILI's How to Avoid Small Area Stains and Blemishes.

END OF SECTION