

# How to Specify Indiana Limestone



## Performance Specifications

The use of a performance specification implies the need for expertise beyond that which typically exists in the office of the designer or specifying authority. In the case of stone cladding, such an expert is an experienced skin-and-connection design engineer. Specifiers should determine, based on preliminary designs, whether such skills are needed. Need will be determined by one or more of the following: knowledge of the performance records of the contemplated systems, materials, or connections; complexity of the cladding and/or connection system; unusual or extreme loading conditions; unusual frame or structural configuration.

If it is determined that no such need exists, DO NOT USE THIS SECTION. One of the earlier sections of this specification, describing conventional methods and materials with known or easily predictable performance records, will prove more economical and effective.\*

If such need is seen to exist, contract documents should make clear who is responsible for providing the engineering services and the extent of the services expected. Such services may include design of the stone cladding, its thicknesses and its connections, and the supervision of any necessary testing of small-size specimens and scale or full-size mock-ups. The experience and capacity to produce satisfactory designs and supervision should be assured.

(Refer to the *Indiana Limestone Handbook, 21st Edition*, published by the Indiana Limestone Institute of America, Inc.)

## Section 04400-Stonework

### Part 1- General

#### 1.1 Related documents:

Related documents include but are not limited to Drawings, Specifications, and General Provisions of the Contract; ASTM C-568, Standard Specification for Limestone Building Stone; ASTM C-97, Test Methods for Absorption and Bulk Specific Gravity of Building Stones; ASTM C-99, Test Method for Modulus of Rupture of Building Stone; ASTM C-170, Test Method for Compressive Strength of Building Stone; Indiana Limestone Handbook, latest edition; Contractors Handbook on Indiana Limestone, latest edition; ILIA Technote on Safety Factors; and other applicable ILIA Technotes.

#### 1.2 Summary

**1.2.1 Extent** of limestone work is indicated on drawings and schedules.

**1.2.2 General:** Provide Indiana Limestone cladding in accordance with the contract documents. The work shall include the following:

- Limestone façade panels.
- Limestone pre-assembled units.
- Limestone copings, sills, soffits, lintels, and miscellaneous features.
- Steel support and retention connections for stonework, including necessary shims.
- Secondary structural steel framing for stonework where not shown or not sized on structural drawings.
- Mockups.
- Installation of stonework.

#### 1.2.3 Related work specified elsewhere:

- Exterior stone paving (sitework).
- Unit masonry.
- Sealants.
- Secondary steel framing for stone support and anchorage as shown and sized on structural drawings.
- Interior stone and paving and exterior stone paving.

**1.2.4** Installation of preset concrete inserts

**1.2.5** Installation of preset masonry inserts

#### 1.3 System description:

**1.3.1 General:** Design, fabricate, and install stonework to withstand normal loads from wind, gravity, movement of building structure, and thermally induced movement, as well as to resist deterioration under conditions of normal use including exposure to weather, without failure.

**1.3.2 Performance Requirements—General:** The cladding requirements shown by the general stone details are

intended to establish basic dimensions of units or modules, plus profiles and sight lines for the stonework. Within these limitations, the contractor shall be responsible for the design of the stonework, and shall request approval of, and make whatever modifications and additions to the details as may be required to fulfill the performance requirements. The visual concept shall be maintained as shown, including profiles and alignment of components.

The requirements for the stone support and anchorage as shown by the details are intended to establish the basic intent of the stone anchorage system. The contractor shall be responsible for the design of the support and anchorage system and shall request approval of, and make whatever modifications and additions to the details as may be required to fulfill the performance requirements. Final shapes and locations shall be as designed by a registered professional engineer.

**Engineering Calculations:** This engineer shall be a registered professional engineer experienced in cladding design to design the cladding support and retention system. The system shall include all items required to connect the stone cladding to the structure (or secondary framing) as shown and detailed on the structural and architectural drawings. The cladding engineer shall be registered in the

state of \_\_\_\_\_ and shall prepare engineering calculations for the justification of all principal stonework, units, fasteners, and anchorage components for compliance with the criteria established in the performance requirements of this section. The calculations shall be submitted to the architect for review and approval. After review, revisions, and final approval, the cladding engineers shall certify a record copy of the calculations with professional engineer's stamp or seal. Based on the design loads, material properties, and safety factors (all as defined in this section), the calculations shall include, as a minimum, the following information:

Stone loads, stresses, and safety factors.

Support and anchorage loads, stresses, safety factors, design loads, and allowable loads.

Stone thicknesses.

Support and anchorage sizes.

Drawings of all support and anchorage items in sufficient detail for fabrication and for the detailing and completion of the shop drawings as prepared by the stone fabricator. The cladding engineer shall review all stone shop drawings prepared by stone installer or fabricator.

### 1.3.3 Performance Requirements—Stone

**Physical Properties:** The Indiana Limestone physical properties shall meet or exceed the values listed in the Indiana Limestone Institute of America, Inc. *Handbook* (ILIA), latest edition.

**Safety Factors-Stone:** Safety factors for Indiana Limestone shall be not less than as listed in the *Technote on Safety Factors*, as published by ILIA.

**Connections and Attachments for Limestone:** Support and Retention Steel: All steel shapes, plated and straps shall be

designed to carry the design loads with safety factors and allowable stresses in accordance with the American Institute of Steel Construction, Inc. (AISC) except that steel supports carrying gravity loads shall be stressed no more than 50% of the yield stress in bending.

**Connections into the Stone:** Expansion bolts, straps, hooks, anchors, and other devices shall be designed to carry the design loads with safety factors not less than listed in ILIA Technote on Safety Factors.

**Attachments to the Structure:** Connections and attachments to the structure or secondary framing shall be designed to carry the design loads with safety factors or allowable stresses in accordance with the following:

Welds: Structural Welding Code (AWS D1.1 and AISC).

Expansion Bolts: Per ICBO evaluation report for the specific bolt to be used. If an ICBO report is not available, use not less than the following:

Safety Factors:

Into 4,000 psi concrete-4 to 1

Into grouted CMU-6 to 1

The combined load factor for combined tension and shear shall satisfy the ILIA Technote on Safety Factors.

Bolts: AISC.

Concrete Embedded (Cast-in) items: PCI or manufacturer's recommendations, whichever is more conservative. The safety factor shall be not less than 4 to 1 based on concrete failure.

**Design Loads:** All cladding and cladding attachments shall be designed to carry the following design loads with safety factors not less than specified in this section:

Wind Loads: (Latest Edition) UBC (or applicable code or wind tunnel test results).

Seismic Loads: Per code where applicable.

Vertical Loads:

Dead Loads – Actual computed weight of cladding.

Live Loads – (Latest Edition) UBC (or applicable code).

### Provisions for Fabrication and Erection Tolerances:

Design, detail and fabricate connections to provide allowance for fabrication tolerances, erection tolerances, and structural deflections.

Concrete structural fabrication and erection tolerances are specified in Division-3 section *Concrete Work*.

Structural steel fabrication and erection tolerances are specified in Division-5 section *Structural Steel*.

**Control of Corrosion:** Prevent galvanic and other forms of corrosion by insulating metals and other materials from direct contact with non-compatible materials, or by suitable coating.

## 1.4 Submittals

**1.4.1 Product Data:** Submit manufacturer's technical data for all stone, stonework accessories, and other manufactured products required.

**1.4.2 Shop Drawings:** Submit cutting and setting drawings

indicating sizes, dimensions, sections, and profiles of stones; arrangement and provisions for jointing, supporting, anchoring, and bonding stonework; and details showing relationship with, attachment to, and reception or, related work. The drawings shall include the details as developed by the cladding engineer as defined in the performance requirements section.

Include large scale details of decorative surfaces and inscriptions.

**1.4.3 Samples:** Submit the following samples:  
Limestone samples in form of sets of three, consisting of stones not less than 12" square. Sample sets will show a range of variations in color and grain to be expected in completed work.  
Sealant samples for each type and color of joint sealant required.

**1.4.4 Data for Limestone cladding:** For limestone cladding, submit the following data which has been signed and stamped by a qualified professional engineer registered in

(Name of State)

who thereby certifies preparing or supervising the preparation of the data to comply with the performance requirements and recognized engineering principles and practices:

Engineering calculations as defined in the performance section.

Connection details as defined in the performance section.

**1.5 Quality assurance**

**1.5.1 Single Source Responsibility for Stone:** Obtain limestone from a single quarry source with resources to provide materials of specified consistent quality. The fabricator and the quarry shall have sufficient capacity to quarry, cut, and deliver the stonework on schedule. Both fabricator and quarry must be members in good standing of Indiana Limestone Institute.

**1.5.2 Single Source Responsibility for Mortar Materials:** Obtain mortar ingredients of uniform quality and from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.

**1.5.3 Single Source Responsibility for Other Materials:** Obtain each type of stone accessory, sealants, and other materials from one manufacturer for each product.

**1.5.4 Information on Drawings and in Specifications** establishes requirements for both aesthetic effects and performance of the limestone cladding. Aesthetic effects are indicated by dimensions, arrangement, alignment and profiles of components and assemblies as they relate to sight lines and relationships to one another and to adjoining work. Performance is indicated by criteria that is subject to verification by either preconstruction or field test, if applicable, or by in service experience.

Do not modify intended aesthetic effects, as judged solely by architect, except with architect's approval and only to

the extent exclusively needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to architect for review and approval.

**1.5.5 Installer Qualifications:** Engage an installer with not less than 10 years experience and who has successfully completed stonework similar in material, design and extent to that indicated for this project. Submit list of completed projects; include project names, addresses, and names of architects and owners.

**1.5.6 Preconstruction Tests:** Contractor shall obtain material tests as noted below:

Preconstruction Testing Service: Contractor shall employ and pay qualified independent testing laboratories to perform preconstruction testing indicated.

Test limestone for compliance with physical property requirements for Limestone Building Stone, Type II, as listed in ASTM C-568. Conduct tests using specimens randomly selected from, and representative of, actual materials proposed for incorporation in the work.

The following test reports shall be submitted:

- ASTM C 99 Modulus of Rupture
- ASTM C 170 Compressive Strength

**1.5.7 Field-Constructed Mock-up:** Prepare mock-ups for the stonework if applicable. Purpose of mock-ups is further verification of selections made for color and finish under sample submittals and establishing standard of quality for aesthetic effects expected in completed work. Build mock-ups to comply with following requirements.

Locate mock-ups on site where indicated or, if not indicated, as directed by architect.

Build mock-ups containing elements typical of the stonework in this project. The extent of the mock-up shall be defined by this section.

Erect mock-ups only after notifying architect when construction will begin.

Retain mock-ups during construction as standard for judging completed stonework. When directed, demolish mock-ups and remove from site.

*Option: Acceptable mock-up may be incorporated into the work.*

**1.5.8 Qualifications for Welding Work:** Qualify welding operators in accordance with AWS Standard Qualification Procedure.

Provide certification that each welder employed in the work is qualified for welding processes involved by having satisfactorily passed AWS qualification tests and, if applicable, by undergoing recertification. Retesting for recertification shall be contractor's responsibility.

**1.6 Delivery, storage and handling**

**1.6.1 Deliver masonry materials** to project in undamaged condition.

**1.6.2 Store and handle stone** and related materials to prevent their deterioration or damage:

Do not use pinch or wrecking bars on stonework.

Lift with wide-belt type slings where possible; do not use wire rope or ropes containing tar or other substances which might cause staining.

Store stone on non-staining wood skids or pallets, covered with non-staining, waterproof membrane. Place and stack skids and stone to distribute weight evenly and to prevent breakage or cracking of stones.

Store cementitious materials off the ground, under cover and in dry location.

**1.7 Project conditions**

**1.7.1 Protect stonework during erection as follows:**

Cover top of walls with non-staining waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24" down both sides and hold securely in place.

Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials from stone without damage to the stonework.

Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

Protect sills, ledges, and projections from droppings of mortar and sealants.

**1.7.2 Cold Weather Protection:** Comply with the following requirements.

*Part 1.7.2 should be part of the specifications in those projects where mortar is used in setting, and where freezing weather is a possibility.*

Remove ice or snow formed on stonework beds by carefully applying heat until top surface is dry to the touch.

Remove stonework damaged by freezing conditions.

Perform the following construction procedures while stonework is progressing:

Temperature ranges indicated apply to air temperatures existing at time of installations.

In heating mortar materials, maintain mixing temperatures selected within 10° F (6° C); do not heat water for mortar to above 160° F (71° C).

Mortar: At 40° F (4.4° C) and below, produce mortar temperatures between 40° F (4.4° C) and 120° F (49° C) by heating mixing water and, at temperatures of 32° F (0° C) and below, sand as well. Always maintain temperature of mortar on boards above freezing.

At 25° F (-4° C) to 20° F (-7° C), heat both sides of walls under construction using salamanders or other heat sources and use windbreaks or enclosures when wind is in excess of 15 mph.

At 20° F (-7° C) and below, provide enclosure and auxiliary heat to maintain an air temperature of at least 40° F (4.4° C) for 24 hours after setting stonework and heat stones so that they are above 20° F (-7° C) at time of installation.

**Part 2-Products**

**2.1 Materials, general**

**2.1.1 Comply with referenced standards** and other requirements indicated applicable to each type of material required.

**2.1.2 Provide stone** from a single quarry for each grade, color, and finish of stone required.

**2.1.3 Make quarried blocks available for inspection** by architect.

**2.2 Limestone:**

**Limestone Building Stone Standard:** ASTM C568.

**2.2.1 Classification:** Category II (Medium Density).

**2.2.2 Variety:** Indiana Limestone.

**2.2.3 Finish of Exterior Limestone Cladding:** As follows:

Finish Indiana Limestone cladding to match standard finish of Indiana Limestone Institute, Inc. designated below

*(Insert finish name here)*

-- OR --

**Finish Indiana Limestone** to match approved samples and/or mock-ups of Indiana Limestone.

**2.2.4 Furnish Stone in accordance with approved samples** and jobsite mock-up for type, variety, grade (if applicable), color, and other characteristics relating to aesthetic effects.

**2.2.5 Indiana Limestone Grade and Color:** Provide color indicated below in accordance with grade and color classification established by Indiana Limestone Institute, Inc.

*(Grade and color name(s)-insert here)*

**2.3 Mortar and grout materials**

**2.3.1 Portland Cement:** ASTM C 150, Type I except Type III may be used for cold weather construction. Provide gray or white cement as needed to produce mortar color required.

**2.3.2 Hydrated Lime:** ASTM C 207. Type S.

**2.3.3 Aggregate:** ASTM C 144; and as indicated below:

**For joints narrower than 1/4"** use aggregate graded with 100 percent passing the No. 8 sieve and 95 percent the No. 16 Sieve.

**2.3.4 Water:** Clean, non-alkaline, and potable.

**2.4 Stone anchors and attachments**

**2.4.1 Provide anchors and attachments** of type and size required to support the stonework fabricated from the following metals for conditions indicated below:

Stainless steel, AISI Type 304 or 316, for anchors and expansion bolts embedded within the stone.

Hot-Dip Galvanized Steel as follows:

Galvanized malleable iron for adjustable inserts embedded in the concrete structure.  
For anchor bolts, nuts and washers not in direct contact with stone; comply with ASTM A 307, Grade A, for material and ASTM C 153, Class C, for galvanizing.

For steel plates, shapes and bars not in direct contact with stone; comply with ASTM A 36 for materials and ASTM A 123 for galvanizing.

For expansion bolts not in direct contact with stone use zinc plated or cadmium plated bolts with stainless steel expansion clips.

For steel angles supporting limestone; comply with ASTM A 36 for materials and ASTM A 123 for galvanizing. Supports protected with one shop coat of zinc-rich or other rust-inhibiting paint, and one job coat of similar, compatible paint, may be used at the discretion of the architect.

**2.4.2 Dovetail Slots:** Where required, furnish dovetail slots, with filler strips, of slot size required to receive anchors provided, fabricated from 0.0336 (22-gauge) galvanized sheet steel complying with ASTM A 446, G90.

**2.5 Preassembled units—Indiana Limestone**

**Performance Requirements:** Performance requirements defined elsewhere in this section apply to the preassembled units.

**2.5.1 Adhesive:** The adhesive shall be a two-component epoxy consisting of epoxy resin and hardener.

**Adhesive Properties:** The adhesive used shall meet the following minimum requirements after a 7-day cure at 75° F.

<b>Property</b>	<b>Value</b>	<b>Test Method</b>
Tensile Bond Strength*	Cohesive failure in stone	ASTM C-321
Tensile Elongation	2.5%	ASTM D-638
Tensile Strength	3,500 psi	ASTM D-638
Compressive Double Shear*	400 psi	MMM G-650A
Compressive Strength	6,000 psi	ASTM D-695
Shore "D" Hardness	75	ASTM D-1706
Water Absorption (24 hours)	0.50%	ASTM D-570

*\*Note: These tests represent bond strength. Other tests are made on the adhesive only.*

**2.5.2 Samples:** Two sample units of stone bonded together with adhesive shall be submitted showing stone and joint quality. Samples shall be 6" long, 3" wide, 3/4" thick, bonded together on the large face, at right angles. No fabrication or assembly shall begin until approval of sample is obtained.

Industry practice permits 1/8" thick adhesive joints.

**2.5.3 Drawings:** The epoxy joint construction including mechanical anchoring and framing shall be shown on the shop drawings.

**2.5.4 Shop Assembly Requirements:** Stone shall be dry and free from grease, oil, dirt, loose particles, and efflorescence. Clean compressed air should be employed to blow stone dust from the pores of the stone. Heat is recommended for the removal of moisture from the stone prior to applying epoxy. No moisture should be observed creeping into areas to be bonded following the removal of heat.

Units shall not be assembled when the stone temperature and the surrounding air temperatures are below 50° F or above 95° F. Assembly of units below 50° F is permitted when the temperature of the stone units and adhesive is raised by heating to a temperature above 50° F. After the units have been joined, heat should continue to be applied to the stone adjacent to the joint area to give the adhesive the curing temperature above 50° F. Approved clips, frames, expansion bolts, and other mechanical connections shall be installed in strict accordance with approved shop drawings.

Adhesive shall be mixed in parts by weight or parts by volume in strict accordance with manufacturer's instructions, with strict compliance to the manufacturer's recommendations on the "pot life" of the adhesive.

Upon joining the stone members together, suitable clamps or bracing shall be used to keep the stone in proper alignment until the adhesive sufficiently hardens. Process shall include any and all shims needed to insure proper alignment.

Assembled limestone units shall not be moved until the adhesive has cured sufficiently to assure there will be no

joint damage. Curing shall continue until the adhesive has reached the required hardness. When stones are pressed together, the adhesive shall flow out of the joint. On exposed joints, in a textured finish, it is recommended that the excessive adhesive be removed after the adhesive has taken on its initial hardening. The extra adhesive may be scraped away with a putty knife. Any excessive adhesive on smooth finish may be removed after complete hardening with the use of power sanders.

All dowels, anchors, expansion bolts, bearing plates, and other steel items in direct contact with the stone or contained within the stone shall be stainless steel AISI Type 304 or 316. Frames, plates, and other steel shapes not in direct contact with the stone shall be ASTM A-36 hot-dipped after fabrication per ASTM A-123. Bolts not in contact with the stone shall be ASTM A-325 or equal and shall be galvanized or plated with zinc or cadmium.

Fabricate and assemble structural framing in shop to comply with AISC *Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings*, including "Commentary" and "Supplements" thereto as issued, and as indicated on final shop drawings.

Weld or bolt connections to comply with the following requirements:

Install high strength threaded fasteners to comply with AISC *Specifications for Structural Joints using ASTM A-325 or A-490 bolts* approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation (RCRBSJ).

Weld connections to comply with AWS D1.1 *Structural Welding Code—Steel*.

**2.5.5 Transportation and Storage:** Extreme care shall be taken to insure that the assembled units are free of torsional stress during transportation, handling, and storage.

**2.5.6 Erection:** The stone fabricator shall make provisions for the employment of the necessary lifting methods of the assembled units, in cooperation with the erector. Such lifting devices as clamps, slings, etc., shall be furnished by the erector.

## 2.6 Stone accessories

**2.6.1 Setting Shims:** Lead, stainless steel, or plastic shims, non-staining to stone, sized to suit joint thicknesses and bed depths of stonework involved without intruding into required depths of joint sealants.

**2.6.2 Concealed Sheet Metal Flashing:** Fabricate from stainless steel or other material complying with requirements specified in Division-7 Section "Flashing and Sheet Metal" in thicknesses indicated but not less than 0.015" thick.

**2.6.3 Plastic Tubing Weeps:** Medium density polyethylene, outside diameter of 1/4" and of length required to extend between exterior face of stone and cavity behind.

## 2.7 Elastomeric Sealants:

Refer to Section 07900 in the (ILIA) *Indiana Limestone Handbook*.

## 2.8 Mortar and grout mixes

**2.8.1 General:** Do not add mixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds, or calcium chloride, unless otherwise indicated.

**2.8.2 Mixing:** Combine and thoroughly mix cementitious materials, water and aggregates in a mechanical batch mixer; comply with referenced ASTM standard for mixing time and water content, unless otherwise indicated.

**2.8.3 Setting Mortar:** Comply with ASTM C 270, Proportion Specification, for types of mortars and applications required below, unless otherwise indicated:

**Set Indiana Limestone** with Type N mortar.

## 2.9 Stone fabrication

**2.9.1 General:** Fabricate stonework in sizes and shapes required to comply with the requirements as shown on approved shop drawings.

**2.9.2 Comply with recommendations** of the Indiana Limestone Institute of America, Inc. (ILIA) as published in the *Indiana Limestone Handbook* (latest edition).

**2.9.3 Cut and drill sinkages and holes** in stones for anchors, fasteners, supports, and lifting devices as indicated or needed to set stonework securely in place; shape beds to fit supports.

**2.9.4 Cut stones** to produce pieces of thickness, size, and shape indicated or required and within fabrication tolerances recommended by ILIA.

### 2.9.5 Thickness of Exterior Stone Cladding:

Provide stone thicknesses required to comply with performance requirements but not less than shown on architectural drawings. Use tables in *Indiana Limestone Handbook* as a guide to size requirements.

**2.9.6 Control depth of stones** and back-checks to maintain a clearance between backs of stones and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stones.

**2.9.7 Cut joints** (bed and vertical) straight and at 90° angle to face, unless otherwise indicated.

**2.9.8 Quirk-miter corners**, unless otherwise indicated; shall provide for cramp anchorage in top and bottom bed joints of corner pieces.

**2.9.9 Cut stones** to produce joints of uniform width and in locations indicated.

*Joint Width:* \_\_\_\_\_

**2.9.10 Contiguous Work:** Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

**2.9.11 Fabricate molded work**, including washes and drips, to produce stone shapes having a uniform profile throughout their entire length and with precisely formed arises slightly

eased to prevent snipping, and matched at joints between units.

**2.9.12 Carve and cut decorative surfaces and inscriptions** to conform with shaded drawings or models approved by architect. Use skilled stone carvers experienced in the successful performance of work similar to that indicated.

**2.9.13 Finish exposed faces and edges** of stones to comply with requirements indicated for finish under each type and application of stone required and to match approved samples and field-constructed mock-ups.

## Part 3-Execution

### 3.1 Examination

**3.1.1 Require installer to examine surfaces** to receive stonework and conditions under which stonework will be installed and to report in writing any conditions which are not in compliance with requirements. Do not proceed with installation until surfaces and conditions comply with requirements indicated in specifications or elsewhere for execution of other work which affects stonework.

### 3.2 Preparation

**3.2.1 Advise installers** of other work about specific requirements relating to placement of inserts, flashing reglets and similar items which will be used by stonework installer for anchoring, supporting and flashing of stonework. Furnish installers of other work with drawings or templates showing locations of these items. General contractor or concrete contractor will provide drawings to locate weld-plates and embeds for connection of stone skin or its system.

**3.2.2 Clean stone surfaces** which have become dirty or stained prior to setting to remove soil, stains and foreign materials. Clean stones by thoroughly scrubbing stones with fiber brushes followed by a thorough drenching with clear water. Use only mild cleaning compounds that contain no acid, caustic, or abrasives.

### 3.3 Setting stone, general

**3.3.1 Execute stonework** by skilled mechanics, and employ skilled stone fitters at the site to do necessary field cutting as stones are set.

Use power saws to cut stones; for exposed edges, produce edges which are cut straight and true. Mallet and chisel will be permitted provided craftsmen are skilled in their use.

**3.3.2 Contiguous Work:** Provide chases, reveals, reglets, openings and other spaces as indicated for accommodating contiguous work. Close up opening in stonework after other work is in place with stonework which matches that already set.

**3.3.3 Set stones** to comply with requirements indicated on drawings and final shop drawings. Install anchors, supports, fasteners and other attachments indicated or necessary to secure stonework in place. Shim and adjust anchors, supports and accessories to set stones accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.

**3.3.4 Dampproofing for stain prevention:** Where indicated on drawings, coatings of either (a) cementitious waterproof stone backing or (b) bituminous dampproofing shall be applied on backs, beds, and joints of all stones used at grade. Dampproof all adjacent concrete surfaces on which limestone will rest, including concrete or cmu haunches and ledges, as well as support angles.

**A.** Dampproof unexposed surfaces of stone to at least 1'-0" above grade.

**B.** Dampproof joints only to within 1" of finished surfaces when using bituminous or asphaltic solutions.

**C.** Stones extending below grade shall be dampproofed as above, and in addition shall be dampproofed to the level of grade on their face surfaces which are covered.

**D.** Cementitious coatings must be allowed to cure before treated stone is set. Due care must be exercised in handling all dampproofed stone to avoid chipping or off-setting.

**3.3.5 Construction Tolerances:** Set stones to comply with the following tolerances:

**Variation from Plumb:** For lines and surfaces of columns, wall and arises, do not exceed 1/4" in 10', 3/8" in a story height or 20' maximum, nor 1/2" in 40' or more. For external corners, expansion joints and other conspicuous lines do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more.

**Variation from Level:** For grades indicated for exposed lintels, sills parapets, horizontal grooves and other conspicuous lines, do not exceed 1/2" in any bay or 20' maximum, not 3/4" in 40' or more.

**Variation of Linear Building Line:** For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.

**Variation in Cross-Sectional Dimensions:** For columns and thickness of walls from dimensions indicated, do not exceed minus 1/4", nor plus 1/2".

**Note: The tolerances in this section are masonry industry setting tolerances and are provided for the convenience of the specifier. As a production industry, the Indiana Limestone industry can not and does not control them.**

**3.3.6 Provide expansion joints,** control joints, and pressure-relieving joints of widths and at locations indicated or required.

Sealants, expansion, and other joints are specified in Division 7 Section "Joint Sealers."

Use no mortar or shims in expansion joints.

### 3.4 Setting stonework with sealant joints

**3.4.1 Support stonework** on gravity supports, and insert anchors for lateral loads, of type and number indicated on final shop drawings, and complying with requirements indicated for material and performance.

**3.4.2 Attach anchors** securely to stones and to backup surfaces.

**3.4.3 Attach framing** for stone support system to structural frame of building at connection points indicated by welded or bolted field connections complying with the following requirements:

Install high strength threaded fasteners to comply with *AISC Specifications for Structural Joints using ASTM A 325 or A 490 bolts* approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation (RCRBSJ).

Weld connections to comply with AWS D1.1 *Structural Welding Code Steel*.

Provide joints to exclude water or permit its escape to exterior of building. Provide weeps at locations where water could accumulate due to condensation or other causes.

For galvanized surfaces of assembled framing, comply with ASTM A 780 for cleaning field welds, bolted connections and abraded areas and application of galvanizing repair paint.

For shop-painted surfaces, clean field welds, bolted connections, and abraded areas, immediately after erection. Apply paint to exposed areas using same material as used for shop painting.

**3.4.4 Fill anchor holes** with non-staining mortar or sealant. Where dowel holes occur at pressure-relieving joints, provide compressive material above and below dowels.

**3.4.5 For stones supported on clip or continuous angles**, set stones on non-corrosive and non-staining shim material in sufficient area to support the load. Mortar may be used in lieu of shims provided that setting pads are provided to maintain joint sizes if stone weight squeezes out of mortar.

Place setting buttons of adequate size, in sufficient quantity, and of same thickness as indicated joint width, to prevent mortar from squeezing out and to maintain uniform joint widths. Hold buttons back from face of stone to provide space for backer rope and sealant.

The joint between bottom of relieving angles and top surface of stones below angles shall be free of mortar or shims to avoid load transfer.

**3.4.6 Install concealed flashing** at continuous shelf angles, lintels, ledges and similar obstructions to the downward flow of water so as to divert such water to the exterior.

**3.4.7 Keep cavities open** where unfilled space is indicated between back of stone veneer and backup wall; do not fill cavities with mortar or grout.

**3.4.8 Place weepholes/vents** in joints where moisture may accumulate including base of cavity walls, above shelf angles and flashing. Locate weepholes/vents at intervals not exceeding 2' and those serving as vents only, at intervals not exceeding 5' horizontally and 20' vertically.

**3.4.9 Where mortar** is used in setting stones on anchors or elsewhere, rake out mortar from joints to depths adequate to

receive sealants and sealant backings.

**3.4.10 Embed ends of lugged sills** on shims or mortar; leave balance of joint open until final sealing.

**3.4.11 Set the stonework** with open vertical joints for installation of joint sealants. Use no shims or spacers in vertical joints.

### 3.5 Installation of joint sealants:

*Specified in Section 07900 in the (ILIA) Indiana Limestone Handbook.*

### 3.6 Adjusting and cleaning

**3.6.1 Repairing Damaged Stone:** Repair of stone is an accepted practice and will be permitted. Some chipping is expected; repair of small chips is not required if it does not detract from the overall appearance of the work, or impair the effectiveness of the mortar or sealant. The criteria for acceptance of chips and repairs will be per standards and practices of the industry unless other criteria are mutually agreed upon by the limestone supplier and the architect.

#### 3.6.2 Remove and replace stonework of the following description:

Stones so damaged that repair is impossible, either structurally or aesthetically.

Defective joints.

Stones and joints not in conformance with approved samples and field-constructed mock-ups.

Stonework not complying with other requirements indicated.

**3.6.3 Replace** in manner which results in stonework conforming to approved samples and field-constructed mock-ups, complying with other requirements and showing no evidence of replacement.

**3.6.4 Clean stonework** using clean water and stiff bristle fiber brushes. Do not use wire brushes, acid type cleaning agents, or other materials or methods which could damage stone. Mechanical or pressure cleaning methods may be used if approved by architect. Protect limestone when adjacent brick is being acid-washed.

### 3.7 Protection

**Provide final protection** and maintain conditions, in a manner acceptable to fabricator and installer, which ensures stonework being without damage or deterioration at time of substantial completion.

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