

04 00 00 Masonry

04 03 05 Masonry Procedures of Heritage Masonry

General note:

- .1 The stone in question is Kingston limestone. In terms of specification for stonework restoration, it does not belong to a geological source but, as is traditional practice, to a quarry source. Quarries in the Kingston area providing matching stone are the only Heritage-appropriate sources and at the time of this writing there is only one such quarry. Sources of stone farther afield, e.g., into Quebec, do NOT produce comparable appropriate products and should not be used.
- .2 This specification primarily addresses restoration of historic stone masonry (pre 1930s). The stone in question is Kingston limestone. In terms of specification for stonework restoration, it does not belong to a geological source but, as is traditional practice, to a quarry source. Quarries in the Kingston area providing matching stone are the only Heritage-appropriate sources and at the time of this writing there is only one such quarry. Sources of stone farther afield, e.g., into Quebec, do NOT produce comparable appropriate products and should not be used.
- .3 Pre 1930, Kingston limestone buildings at Queen's University were placed with true lime mortar and no Portland cement. The last known Queen's University cases of true lime mortar preparation (slaking lime from quicklime, batched with carefully controlled coarse sand and no cements, and negligible added water) were Kingston Hall and Carruthers Hall dating to 1990. At the time of this writing, there are only a few masonries restoration firms that are deeply experienced and long practiced in lime mortar preparation. At the time of this writing, sources for quicklime suited to use in stonework are also limited. Often-cited sources for quicklime are likely to be decades old and long since having ceased production. Sources of agricultural lime are generally not suitable – the quality of quicklime used in agricultural purposes is not so sensitive to under-fired and over-fired lumps of lime.
- .4 If project circumstances warrant true heritage conservation/restoration using historically prepared lime mortars, then pre-qualification of masons is an essential first step.
- .5 Only in such cases should reference be made to quicklime, slaked lime, lime putty, "coarse stuff", "hot mix" etc.
- .6 If factory prepared dry premixed mortar (i.e., in bags or pails) is being used then the sand and cementitious components should NOT be specified as they are not variables that can be site controlled.
- .7 It is unlikely that Queen's University buildings pre-1930 were pointed with ribbon pointing or any true tuck-pointing. In the 1930s and later, many repairs were certainly done using ribbon pointing – albeit often with Portland cement-based mortar. Do not replicate ribbon pointing and instead adhere to good practice of a joint flush to the arris of the stone.
 - Assess "hidden" locations for potential clues as to original point colour, style.

Submittals:

- .1 Submit MSDS sheets for all products of the Work, neatly copied, current versions, in 3-ring binders.
 - Organize by specification Section.
 - Provide one (1) copy to the Owner and maintain another copy on site.

Environmental Conditions, Protection:

General:

- .1 Execute Work only as set out under CSA A371 and as augmented herein.
- .2 Execute Work only for air temperatures between 5°C (41°F) and 35°C (95°F) for the 24 hours leading up to the time of Work, and for a period of no less than 72 hours after the placement of mortar.
 - Noted temperatures apply to both the substrate and air temperatures.
 - For conditions outside these limitations, extraordinary measures will be necessary.

Protection:

- .1 Protect all new masonry from rain, wind, and sun for a period of no less than 72 hours.
- .2 Covers must be wind secure.
- .3 Damp Curing of Bedding/Laying Mortar:
 - Maintain dampness under jute/burlap covers for no less than 24 hours.
- .4 Damp Curing of Pointing Mortar:
 - For temperatures of less than 30°C (86°F) at the time of pointing mortar placement and for 48 hours following, maintain damp curing conditions utilizing wetted jute/burlap or equal.
 - Maintain dampness in jute/burlap through the curing period including weekends.
 - Ensure that burlap is wind secure and kept damp for at least 48 hours.
 - For temperatures of 30°C (86°F) and less than 35°C (95°F) at the time of pointing mortar placement and for 72 hours following, maintain damp curing conditions utilizing wetted jute/burlap or equal, and with polyethylene covers to limit evaporation.
 - Maintain dampness in jute/burlap through the curing period including weekends.
 - Ensure that burlap and covers are wind secure and kept damp for at least 72 hours.
 - For temperatures of more than 35°C (95°F) at the time of pointing mortar placement and for 72 hours following, maintain damp curing conditions utilizing wetted jute/burlap or equal, and with polyethylene covers to limit evaporation.
 - Ensure increased frequency of misting of the joints, and/or spraying of the jute throughout the course of the day.
 - Maintain dampness in jute/burlap through the curing period including weekends.
 - Ensure that burlap and covers are wind secure and kept damp for at least 72 hours.
- .5 Maintain watertightness of the building during restoration Work.

Hot Weather Work:

General:

- .1 Prepare and slake mortar during both mixing and while awaiting use in a continuously shaded location.
- .2 Set stone units promptly after placing mortar.
- .3 During periods of Work, and for 72 hours following Work, when the air temperatures are at or above 38°C (100°F), or when the air temperatures are at or above 32°C (90°F) accompanied by winds greater than 13 km/hr, the spread of mortar shall not exceed 0.6m (2') and stones shall be set within 1 minute of placing the mortar.
 - This is a stricter limitation than for brick and block due to the extra time that setting of stone units requires.

Cold Weather Work:

- .1 Execute Work when ambient temperature is above 5°C (41°F), and has been for at least 24 hours before placing masonry, and is expected to be for at least 48 hours after completion of placing masonry.
 - When ambient temperature is below 5°C (41°F) exercise care to adhere to accepted industry practices and as set out under CSA A371 for Cold Weather procedures including heating the sand and/or the water to a minimum of 20°C (68°F), maximum of 70°C (158°F).
- .2 Prepare and maintain temperature of mortar between 5°C (41°F) and 50°C (122°F) until used.

04 03 06 Cleaning of stonework

General note:

Description:

- .1 This Section is an outline of cleaning of the stonework.
- .2 In accordance with best practices, cleaning shall be by the gentlest means possible that produces the desired result.
 - It is expected that most cleaning will be by prolonged (24-hour to 48-hour) gentle sprinkler soaking of affected areas.
 - A light power wash and brooming could be required after the prolonged water washing.
- .3 Routine cleaning of stonework after curing of pointing mortar, replacing damaged stone, etc., is not specifically included in this Section.

Related Work:

- .1 Section 04 03 04, Historic Replacement of Quarried Stone
- .2 Section 04 03 05, Masonry Procedures for Historic Masonry

References:

- .1 Standards and Guidelines for the Conservation of Historic Places in Canada.
- .2 US National Parks Service, Preservation Brief 1.
- .3 US National Parks Service, Preservation Tech Note 3, Masonry, Water Soak Cleaning of Limestone.
- .4 Other:
 - City of Kingston, Policy on Masonry Restoration in Heritage Buildings (April 2013)
<https://www.cityofkingston.ca/documents/10180/20847/Policy+-+Masonry+Restoration+in+Heritage+Buildings/c2d8d166-e0b3-4a2a-8079-f359b418bc46>

Existing Conditions:

- .1 Make examination with the Consultant to confirm all areas in need of cleaning and to discuss cleaning procedures and options.
- .2 In advance of cleaning, coordinate with the Owner for sheltering of the doors and any windows potentially impacted.
- .3 Allow to clean on a weekend and/or Civic Holiday if water rundown protection cannot be provided to protect persons using entrances/exits.

Environmental Conditions, Protection:

- .1 Execute Work only when temperatures are, and are forecast to remain for at least 72 hours, above 10°C (50°F).
- .2 Execute Work in a manner that controls the spread of water and masonry/mortar dust-filled water (slurry).
 - Take all feasible measures to prevent moisture intrusion at the main entry door and windows.
- .3 All points of potential entry of water to the building are to be closed and/or protected.

Preparation:

- .1 Provide all requisite protection of the building, openings in the building, and for persons using entrances/exits from water penetration and damage.
 - Ensure same assemblies are wind-secure.
- .2 Shelter weathered painted surfaces that could be adversely affected by water soaking.
- .3 Place barricades around areas subject to becoming muddy from the Work.

- .4 If hoses must cross walkways, provide purpose-made covers (also known as bridges or cross-overs), with clear visibility, and rated with ramping and loading capacity to the requirements of the Accessibility for Ontarians with Disabilities Act.
 - Linebacker “Guard Dog” ADA rated or equal product.
- .5 Coordinate with the Owner to communicate the nature of the cleaning to the occupants, to ensure that openings are kept closed, and to have furnishings, equipment, books and paper products, and personal materials removed from areas of potential incursion of water.
- .6 Owner to ensure that the Contractor shall have on-going access to all affected interior spaces to observe for water incursions.
- .7 Coordinate with the Consultant as to the Contractor's intention/proposal for sequencing of cleaning under this Section.

Cleaning – Water Washing:

- .1 In keeping with standards of best practice, gentle water cleaning is to be undertaken.
- .2 Application of water by sprinkler or sprinkler hose to affected areas at overhangs, arches, lintels and jambs is required where atmospheric dirt has not been washed by run-down water.
- .3 Water shall be maintained keeping the area wet (low flow only) for a period of 24-hours to 48-hours.
 - The Contractor shall make on-going assessments so that any water infiltration is immediately abated and cleaned-up and so that water soaking can be stopped as soon as effective results appear to have been achieved – subject to Consultant confirmation.
 - Make on-going interior observation for water incursion.
 - Assessment will be made by the Consultant at 24 hours and soaking can be stopped if the cleaning has been effective.
 - Assessment will be made by the Consultant at 48 hours at which time soaking will be stopped if results are satisfactory, or agreement will be reached between parties as to further soaking/washing if it appears that the results would be increasingly effective.
 - Such extended duration would be at an agreed Extra cost to the Contract.
 - The 48-hour duration is the least to be expected within the Contract price.
 - That will be extended over several additional days if start/stop with the work day is required to avoid the risk of tampering when unattended, and/or of water entry when unattended.
- .4 After prolonged washing has been deemed to be satisfactory, undertake stiff bristle brushing and light power washing with a fan tip to complete removal of dirt accumulation.
 - Test the power wash to ensure that stone, painted wood and other surfaces are not marred.
- .5 Provide final rinse of all affected areas.

Review:

- .1 The Base Bid shall include only the “Cleaning – Water Washing” procedures noted above.
- .2 If additional measures are required, same will progress through steps as agreed by the Consultant.
 - The next step would be that of non-ionic surfactant detergent wash at 100-200 psi and including brooming/brushing – e.g., using Spectrum Laboratory Products (GAF) “Igepal”, Union Carbide “Tergitol”, Rohm & Haas “Triton” or approved equal.
 - Included would be test applications and assessment.
 - High pressure washing, acid washing, sodium hydroxide based cleaning, poultice application and steam cleaning are not expected to be considered for this project.
 - The above is for information only and is not part of the Contract price.

Completion:

- .1 Upon completion wash affected windows and building surfaces, clean grade of residue of the Work.

04 03 07 Historic Repointing of stonework

Description:

- .1 This Section outlines the procedures for repointing of stonework in the restoration Work.

Related Work:

- .1 Section 04 03 05, Masonry Procedures for Historic Masonry
- .2 Section 04 03 08, Historic Mortar for Stone Masonry
- .3 Section 04 03 42, Replacement of Quarried Stone

References:

- .1 CSA A371-04 (R2014) Masonry Construction for Buildings
- .2 Other:
 - City of Kingston, Policy on Masonry Restoration in Heritage Buildings (April 2013) <https://www.cityofkingston.ca/documents/10180/20847/Policy+-+Masonry+Restoration+in+Heritage+Buildings/c2d8d166-e0b3-4a2a-8079-f359b418bc46>

Mock-up:

- .1 Refer to 04 03 42, Historic Replacement of Quarried Stone.

Environmental Conditions, Protection:

- .1 Refer to Section 04 03 05, Masonry Procedures for Historic Masonry.

PRODUCTS

Materials:

- .1 Mortar: Refer to Section 04 03 08, Historic Mortar for Stone Masonry

EXECUTION

Preparation:

- .1 Ensure that windows and doors are protected from damage and to permit ongoing safe use of doors where required under the Contract.
 - Utilize plywood to protect against bouncing of debris into areas impacting safe access to/from the building, impacting Owner equipment, vehicles, etc.
- .2 Ensure that windows are closed.
 - Coordinate with the Owner to communicate the necessity of window closure.
 - Coordinate with the Owner to communicate the necessity of not blocking open doorways.
- .3 Provide hose extensions for any window air conditioners that must remain in operation and that are located where condensate run-down could otherwise impact fresh mortar.
- .4 Cover and protect all Owner equipment against impact damage, dust intrusion impacting operation, gumming up of coils by combined dust and precipitation, etc.
- .5 Ensure that air intakes and louvres are covered.
 - Covers for non-operation fans can be by covers or plywood but same must be removed before fans are returned to operation or significant damage could result to ducts, dampers, etc.
 - Protection can also be by Owner provided and directed self-adhesive backed filter material cut to fit.
 - The Owner must supply appropriate MERV 8 or similar material to ensure that air flow characteristics will not be unduly diminished.

- .6 Make review of the project Designated Substance Report with all crew to make them aware of any problems expected, to make them aware of known products of the work – such that they will better know when unexpected products are encountered for which assessment action by the Owner will be required.

Preparation of Joints:

- .1 Cut out mortar in the joints to no less than 1½" deep and an expected average depth of 2".
- Continue cutting out until sound mortar is found.
 - Review with the Consultant for projects with excessive sandy cores before risking instability of the stonework.
 - Cut out can be by hand tools, reciprocating tools and/or chippers.
 - Chip only using tools smaller than the joint width.
 - If grinding is needed for finer joints, care is to be taken to not cut into the abutting stones at T joints.
 - Workers lacking the experience and/or failing to exercise due care shall be removed from the project.
 - Leave no loose material within the cut-back joints or at the back of same.
 - Leave no residual mortar on the joint faces.
 - Carefully removed over-pointing of mortar extending onto the face of stone units in order to fully expose the stone arris.
- .2 Use wedges and other usual means to stabilize the stonework.
- .3 Do not remove mortar to the point that wall areas become unstable without first placing new mortar and allowing same to cure before progressing.
- In the alternative, if the mortar is that loose, the Contractor can at their discretion remove loose stone fully to a larger area while still ensuring stability and safety is maintained.
- .4 Remove all sundry metal embeds found such as abandoned anchors, abandoned downpipe stand-off brackets, etc.
- .5 Blow all debris from the prepared joints of the walls.
- On no less than a daily basis, clean up the debris of the rake-out stage at grade, on window sills, etc.
 - Do not water wash the walls at this stage if there is risk of water entry to the building.
- .6 Leave prepared raked-back joints for review by the Consultant.

Placing Pointing Mortar:

General:

- .1 Mortar preparation and handling shall be as set out in Section 04 03 08, Historic Mortar for Stone Masonry

- .2 Protection shall be as set out in Section 04 03 05, Masonry Procedures for Heritage Masonry.
- .3 Pointing mortar shall be applied in multiple lifts, no less than ½” each, no more than ¾” each.
- .4 Thoroughly flush joints with water to wet the stone and bedding mortar but do not commence while free water is present.
- .5 Using suitable slickers and tools, fill joints fully, forcing the mortar tightly into the joint.
- .6 Fill the final lift flush to the arris of the stone.
 - Do not over-tool the joints.
- .7 Finish with a flush joint and lightly apply a stiff bristle brush to leave a 60-grit sandpaper-like surface finish.
 - Finish is subject to review and approval at the mock-up stage.

Cleaning:

- .1 As Work commences, remove and clean-up mortar droppings and smears.
- .2 Upon completion, and after due curing time, and ensuring that the Work is watertight, lightly pressure wash and brush the stonework to remove any remaining residue of mortar on the stone units.

04 03 08 Historic Mortar for Stone Masonry

GENERAL

Description:

- .1 This Section outlines the mortar products and mortar mixing procedures for use in placing stone units (and back-up brick/block core units where applicable) and for pointing, inclusive of mixing directions and use limitations.

Related Work:

- .1 Section 04 03 07, Historic Repointing of Stone

References:

- .1 ASTM C207-06(2011) Specification for Hydrated Lime for Masonry.
- .2 CAN/CSA-A3000-13 Portland Cement.
- .3 CAN/CSA-A3000-98 A8-98 Masonry Cement.
- .4 CSA A179-04 (R2014) Mortar and Grout for Unit Masonry.
- .5 CSA A371 Masonry Construction for Buildings

.6 Other:

- City of Kingston, Policy on Masonry Restoration in Heritage Buildings (April 2013) <https://www.cityofkingston.ca/documents/10180/20847/Policy+-+Masonry+Restoration+in+Heritage+Buildings/c2d8d166-e0b3-4a2a-8079-f359b418bc46>

Submittals:

.1 Provide written submission of mortar mixer to be used.

- Provide confirmation from the manufacturer that same mixer satisfies their requirement.

Samples:

.1 Submit, in accordance with Section 01 33 00, Submittal Procedures, technical data sheets for all products used in mortar preparation.

.2 Data sheets shall include:

- compressive strength.
- water retention; and,
- air content.

.3 For any proposed mortar products utilizing White Portland cement, the technical data sheets, not product brochures, must explicitly reference that only White Portland cement is used.

.4 Once Work commences with approved products, no substitutions will be approved.

Alternatives:

.1 If submitting product data sheets for alternatives, submit, in accordance with Section 01 33 00, Submittal Procedures.

.2 Provide clear cross-reference to strength characteristics of specified mortar compared to proposed mortar – it is not the role of the Consultant to seek out comparison data.

.3 Provide clear reference to the sieve analysis of premixed aggregate.

- If any cement and aggregate are proposed to be site mixed in lieu of factory prepared, provide the sieve analysis of the aggregate and provide also a 1 gallon sample of same noting the source quarry and the quarry's classification of their sample product.

.4 Provide a plan to deliver the proposed alternative product to the site in sufficient bulk to serve the entire project, or at least a major portion of same so that consistency can be assured.

.5 If the Consultant finds the above submittals to be satisfactory, proceed to having mortar cubes prepared and tested by a testing lab satisfactory to the Consultant.

.6 No alternative products are to be delivered to the site until the Consultant approves the test reports and is otherwise assured that quality control of the site mixing of aggregate and cements can be maintained.

- .7 If alternatives are approved, the Contractor will be responsible for the cost of preparing a written Quality Control procedure for the mixing, and shall be responsible for ensuring quality control of the mixed product.
 - This could require a retest of mortar cubes if later deliveries of bulk material appear to vary from earlier, approved products.

Delivery, Storage and Handling:

- .1 Stored materials to be maintained dry, level and supported above the ground including being protected from splash water, rain run-down, etc.
- .2 Deliver materials in sealed containers with all labels intact.
 - For any products delivered to the site for which labels do not apply (e.g., sand if applicable), provide copies of weigh bills to the Consultant upon delivery of same products.
- .3 Handle materials in safe manner in accordance with manufacturer's instructions.
- .4 Store materials at temperatures between the temperatures as set out by the manufacturer.

Existing Conditions:

- .1 Matching of the pointing mortar colour to the original colour shall be by custom colour sample preparation.

Environmental Conditions, Protection:

- .1 Refer to Section 04 03 05, Masonry Procedures for Historic Masonry.

PRODUCTS

Materials:

General:

- .1 The below listed products have been successfully used on numerous Queen's University buildings, Daubois will have on file the colour matching information necessary.
- .2 Some of the products listed can require larger volume purchases and incur longer lead time on delivery.
- .3 Pre-mixed products are called out for greatly improved quality control. If site-mixed products are to be used, pre-start samples will need to be prepared and tested (approx.. 30 days) and regular quality control testing will be needed throughout the course of the work. The Consultant should note that the testing of that type would normally be via a Cash Allowance.
- .4 Selected products below comply with the City of Kingston, Policy on Masonry Restoration of Heritage Buildings, section 4.2, Recommended Mortar.
- .5 Any proposals for alternatives must also satisfy same Policy.
- .6 Water: potable, no admixtures.

Laying/Bedding Mortar:

- .1 Bedding mortar shall be of a factory mixed Type N product of General Use (GU) hydrated lime, Type S hydrated lime, and coarse sand aggregate; factory mixed air entraining agent is also required.
- .2 Approved product for bedding mortar:
 - Daubois Bétomix Plus Type N
 - Note that this product cannot be used for pointing mortar.
 - Or approved equal.

Pointing Mortar:

- .1 Pointing mortar shall be of a factory mixed Type O product of General Use (GU) hydrated lime, Type S hydrated lime, and coarse sand aggregate; factory mixed air entraining agent and colouring agent are also required.
- .2 Approved product for pointing mortar:
 - Daubois Restomix (Type O)
 - Or approved equal.
 - Colour to be custom prepared.

EXECUTION

Mortar Preparation.

- .1 Mortar shall be prepared, mixed, and used in accordance with the manufacturer's latest published instructions.
- .2 Mortar shall be mixed and held for use in a shaded area, sheltered from direct sun and wind.
- .3 Mortar shall be mixed and held for use in a manner that is protected from rain.
- .4 Ensure all workers responsible for mortar preparation and use are familiar with these instructions.
- .5 Strictly adhere to the manufacturer's mixing conditions and times and as given herein.
 - Use only mechanical mixer satisfactory to the manufacturer, minimum $\frac{3}{4}$ full.
 - Use only approved batching boxes/volumes.

Laying/Bedding mortar:

- Add water first.
- Slowly introduce dry ingredient.
- Mix for 3-5 minutes, adding water only in controlled amounts to adjust consistency.

- Allow mixture to slake/rest for 2-5 minutes.
 - Do not omit slaking.
- Remix for 1 minute.
- For small batches, conform to alternate manufacturer's directions.

Pointing mortar:

- Add water first.
 - Combine dry ingredients while mixing for a controlled period of time (3-5 minutes).
 - Allow mixture to slake 30-45 minutes before adding additional water to within the manufacturer's specified limits (depending on humidity and temperature) and completing mixing.
 - Slaking is essential; do not omit the slaking period.
- .6 Discard mortar not used within the manufacturer's limitation periods and as modified below.
- .7 Consultant to note that temperatures and times noted below apply to the Daubois products and will certainly vary if alternatives are approved.
- Laying/Bedding Mortar: $\frac{3}{4}$ hours for temperatures above 35°C; 1½ hours for temperatures above 25°C and at/below 35°C; 2 hours for temperatures under 25°C.
 - Pointing Mortar: $\frac{3}{4}$ hours for temperatures above 35°C; 1½ hours for temperatures above 25°C and at/below 35°C; 2 hours for temperatures under 25°C.
- .8 To ensure compliance with the above, maintain a written log throughout the course of each day.
- Log shall be maintained on the "wall" of the shaded mixing area and subject to review and confirmation throughout the course of the day.
- .9 It shall be the mortar mixer operator in conjunction with the foreman that monitors the discard times for mortar and ensures that this is adhered to and logged by the masons.
- .10 Discard mortar in the Contractor's disposal bin, never in the core of the masonry Work.

04 03 09 Historic Grouting

Description:

- .1 This Section outlines the procedures for the grouting of the historic stonework.
- .2 This Section addresses low pressure grouting of stone walls to provide cohesion of inner and outer wythes across the core. This is essentially a structural repair. It is a repair methodology prone to leakage of milky grout into building interiors at window surrounds, floor levels, electrical outlets, etc. Considerable focus is needed on relocating occupant furnishings, equipment, etc.

Related Work:

- .1 Section 04 03 07, Historic Masonry Repointing of Stone
- .2 Section 04 03 42, Historic Replacement of Quarried Stone

References:

- .1 CSA A179-R2014 Mortar and Grout for Unit Masonry
- .2 CSA A371-04 (R2014) Masonry Construction for Buildings
- .3 CSA A179-04 (R2014) Mortar and Grout for Unit Masonry
- .4 Other:
 - City of Kingston, Policy on Masonry Restoration in Heritage Buildings (April 2013) <https://www.cityofkingston.ca/documents/10180/20847/Policy+-+Masonry+Restoration+in+Heritage+Buildings/c2d8d166-e0b3-4a2a-8079-f359b418bc46>

Delivery, Storage and Handling:

- .1 Store materials to be maintained dry, level and supported above the ground by at least 8" (double pallet) and including being protected from splash water, rain run-down, etc.
- .2 Store bags in a cool area, at least shaded.
- .3 Deliver materials in sealed containers with all labels intact.
- .4 Handle materials in safe manner in accordance with manufacturer's instructions.
- .5 Store materials at temperatures as set out by the manufacturer.

Environmental Conditions:

- .1 Ensure that the temperature (surface, surrounding and material) is between 5°C (40°F) and 35°C (95°F), during the application and for the following 72 hours.

PRODUCTS

Grout:

- .1 Injection or gravity placed grout based on natural hydraulic lime.
 - Approved product (for all typical areas):
 - Daubois F-20 grout for areas needing higher flow/penetration.
 - Alternative product (select locations only):
 - Daubois B-1015 grout for areas needing lower flow (controlled penetration so as to limit risk of damage).
 - Above item is for use in locations where grout entry to the building poses great risk that cannot be adequately protected and where this grout will be placed in an effort to form a barrier against the F-20 incursion.
 - Proposals for alternative products will be considered and should be submitted in accordance with 01 33 00, Submittal Procedures.

EXECUTION

Measurement:

- .1 The Consultant should calculate closely the gross wall area, net of windows and doors and then assess expected void space within the wall. This could be a low of 5% to 10% and even 15% (likely maximum) of the wall volume. Spilled grout and grout that seeps into the building is part of the grout volume. Contractors need to know the gross area of coverage as this helps them quote a price based on the number of holes that must be drilled regardless of how much grout is injected. Grouting can cost \$3,000/m³ so unit prices should be defined in advance including how any shortfall from the allowance is to be calculated/costed. Tenders should carefully set out how grout costs are calculated and how shortfalls or excesses will be costed. Keep in mind that the Contractor must do all site set-up and must drill all the specified holes regardless of how much grout flows into the wall so actual grout used is actually not the largest cost..
- .2 The volumetric allowance for grouting within the Contract Price is ___ m³.
- .3 Measurement will be by detailed logging of grout used.
 - Volume of grout delivered to the site will also be logged to better confirm volumes.

Preparation:

- .1 Consultant to note that the sequence of work setting out grouting to be done AFTER stone replacement is important. That procedure/order aids in clearing at least some of the sandy core of the walls – the difference can almost double the volume of grout that can flow into they wall. This better ensures back-filling at stone replacement locations and limits the risk of staining to finished pointing.
- .2 Grouting shall be done after stone replacement is complete, and ideally also after mortar joint rake-out is also complete (i.e., before repointing, or in the least, before the final lift of pointing mortar).
- .3 Make examination of the area of Work for high risk areas of leakage of grout.

- Examples would be major electrical panels or immovable equipment.
- Take all feasible precautions to shield same from grout dripping/flow.
- Prepare a plan to create a barrier using the lower-flow/penetration grout in areas needing maximum protection (such as near major electrical panels, sensitive areas, etc.).

Initial Mock-Up / Sampling:

- .1 No less than two mock-ups of 6'x6' shall be executed; one for each grout product.
- .2 Undertake the mock-up by drilling holes in the wall to establish the required spacing of injection tubes.
 - An estimate is 2' centres in both directions but this can be expected to vary.
- .3 The depth of drilling must be no less than 75% of the depth of the stone walls.
- .4 Do not drill into speed tile (evidenced by extracted dust).
- .5 Verify that the hole depth remains clear after drilling and is not refilling with debris.
 - Redrill and/or vacuum as needed to clear the hole to full depth.
- .6 For the mock-up of the lower flow grout, inject grout in a manner that allows assessment as to how effective it will be in forming a barrier in the wall that will prevent the higher flow grout from extending past that barrier.
- .7 Upon completion of each of the two mock-ups, cut out two stones (per mock-up) separated by no less than 2' in areas satisfactory to the Consultant
 - Make review with the Consultant as to adequacy of the grout flow.
- .8 Make review as to what hole spacing and application procedures best achieve the grout filling of the walls.

Mixing:

- .1 Mix the grout in a shaded and rain protected area.
- .2 Mix the grout with protection on grade to control spills of dust and slurry.
- .3 One party shall be designated to mix the grout and shall log the number of bags mixed and the areas of Work to which the grout is being delivered.
 - The log must be visible for review by the Consultant and kept up-to-date at all times on a bag-by-bag basis or as close to that as is reasonable depending on productivity.
 - Logs to be sent to the Consultant no less than weekly.
 - Logs shall note how many bags were used, how many bags are on site.
 - Logs shall separately record the lower flow and higher flow grout products.

- .4 Dry ingredients of no less than full bags shall be slowly added to 10 litres (2.2 gallons) of water and mixed with a bi-level Jiffler mixer attachment for a minimum of 5 minutes and until homogeneous.
 - Only full bags are to be mixed.
- .5 In filling the grout tank (“pot”) utilize a stainless-steel strainer.
- .6 As grout injection is time-consuming, periodically (maximum of 30-minute intervals) re-mix grout as required.

Application:

- .1 Coordinate with the occupants through the Owner to ensure that all furnishings and equipment are moved away from the exterior walls and that a clear path exists along the walls for observation and clean-up.
- .2 Coordinate to have access to all rooms at the time of grouting, inclusive on lower floors in case of long vertical grout flows including to adjacent areas/rooms.
- .3 Ensure that adequate observers are in place to make review of potential grout seepage at the interior.
 - Observers to:
 - ensure that they have adequate access to all interior areas;
 - be in communication with the grout applicators;
 - be ready to make immediate clean-up and protection measures; and,
 - have all required rags, water, pails, and cleaning and disposal supplies.
 - Cleaning of grout must be thorough to “original” conditions and must include removal of the haze that forms even after apparently effective initial cleaning.
- .4 Apply grout to cleaned area of Work.
- .5 Application can be by gravity flow where the top of a wall is open (such as at removed copings and window sills).
- .6 Application using a compressor/pump shall be at 10 psi (0.7 bars).
- .7 Commence from the low point, moving upward as grout appears at the next injection sites.
- .8 Plug injection sites as work proceeds and clean the wall immediately and keeping wet to prevent haze.

Clean-up:

- .1 In addition to interior clean-up, clean-up all grout and debris from grade and roofing.
- .2 Wash down stonework as merited.

04 03 42 Historic Replacement of Quarried Stone

GENERAL

Description:

- .1 This Section outlines the procedures for the replacement of quarried stone.
- .2 The Consultant is responsible for identifying the original stone and stone finishes. Specifying a durable stone unit is the role of the Consultant; this is not to be left to the Contractor/Mason. Where replacements are generally no longer available due to quarry closure, such as is often the case for Queenston limestone for example, the Consultant is to identify the target alternate product/source for bidding purposes. During the start-up period, the Consultant and Contractor/Mason can review alternatives in the usual manner and as could impact delivery time, offer a credit, etc.
- .3 In terms applicable to heritage stone replacement, Kingston limestone does not belong to a geological source but rather to a quarry source. Quarries in the Kingston area providing matching stone are the only Heritage-appropriate sources and at the time of this writing there is only one such quarry. Sources of stone farther afield, e.g., into Quebec, do NOT produce comparable appropriate products and should not be used.

Related Work:

- .1 Section 04 03 05, Masonry Procedures for Historic Masonry
- .2 Section 04 03 07, Historic Repointing of Stone
- .3 Section 04 03 08, Historic Mortar for Stone Masonry
- .4 Section 04 03 09, Historic Grouting
- .5 Section 04 03 43.1, Conservation Treatments and Repair of Stone – Fractured Stone Repair
- .6 Section 07 62 01, Copper Flashings and Trim

References:

- .1 CSA A179-R2014 Mortar and Grout for Unit Masonry
- .2 CSA A371-04 (R2014) Masonry Construction for Buildings
- .3 CSA A179-94 Mortar and Grout for Unit Masonry
- .4 Other:
 - City of Kingston, Policy on Masonry Restoration in Heritage Buildings (April 2013) <https://www.cityofkingston.ca/documents/10180/20847/Policy+-+Masonry+Restoration+in+Heritage+Buildings/c2d8d166-e0b3-4a2a-8079-f359b418bc46>

Mock-up:

- .1 The Contractor shall prepare a mock-up for review of the Consultant setting out the process of stone installation including:
 - removal of damaged stone in a manner that leaves adjacent stone and back-up stone unaffected;
 - removal of the damage stone such that the wall is not destabilized in the process;
 - removal of loose debris;
 - pre-wetting of replacement stone and of the stone surfaces in the wall opening;
 - fitting of the stone in the opening to align the arrises of the new stone with those of the surrounding stone;
 - setting of new stone in the wall in a manner that ensure that same are level and plumb in all orientations;
 - setting of the stone to ensure that the bedding mortar is complete, not having been displaced by the laborious process of placing of the heavy stone units;
 - This process is presumed to incorporate the use of wetted hardwood wedges.
 - raking back of the bedding mortar to leave no less than 2 lifts of pointing mortar to be placed subsequently.
- .2 The above noted mock-up shall also by necessity include:
 - the proper preparation/mixing and laying of mortar;
 - the setting and support of stone units;
 - the infill of the core with solid masonry units;
 - the raking-back of the bedding mortar;
 - the protection for damp curing of the fresh stonework;
 - the proper pointing in multiple lifts of the pointing mortar;
 - the final finishing of the pointing; and,
 - the proper protection for damp curing of the pointing mortar.
- .3 It is intended that this mock-up be incorporated into the finished Work.

Submittals:

- .1 Per 01 33 00, Submittals, provide dimension sketches of replacement dressed stones in advance of ordering.
 - This covers lintels, wash courses, sills, plinths, copings and similar dressed stone.

.2 Samples:

- The Contractor and quarry shall provide samples of rock faced stone units showing characteristic cutting and pitching of the stone face.
- Provide samples of dressed stone surfaces showing bush hammered faces, toothed-chisel work, margins to quoins, flame finishes, honed finishes, etc., as needed to match the original stones.
- Where specified stone product cannot be sourced, provide samples to closely match original complete with full identification of the quarry and product identification.

PRODUCTS

Stone:

- .1 Kingston Limestone from the "Rideauview Contracts" Inverary quarries unless written authorization is given in advance for an alternate source.
- Fully dressed ashlar units with machine cut faces, and edges, matching the size of the original stones.
 - Allow for nominally wider stones (as seen at the face) to prevent restored walls from having any unduly wide mortar joints where the stonework has spread.
 - Finish(es) to exposed faces to match original.
 - Bush hammer finish to carry to edge of unit (hand finished if needed).
 - Margins to match original is size and by tooth chisel finish as applicable.
 - Rock-face units shall have squared corners and have "pitch" to match original stone units on this building (note that Queen's buildings do not all have a common pitch).
 - Pitch cut shall vary as it does on the original building – estimated 1" to 3" on average and a small number being outside this range.
 - Existing units are expected to be found to average in depth between 8" and 12" with a normal minimum of 6" and normal maximum of 14".
- .2 Allow for increased length and depth of stones at buttresses.

Mortar:

- .1 Refer to Section 04 03 08, Historic Mortar for Stone Masonry

Concrete/Brick Unit Masonry:

- .1 In cases such as chimneys, the core is likely to be of brick. Rebuilding is usually best with concrete (brick or block) units for added durability – except in cases where rare strict heritage concerns demand a closer match to original conditions.

- .2 Concrete block and concrete brick units of sizes to suit back-up masonry dimensions, steps in the stone coursing, etc.

Reinforcing:

- .1 Reinforcing often applies only to such areas of reconstruction as chimneys. Items shown are merely representative samples and subject to the Consultant's engineering review.
- .2 For unit masonry such as at chimneys: Blok-Lok BL-30 Truss Reinforcement, stainless steel, satisfying ASTM 79-AISI, Type 302 and 304, or approved equal alternate product.
- .3 For dowels to copings: Stainless steel threaded rod, 3/4" diameter, estimated length of 16".
- .4 Stainless steel helical stitching ties, sized to suit.
 - Approved Product: Strongtie Heli-Tie, or approved equal.
- .5 For reinforcing of stone rebuilt with solid back-up: Blok-Lok BL-407 in min. 16 gauge stainless steel wire, with embed depth to 50% of stone wythe, or approved equal alternate product.

Membrane Flashing:

- .1 While few historic stone buildings have through-wall flashings, same should be used under all copings (at parapets and stairs), and under chimney caps.
- .2 Same flashing should also be used if stone lintels are backed-up by, or even supported by, steel lintels.
- .3 Ensure only non-staining flashing products are approved.
- .4 Through wall flashing membrane of 1.0 mm SBS rubberized asphalt.
 - Bakor "Blueskin TWF", or approved equal.

Sealants:

- .1 As set out in 07 92 10.

Finishes, Dressing:

- .1 Dress exposed surfaces of stone to match original stone finish.
- .2 Bush-hammer exposed stone surfaces to the texture of the original.
 - Examine original stone finish as to number of tips/spacing of same on the tool head.
 - Where the original hand-executed finish was done with arcs in the execution, make best effort to replicate same.
 - Where pneumatic tools are used, the quarry must provide sufficient samples to confirm a match to the original finish.
- .3 Tooth chisel edges of treads and/or margins to match original.

- .4 Toothed and hammered finished to be brought to the stone unit edges as suited to match the original.
 - Chipping is inevitable but is not to exceed that of original stone units.
- .5 For planar, non-textured, stone finishes, provide [honed][flamed] finish to best match.
- .6 For rock face units, ensure that pitch cut at the face is executed to the range of the original units.
- .7 Neatly cut and pitched faces will not suit walls of split stone faces. Hand-cut faces will rarely match well the appearance of split faces.
- .8 For more coarsely cut original stone units, such as with “split” stone faces, replicate same appearance in the replacement units.

EXECUTION

Preparation – Site Review

- .1 Upon commencing Work, the Consultant and Contractor will make direct examination of all stones flagged for replacement.
 - Provide elevated work platform such as scaffold, scissor lift, genie lift, etc.
- .2 Stones will be closely examined for potential repair alternatives to that of replacement.
- .3 All stones to be replaced will be charted by the Contractor with dimensions and finishes noted.
 - Height of replacement stones to generally match the normal course height modules on this building.
 - In cases of poor prior coursing/laying of units, alter unit height/width to suit site conditions to achieve a final joint dimension of approximately $\frac{3}{4}$ ”.
 - Length of stones to be resized if needed to allow the adjacent stones to be trimmed where edges are damaged, and/or where stones have shifted, to create a final joint width of approximately $\frac{5}{8}$ ” to $\frac{3}{4}$ ”.

Protection:

- .1 Per Section 04 03 05, Masonry Procedures for Historic Masonry.
- .2 Maintain protection throughout the course of the Work.

Stone Unit Quantities:

- .1 Allow to replace all stone units called out on the Drawings, on Marked-up Photographs and otherwise as noted herein.
 - Contractor must examine adjacent stones to those called out for replacement.

- .2 If a contractor elects to smash stone out of the wall in a manner uncaring as to damage to adjacent units, then the cost of the project will rise unduly. The following clause motivates a Contractor to exercise due care. In many cases, hidden cracks will cause a stone to split but generally there will be some weathering at the split interface to support the Contractor in counting the adjacent stone as one from the “allowance” – see below. The Consultant and Contractor need to work closely to account for such unit replacements fairly.
 - If adjacent stones are initially sound but become broken in the process of cutting out the target units, then replacement of the adjacent stone units is at the Contractor's cost.
- .3 Where a supplemental allowance is included, replacement work is based on the number of units – allowing that some will be larger, some will be smaller but access/labour per unit is largely unaffected. Adjust the dimensions and numbers shown to suit the project at hand. Allowance shall include all those not visible from grade due to obstructions, due to viewing distance and angles, etc. The depth for replacement stone should be enough to extend into the core of the wall and not be a shallow veneer-like unit.
- .4 Allowance for additional stone units:
 - The allowance noted below is for stone units NOT shown on the Drawings, in Marked-up Photographs or otherwise specifically referenced herein.
 - The noted allowance is for rock faced units and not for dressed units such as copings, lintels, plinths, wash stones, etc.
 - 500 units of average size:
 - Width 14”
 - Height 10”
 - Depth 10”
- .5 Allowance for Cracked Stone “Plugs”:
 - Up to 50 cracked stone plugs of 4”x6” face size or smaller will be replaced where directed by the Consultant within the Contract price and can be cut from salvaged stone where feasible.

Stonework – Placing Laying/Bedding Mortar:

- .1 Note that laying and pointing mortars are not the same on this project.
- .2 Stone units to be mortared must be clean and have been soaked in water, but allowed to surface dry and be absent of free water.
 - Kingston limestone is minimally absorptive, so wetting cannot be left to the “last minute” before laying.
 - Keep stone units shaded pending installation.
- .3 Dry fit stone unit to line and level along the arrises of the stone units.
 - Re-cut as needed to ensure proper fit.
- .4 Back-Grouting:

- Ideally, stone replacement precedes wall grouting. In that way, loose sandy core material is removed enhancing the voids into which grout can flow. However, if grouting is not part of the project, back-grouting must take place as work progresses.
 - Do not back-grout at openings for stone replacement if primary wall grouting is to follow on this project.
 - Prefill back bedding and voids before setting bedding mortar.
 - Force mortar behind surrounding stone units.
 - Back bedding to be fresh mortar only, not discards.
- .5 The all-too-common industry practice of disposing of past-temper mortar in the wall core is not acceptable.
- .6 Place laying/bedding mortar for 1 stone at a time only.
 - This is a specified limitation of the Daubois product.
- .7 Secure stone units in place with wetted wood wedges.
- .8 Ensure that mortar bedding is packed solid after shifting stone units into place.
- .9 Rake back face joints minimum 1½" to leave ready for at least 2 lifts of pointing.
- .10 For all Work, regardless of temperature and wind conditions, protect stonework from sun and wind to control the curing by using damp jute/burlap per Section 04 03 05, Masonry Procedures for Heritage Masonry.

Lintels, Plinths, String Courses, etc.:

- .1 In advance of removing lintels/plinths/string courses for replacement with new units (or removal and repair), rake out mortar to allow installation of a bearing steel lintel to serve to carry the stone above without cracking or movement.
- .2 Installed new lintel must be fully mortared at bottom bearing bed joints, and at top bed joint to carry stone above.
- .3 The stonework above the lintel is likely to be compromised in the lintel replacement and grouting will restore needed stability. This can be deleted below if full wall grouting is part of the work.
- .4 Complete installation by grouting wall area above the lintel in accordance with Section 04 03 09, Historic Grouting.

Stair Treads:

- .1 New treads should be sized to provide reduced mortar bed depth and joint width in order to minimize movements resulting from mortar deterioration arising in turn from extreme use of de-icing salt. A bedding joint and had joint of ½" is likely a suitable target but requires close review of site conditions.
- .2 Make note of Drawing details and/or specifications calling for tight joints and shallow bedding of stair treads.

- .3 Do not reinstate treads without first repairing (often rebuilding) the concrete structure below. Also ensure that the concrete (new or repaired) is waterproofed. Provide a waterproofing Section. If concrete repairs are required, waterproofing that can go on fresh concrete is likely needed to maintain progress. Products like Tremco TREMproof 250GC are often suitable. Modified bitumen is rarely suitable due to the need to wait for substantial cure of new concrete.
- .4 Integrate installation of treads with waterproofing (refer to Section _____) to concrete substrates.

Chimneys:

- .1 Demolition of existing chimneys is to be undertaken as set out in Section 04 05 05, Selective Demolition.
- .2 Brick/Block Core:
 - Raise new core of concrete unit (brick or block) masonry only as high as the next course of facing stone.
 - If the Consultant has specified hollow block that is to have vertical bars and grouted cores, specify that here.
 - Place rebar and grout cores of block if set out by the Consultant.
 - Core must be solid, absent the use of broken units, voids or large areas of mortar fill.
 - Ensure masonry is pre-wetted to avoid drawing moisture unduly from the bedding mortar.
 - In raising the masonry core, allow for 20% of new face stones to have an increased 8" of depth to tie the stone into the core.
 - Through-Wall membrane flashing:
 - Place through wall membrane flashing at the base of the chimney nominally above the roof flashing.
 - Keep membrane back 1½" at the face of the stonework so that pointing mortar can be placed in the specified 2 lifts.
 - In-bed reinforcing is as specified by the Consultant's engineer.
 - Place reinforcing in bed joints of the core at maximum 16" o.c. vertical.
 - Lap reinforcing at corners.
 - Set reinforcing in the bedding mortar, do not set on dry masonry. Place additional mortar over top.
 - Collar Joint:
 - Place collar joint mortar with each course to best ensure that it is fully filled.
- .3 Use only fresh mortar, not past-temper mortar.
- .4 Before setting caps to the chimneys, place through-wall membrane over entire masonry leaving both membrane and mortar back 1½" from exposed faces.

Parapet Copings:

- .5 The copings to parapets are to be removed to enable repairs.
- .6 Consultant to note here is original metal is to be reused or replaced.
 - Allow to remove also overlying metal flashings.
 - Great care is needed in the removal of copings with integral projected rock-faced “teeth” set into the main wall to prevent sliding.
 - Repair broken units in accordance with Section 04 03 43.1, Conservation Treatments and Repair of Stone - Fractured Stone Repair.
 - Care is needed to remove copings fixed with dowels.
- .7 To the extent noted on the Drawings, the inner faces of the parapet walls are to be dismantled and rebuilt.
 - Where step flashings, soaker flashings and/or flashing skirts are in place on the back of the parapet, allow to remove and reinstate same.
 - Maintain watertightness of the roof/wall.
- .8 Grouting at Parapets:
 - Fully grout the open top of the parapets.
 - Work shall be in general accordance with materials and procedures set out in Section 04 03 09, Historic Grouting, but using gravity flow.
- .9 Once stone repairs and grouting are completed, place a membrane sub-sill flashing.
 - Keep membrane back 1½” at the inner and outer faces of the copings so that pointing mortar can be placed in multiple (2) lifts.
- .10 Place stainless steel dowels, 2 per coping unit:
 - Review with the Consultant the intended procedure for setting dowels.
 - Dowels can either first be epoxy set into the underside of the copings (generally as noted in Section 04 03 43.1, Conservation Treatments and Repair of Stone – Fractured Stone Repair); or,
 - Dowels can be set into the restored solid core of the wall and left projecting – in which case the holes in the underside of the coping stones shall be filled with Cathedral Products “MasonRE Adhesive” or approved equal – refer to Section 04 03 43.2 for product information).
- .11 The mortar bedding to the copings must be fully filled and not include any voids or incomplete/shallow fill.
 - Rake back bedding mortar in the normal manner to leave ready for minimum of 2 lifts of pointing mortar.
- .12 Fully protect the copings and cheek walls (both sides) in the manner prescribed for the Work.

- Ensure damp curing is rigorous to minimize rapid moisture loss given the 2-sides and top exposures for moisture loss.

.13 Reinstate all flashings to the back of the parapets.

.14 Reinstate all flashings to the top of the copings.

Stair Copings:

.1 The copings are to be removed to enable repairs.

.2 To the extent noted on the Drawings, the inner faces of the cheek walls are to be dismantled and rebuilt.

.3 Grouting:

- Fully grout the cheek walls including by holes made near grade and extending upward to the copings.
- Grouting by gravity flow through the open top of the wall is suitable but must also include injection through the outer sides of the cheek walls to ensure full depth of penetration.

.4 The tops of the stone cheek walls shall be finished nominally sloped to the sides to further limit risk of water entry at dowels.

.5 Once stone repairs and grouting are completed, place a membrane sub-sill flashing.

- Keep membrane back 1½” at the inner and outer faces of the copings so that pointing mortar can be placed in multiple (2) lifts, and to .

.6 Place stainless steel dowels, 2 per coping unit:

- Review with the Consultant the intended procedure for setting dowels.
 - Dowels can either first be epoxy set into the underside of the copings (generally as noted in Section 04 03 43.1, Conservation Treatments and Repair of Stone – Fractured Stone Repair); or,
 - Dowels can be set into the restored solid core of the wall and left projecting – in which case the holes in the underside of the coping stones shall be filled with Cathedral Products “MasonRE Adhesive” or approved equal – refer to Section 04 03 43.2 for product information).

.7 The mortar bedding to the copings must be fully filled and not include any voids or incomplete/shallow fill.

- Rake back bedding mortar in the normal manner to leave ready for minimum of 2 lifts of pointing mortar.

.8 Fully protect the copings and cheek walls (both sides) in the manner prescribed for the Work.

- Ensure damp curing is rigorous to minimize rapid moisture loss given the 2-sides and top exposures for moisture loss.

Buttresses:

- .1 Buttresses on most heritage stone buildings at Queen's University are aesthetic only. They are generally NOT tied well into the walls and generally not coursed into the coursing of the walls. As the taller heavier main walls lose lime from the mortar, the main walls settle (creep) more than do the shorter height buttresses. This leads to displacements and cracking. These conditions ultimately need to be corrected.
- .2 Dismantle and rebuild buttresses as noted on the Drawings.
- .3 Execute Work in accordance with all necessary safety provisions.
- .4 Dismantle stonework from the roof copings downward.
- .5 Allow to provide dowels for copings, wash courses and large stone corbels.
 - Allow to remove and reinstall metal coping flashings.
 - Allow to replace step flashings on the backs of copings.
- .6 As noted on the Drawings, and in general, in rebuilding the buttresses, allow to extend pairs of stones of the buttresses into the main wall and/or pairs of stones on the main wall into the buttresses.
- .7 Do not fill the core of the buttress with mortar without using also clean stone fill.
 - Do not use salvaged stone without first cleaning of old mortar.
- .8 Despite all efforts to be made to fill the cores as the buttresses are rebuilt, these areas are nonetheless to be grouted as part of Section 04 03 09.

Sheet Metal (Copper) Flashings:

- .1 Upon completion of stone repairs, undertake sheet metal (copper) flashing repairs and upgrades noted on the Drawings and as specified – refer to Section 07 62 01, Copper Flashings and Trim.

Completion:

- .1 Pointing Work shall be as set out in Section 04 03 07, Historic Masonry Repointing of Stone.
- .2 Sealants shall be applied to all skyward facing joints (such as exposed copings, between plinth course stones, etc., in accordance with Section 07 92 10.

04 03 43.1 Conservation Treatment & Repair of Stone - Fractured Stone Repairs

GENERAL

Description:

- .1 This Section addresses stone repairs that involve crack repair by first removing the stone and then effecting repair by epoxy and pins. An alternative is presented to in situ repair.
- .2 This Section addresses:
 - Fractured stone repairs – dowel/pin and epoxy repair of cracked stone units after removal of the stone.
 - Fractured stone repairs – dowel and epoxy repair of cracked stone units by angle drilling of in situ stones.
 - The above noted repair types are expected within the Base Contract.
 - Also addressed is an alternative approach for crack injection repairs of in situ stones.
 - This repair type is not expected within the Base Contract.
- .3 Where the cost for repair is less than, or even close to, the cost of a new stone (supplied and installed), it is deemed appropriate to repair an existing stone for reinstallation and thereby preserve the heritage material.

Related Requirements:

- .1 04 03 07, Historic Masonry Repointing and Resetting of Stone
- .2 04 03 08, Historic Mortar for Stone Masonry
- .3 04 03 42, Historic Replacement of Quarried Stone
- .4 04 03 43.2 , Conservation Treatments and Repair of Stone – Refacing Stone (Dutchman Repair)
- .5 04 03 43.3, Conservation Treatments and Repair of Stone – Refacing Stone (Fill Repair)

Existing Conditions:

- .1 All damaged stones scheduled for replacement and/or repair shall first be examined and reviewed with the Consultant so that repairs are not commenced on stones that ultimately are deemed to require replacement, or vice versa.

Mock-up:

- .1 Conduct a sample stone repair in accordance with the measures set out herein.
- .2 Include all epoxy clean-up and epoxy and stone dust treatment at crack face, and stone plug fill of drill holes to demonstrate end result.

Environmental Conditions:

- .1 Adhere to manufacturer specification as to temperatures for the application of epoxy, and for the “pot life” times and setting times.
- .2 Condition Part A and Part B materials at between 18°C (64°F) to 29°C (84°F).

PRODUCTS

Materials:

- .1 Epoxy paste adhesive for the interfaces in the fractured stone-to-stone repairs:
 - Sikadur 31 Hi-Mod Gel, or approved equal.
- .2 Epoxy anchoring for threaded rods used in the stone-to-stone repairs:
 - Sika AnchorFix-3001, or approved equal.
- .3 Dowels:
 - Stainless steel (304 or 316) threaded rods, 1/4" diameter.
- .4 Masking tape:
 - 2" duct tape or similar, verified to adhere to cleaned stone and not contribute to staining.
- .5 If the Consultant is aware of and expert with an alternative to Cathedral Stone Products then same can be approved as an alternate. The Consultant must verify to be equal or better in terms of supply/delivery/warranty and equally suited to job site conditions, environmental conditions, worker training and quality control.
- .6 Note that the listed product below is for in situ repair, so stone removal is not required., However, drilling is required and the product is priced at roughly \$1000 per pail so it is not clear when this becomes cost-effective over epoxy repair of a removed stone.
- .7 Note that this Section is not meant for applications expected to be suitable for dispersed hydrated lime injection.
- .8 Cathedral Products Jahn M30 #31 for injection repair to hard stone.
- .9 Consultant to confirm Division 1 reference below.
 - For proposals for alternate products, submittal of detailed literature, test reports, and comparative installation guides must be in accordance with 01 33 00, Submittal Procedures, but amended here to be submitted to the Consultant no less than 30 days in advance of start-up of Work of this Section.

EXECUTION

Fractured Stone Repairs – Epoxy and Pins:

- .1 This sub-section applies to epoxy and pin repairs for both in situ stone repairs (by angled drilling and setting of rods in epoxy) and for repairs to removed units (by epoxy interface adhesion, and drilling and setting of rods in epoxy).
- .2 Where tape is used for masking, do not leave exposed in the sun, or apply sooner than necessary, or leave on the surface any longer than necessary.
- .3 Epoxy Application – Interfaces of removed stone:

- Verify the proper fit of the stone units and clamp/secure same together rigidly, and to workbench.
- Mark locations for 4 holes, preferred $\frac{3}{8}$ " diameter, in an end of the stone that will not be exposed (as applicable).
 - This will leave $\frac{1}{16}$ " gap all around plus the thread depth for epoxy.
- Drill through the stone extending a minimum of 3" past the final fracture plane.
 - Collect the stone dust for use in the surface treatment of the repair.
- Cut threaded rods to extend full length of the holes unless one end is at an exposed end – in which case cut short 1".
- Dry fit a threaded rod or wood dowel to assist in preventing shifting of the stone and proceed to finish drilling all holes in the same manner.
- Because of the heritage preservation goals, repair measures set out below exceed some accepted industry measures.
 - Before separating the stone segments, wrap each join line with 2" masking tape, and mark the tape to designate the mating faces.
- The masking tape will aid in protecting the faces from epoxy squeeze-out, simplifying clean-up.
 - Slice the masking tape at the join lines and separate the stone segments.
- Use a steel brush to loosen drill dust in the holes.
 - Use compressed air and a lance to clean the holes fully.
- Wet-wipe (water only) the interfaces of all dust contact.
- Allow the stone interfaces to dry of visible moisture.
- Epoxy Preparation - Interfaces:
 - Mixing of epoxy paste (for interface adhesion):
 - Condition materials to maximum 18°C (64°F) to 29°C (84°F).
 - Mix A and B products in equal volumes.
 - Mix for 3 minutes using a paddle and low speed.
 - Epoxy should be uniform, absent swirls in colour.
- Adhere to pot-life limitations of 30 minutes (summertime) or less as could apply based on air temperature.
- Epoxy bond relies on full wetting of the clean, prepared surface.
 - Apply epoxy paste adhesive with flexible plastic applicator, suited to follow the irregular contours of the interfaces, working the epoxy onto the surface fully.
 - Do not apply epoxy exceeding $\frac{1}{16}$ " (1.5 mm) per face.

- Mate stone segments and clamp in order to ensure that excess epoxy is forced out.
- Check alignment of faces.
 - Place (dry) threaded rods or plastic tubing to keep drilled holes free of epoxy.
 - When all segments are bonded at the interfaces, removed excess epoxy, then peel off masking tape and clean residual epoxy from the face.
 - Apply stone dust from drilling directly into the fresh epoxy at the interface lines.
- Epoxy Application – Threaded Rods
 - Note that this step basically applies to both in situ repairs, and removed stone repairs albeit the drilling varies from angled at the face to through-the-end of stone units.
 - Preparation: Ensure that holes remain clear for dowels/pins/rods.
 - As needed, ream the hole of any epoxy from the interface adhesion process.
 - Use a wire brush and air lance to remove duct from the hole.
 - Mask the surface of the stone if it will be exposed so that outpouring resin during the filling operation does not spill over the stone face.
 - The working time of the mixed epoxy is likely to be limited to less than 10 minutes in the summer, even to 4 minutes if temperatures reach 35°C (95°F).
 - Utilize a suitable static mixer nozzle and a dispensing gun with a mechanical advantage of at least 26:1 or use a pneumatic dispenser.
 - Cut to length an extension nozzle/tube.
 - Commence trial dispensing, intentionally wasting the initial stream to ensure that full mixing is occurring.
 - With a uniform mixture occurring (absent streaking), attach the extension nozzle.
 - Insert the extension tip to the base of the hole and begin filling, slowly withdrawing the extension tube.
 - Cease dispensing when the resin reaches to within 1” of the face of the stone.
 - Insert the threaded rods to full depth, both plunging lightly inward and outward while “threading” it in to ensure full wetting and filling.
 - This must be achieved within the very limited “working time”.
 - Clean-up excess epoxy.

- Fill the end of the hole (approximately ¼" deep) with an epoxy stone dust mixture
- Let the assembly sit for the specified load time – likely to be on the order of 4 to 6 hours in the summertime.
 - When an anchor load is not intended to be applied, review with the Consultant as to the time merited before the stone is hoisted and or lifted into place.
- Stone plugs:
 - If any stone units require dowels/pins larger than ⅜" (in ½" holes), utilize stone plugs for the final fill.
- Clean affected adjacent surfaces with water and rubber sponger in multiple stages to avoid a halo-like staining effect on adjacent masonry (as applicable).

Fractured Stone Repairs – In Situ Crack Injection:

- .4 It is up to the Contractor to consider the cost-effectiveness of this approach to crack repairs except where the Drawings or the Specifications directly identify this repair method for identified locations.
- .5 This sub-section applies to in situ stone repairs by crack injection with Jahn M30 #31.
- .6 Wash the surface and interior of the crack using clean water to remove all dust, loose or deleterious material, which could prevent proper flow and/or adhesion.
 - Mixing:
 - The mixing ratio is approximately 1 part powder to 1 part water by volume.
 - Mixing must be done with a high speed drill (3,000 RPM or higher) equipped with a Jiffler-type mixing paddle.
 - After mixing, the grout should be poured into another clean container using a sieve.
 - Additional or repeated agitation is necessary if the grout is allowed to sit prior to use.
 - Injection Procedures:
 - Immediately before injection, moisten interior of the crack by flushing with water.
 - If the crack is allowed to dry out before the grout is injected, this step must be repeated. This is very important.
 - Transverse Cracks:
 - Drill a series of injection ports in the center of the crack.
 - These ports should be drilled in a downward direction.
 - Seal the crack with removable, non-staining clay, sealant, or caulk.

- Inject grout into the lowest port and continue until it flows freely from this port and other ports at the same level.
- Seal ports using non-staining clay, sealant, or caulk and proceed in identical fashion until the crack is filled.
- Clean up overflow and runs immediately with clean water.
- Lateral Cracks:
 - Drill a series of injection ports in a square configuration (90° angles) on the face of the substrate to create a “drill frame”.
 - Ports should be drilled in a downward direction.
 - Wash the surface and interior of the crack using clean water to remove dust and loose debris.
 - Any dust or debris remaining between the layers will impede the flow of the grout.
 - If this is the case, more holes will be required to attempt to fill all hollow areas.
 - Inject grout into lower left port and proceed until it flows freely from this port and other ports at the same level.
 - Seal ports using non-staining clay, sealant, or caulk. Inject grout into lower right port and proceed in identical fashion.
 - The order of injection is lower left, lower right, upper left, and then upper right.
 - Clean up overflow and runs immediately with clean water.
- Removal of Sealant
 - Let the grout dry (approximately 24 hours) and remove all sealant, caulk, or clay.
 - After removing the sealant, repair the crack surface and injection holes with Jahn Mortar that matches the color and type of existing masonry.
- Clean Up
 - While injecting, continually check for grout runs and spills on the surface of the masonry, and clean the surface before the grout has time to set.
 - This is normally done with a clean sponge and water, and may have to be repeated several times, rinsing the sponge with clean water.
 - Remove uncured grout from tools and equipment with water as soon as possible.
 - Cured grout may only be removed chemically or mechanically

Clean-up:

- .1 Protect roof, walls, windows and building interior, as well as plants, grass and adjacent grounds from excessive water.
- .2 Clean stonework surfaces after repairs have been completed and mortar has set.
- .3 Clean stone surfaces of grout or mortar residue resulting from work performed without damage to stone or joints.
- .4 Clear site of debris, surplus material and equipment, leaving work area in clean and safe condition.

04 03 43.2 Conservation Treatments and Repair of Stone - Refacing Stone (Dutchman Repair)

GENERAL

Description:

- .1 This Section addresses stone repairs that involve cutting out only a portion at the face of an in situ stone and then applying a new "face" to that stone. This is a very costly repair methodology and thus there are limited applications for which this repair methodology is cost-effective. This would include cases where the stone in question is very costly or hard to obtain in large size, or the stone in question cannot easily be removed for stability/strength reasons. In most respects, this is a cosmetic and not structural repair.
- .2 This Section addresses:
 - Refacing of partly deteriorated stone with a shallow stone slab – i.e., Dutchman repairs are generally for refacing slabs of from 2" to 4" thickness.
 - This Section applies to repairs for in situ stone repairs.
 - This Section applies to repairs when the surrounding stones in the wall adjacent to the damaged stone are not expected to induce new stresses that would cause the replaced/refaced stone to again be damaged.
- .3 The Base Contract scope of Work does not involve this type of repair.
- .4 Where the cost for repair is less than, or even close to, the cost of a new stone (supplied and installed), it is deemed appropriate to repair an existing stone for reinstallation and thereby preserve the heritage material.

Related Requirements:

- .1 04 03 07, Historic Masonry Repointing and Resetting of Stone
- .2 04 03 08, Historic Mortar for Stone Masonry
- .3 04 03 42, Historic Replacement of Quarried Stone
- .4 04 03 43.1 , Conservation Treatments and Repair of Stone – Fractured Stone Repair
- .5 04 03 43.3, Conservation Treatments and Repair of Stone – Refacing Stone (Fill Repair)

Existing Conditions

- .1 All damaged stones scheduled for replacement and/or repair shall first be examined and reviewed with the Consultant so that repairs are not commenced on stones that ultimately are deemed to require replacement, or vice versa.

Mock-up:

- .1 Only if this repair type is found to be required will a mock-up be required.
- .2 Conduct a sample stone repair in accordance with the measures set out herein.
 - Allow to do same in situ for a stone face on the order of 16" wide, 10" high and to a depth of 2".

Environmental Conditions:

- .3 If an alternative product supplier is selected, revise to suit that supplier's specifications.
- .4 Adhere to manufacturer specification as to temperatures for the application of the MasonRE Adhesive – being from 4.4°C (40°F) to 32.2°C (90°F).

PRODUCTS

Materials:

- .5 Epoxy anchoring for threaded rods:
 - Sika AnchorFix-3001, or approved equal.
- .6 Dowels:
 - Stainless steel (304 or 316) threaded rods, ¼" diameter.
- .7 Masonry Adhesive:
 - If the Consultant is aware of and expert with an alternative to Cathedral Stone Products then same can be approved as an alternate. The Consultant must verify to be equal or better in terms of supply/delivery/warranty and equally suited to job site conditions, environmental conditions, worker training and quality control.
 - Cathedral Stone Products, "MasonRE Adhesive", or approved equal.
 - The above noted product also bears the name "Natural Adhesive".
 - For proposals for alternate products, submittal of detailed literature, test reports, and comparative installation guides must be in accordance with 01 33 00, Submittal Procedures, but amended here to be submitted to the Consultant no less than 30 days in advance of start-up of Work of this Section.

EXECUTION

Fractured Stone Repairs – Dutchman Repair:

.1 Stone Preparation:

- Remove the stone face that is damaged/spalled.
- Where same stone face is to be reused (such as in the case of a 2" thick or deeper spall/split in the plane of the face of the stone), cut back irregularities on the back of the facing piece.
 - Shallower spalls and/or spalls to damaged to reuse shall be replaced by new slabs as noted below.
- Where a new slab is to be utilized:
 - Prepare a new stone face to match the stone type, character and finish of the original.
 - Cut to a slab thickness of no less than 2" and no more than 4".
 - In most cases, where refacing slabs more than 4" are required, stone replacement should be utilized but shall be subject to review with the Consultant on a stone-by-stone basis.
- Prepare the remaining back portion of the stone still in the wall by chipping back until the repaired/replaced face slab fits into the opening and deeper than the surrounding arrises.
- For stone with face dimensions 12" by 12" or smaller than 1 sq.ft., mark locations for 2 holes.
- For stone with face dimensions larger than 1 sq.ft., mark locations for 4 holes.
 - This can be reviewed with the Consultant.
- Drill a pilot hole to determine the expected depth of stone in the back of the wall opening.
- Drill $\frac{3}{8}$ " holes in the back stone to not penetrate fully through the stone but to no less than 1" deep.
 - Holes should be as orthogonal to the wall as can reasonably be achieved.
- Dry-fit $\frac{1}{4}$ " threaded stainless steel pins.
 - Cut them to length so that they are set to the back of the prepared holes and project outward to no closer than 1" to the arrises of the stonework.
- Use a steel brush to loosen drill dust in the holes.
 - Use compressed air and a lance to clean the holes fully.
- Wet-wipe (water only) the interfaces of all dust contact.

- Allow the stone interfaces to dry of visible moisture.
- .2 Epoxy Placement (for pins):
- The working time of the mixed epoxy is likely to be limited to less than 10 minutes in the summer, even to 4 minutes if temperatures reach 35°C.
 - Utilize a suitable static mixer nozzle and a dispensing gun with a mechanical advantage of at least 26:1 or use a pneumatic dispenser.
 - Cut to length an extension nozzle/tube if the hole is deeper than the dispensing nozzle itself.
 - Commence trial dispensing, intentionally wasting the initial stream to ensure that full mixing is occurring.
 - With a uniform mixture occurring (absent streaking), attach the extension nozzle.
 - Insert the extension tip to the base of the hole and begin filling, slowly withdrawing the extension tube.
 - Cease dispensing when the resin reaches to within 1" of the face of the stone.
 - Insert the threaded rods to full depth, both plunging lightly inward and outward while "threading" it in to ensure full wetting and filling.
 - This must be achieved within the very limited "working time".
- .3 Fit of Refaced stone/slab:
- Measure and mark holes in the back of the stone slab.
 - Drill ½" diameter holes to a depth of no less than 1" and as much as to within 1" of the outer face of the slab.
 - Set the stainless steel pins in the back stone and dry fit the stone slab in place.
 - Adjust holes as required until the arrises of the stone slab fit nominally ¼" to ½" deeper than the arrises of the surrounding stones.
- .4 Epoxy injection (backing stone):
- Inject the epoxy anchoring adhesive filling the ⅜" drilled holes fully.
 - Insert the threaded rods to full depth.
- .5 Test-fit wood blocking across the stone opening spanning from side to side, or from top to bottom, secured into mortar joints.
- This will be used to hold the refacing stone slab in place.
 - This can be predrilled and rotated like a clock hand to be out of the way but ready for use.
- .6 MasonRE Adhesive:
- Clean the opening in the wall of all debris especially loose mortar which can prevent proper fit of the refacing stone slab.

- Clean the face of the back stone and the back of the refacing stone slab.
 - Mix the MasonRE Adhesive in accordance with Cathedral Stone Products specifications – for which volume of water shall be at or less than the volume of powder.
 - Mixing must be complete and a nominal slaking time is warranted.
 - A paste is required.
 - Moisten the stone at the back of the wall opening, and the back of the refacing stone slab, including the ½” diameter holes in the back of the slab.
 - Do not leave pooled water, but ensure that surfaces are well dampened and glistening.
 - Apply MasonRE Adhesive by tooling a thin layer onto the stone at the back of the opening, including over the projecting pins.
 - Apply MasonRE Adhesive onto the back of the refacing stone slab, including into the ½” diameter holes.
 - The volume of adhesive placed in this fashion will vary by the gap existing between the refacing stone slab and the stone at the back of the wall.
 - The adhesive fill must be nominally more than required to fill that gap.
 - Set the refacing stone slab in place and tap it into place with a wood or rubber mallet, until the stone arrises are aligned around the refacing stone slab.
 - Secure the prepared wood blocking over the stone face and set wetted wood shims as needed to hold the repaired slab in place until cured – at least 24 hours.
 - Protect from the sun and wind during the cure period.
- .7 Clean-up wet MasonRE Adhesive that has come to the surface and rake back at least 1” from the arrises of the refacing stone slab.
- .8 Clean-up all adhesive from the face of the surrounding stones without disturbing the refacing stone slab.

Completion:

- .1 After curing, carefully remove the shims and securing blocking.
- .2 All required mortar jointing shall be completed by back pointing and finish pointing in maximum ½” lifts and in accordance with 04 03 07, Historic Masonry Repointing and Resetting of Stone (and Concrete Masonry).

04 03 43.3 Conservation Treatments and Repair of Stone - Refacing Stone (Fill Repair)

GENERAL

Description:

- .1 This Section addresses aesthetic/cosmetic “fill repair” and applies to Jahn mortar repairs. Too often this product is treated as if it can be “trowelled over” damaged stone – as if it were Bondo being applied over a dent. Instead, shallow damaged and deteriorated areas must first be cut deeper, and squared off. “Feathering” with the product is not permitted. Additionally, while the product can be custom colour matched, stone is rarely of a uniform hue/shade across a surface, let alone from stone to stone. Further complicating colour matching is that small changes in water content of the mixed product could impart noticeable changes in colour. Finally, normal oxidation of a stone will vary over time and make “hiding of squared off repairs” unlikely. Use this repair approach with caution and only where it is better used than leaving the stone in its surface-deteriorated condition.
- .2 This Section addresses:
 - Refacing of partly deteriorated stone with fill – i.e., Jahn mortar repairs of salvaged stone units.
- .3 The Base Contract scope of Work does involve this type of repair.
- .4 Where the cost for repair is less than, or even close to, the cost of a new stone (supplied and installed), it is deemed appropriate to repair an existing stone for reinstallation and thereby preserve the heritage material.

Related Requirements:

- .1 04 03 07, Historic Masonry Repointing and Resetting of Stone
- .2 04 03 08, Historic Mortar for Stone Masonry
- .3 04 03 42, Historic Replacement of Quarried Stone
- .4 04 03 43.1, Conservation Treatments and Repair of Stone – Fractured Stone Repair
- .5 04 03 43.2, Conservation Treatments and Repair of Stone – Refacing Stone (Dutchman Repair)

Qualifications:

- .1 Only persons with established skills in restoration using these products will be permitted to undertake repairs under this Section.
 - Persons proposed to undertake these repairs must have previously proven their skill-set to the satisfaction of the Consultant, and shall provide the Owner with a listing of qualified projects; or,

- Cathedral Products generally does not sell to contractors that have not attended training, but that could have been many years earlier and with staff that are no longer at that firm. Hence, it is a pre-qualification of the worker, not the Contractor, that should be sought.
- If an alternative product supplier is selected, revise to suit that supplier's training and pre-qualifications.
- Persons proposed to undertake these repairs must show proof of attendance at the Jahn Certification Masonry Restoration Workshops in Hanover, Maryland.

Existing Conditions

- .1 All damaged stones scheduled for replacement and/or repair shall first be examined and reviewed with the Consultant so that repairs are not commenced on stones that ultimately are deemed to require replacement, or vice versa.

Mock-up:

- .1 Conduct two sample stone repairs in accordance with the measures set out herein.
- .2 One mock-up shall include provision of the bush-hammer and/or other finish needed to match the original/adjacent finishes.

Environmental Conditions:

- .1 Consultant should note that the supplier specification noted below can make using this product impractical in terms of normal summer conditions without removing stone from the wall and making repairs in a shop-like setting.
- .2 If an alternative product supplier is selected, revise to suit.
- .3 Cathedral Stone Product, Inc. specifies an upper limit for temperature of 90°F (32°C), and that conditions be absent of high relative humidity.

PRODUCTS

Materials:

- .4 Epoxy anchoring for threaded rods:
 - Sika AnchorFix-3001, or approved equal.
- .5 Dowels:
 - Stainless steel (304 or 316) threaded rods, ¼" diameter.
- .6 Masking tape:
 - 2" tape, verified to adhere to cleaned stone while not leaving residue or contributing to staining.

- .7 If the Consultant is aware of and expert with an alternative to Cathedral Stone Products then same can be approved as an alternate. The Consultant must verify to be equal or better in terms of supply/delivery/warranty and equally suited to job site conditions, environmental conditions, worker training and quality control.
- .8 Fill Repair Mortar:
- For proposals for alternate products to those listed below, submittal of detailed literature, test reports, and comparative installation guides must be in accordance with 01 33 00, Submittal Procedures, but amended here to be submitted to the Consultant no less than 30 days in advance of start-up of Work of this Section.
 - Cathedral Stone Products, Jahn M70
 - The General Contractor must be certified by Cathedral Stone Products, Inc.
- .9 Consultant should have an option price defined at tender for a CREDIT if a standard colour can be used in lieu of a custom colour,
- A custom colour is to be ordered after review by the Consultant and Contractor as to representative stone samples.
 - Allow for one custom colour.
 - If more are required, additional custom colours would be at an extra cost to the Contract.
 - Allow for the lead time needed.
 - Corotech V160 Surface Tolerant Epoxy Mastic
 - The above product is unlikely to be required but is noted in case iron embeds are encountered.
 - An extra cost to the Contract would apply if this product is found to be required and as approved by the Consultant.
 - Proposal for alternate products acceptable to the supplier of the fill repair mortar will be considered by the Consultant.

EXECUTION

Preparation:

- .1 Do not conduct M70 repairs to surfaces and in air temperatures exceeding 32°C (90°F) and/or at high relative humidity.
- To that end, summertime repairs might need to be undertaken on stones removed from the building and placed in a controlled environment such as a shop.
 - The Contractor shall anticipate work conditions at the time of bidding based on the Owners stated schedule requirements and shall make allowance for any need to remove stone in lieu of making in situ repairs.

- .2 Remove all loose material at the interfaces to be repaired.
- .3 Cut the area of repair, including at the edges of same, to a minimum of ½".
 - Do not feather the fill repair mortar.
- .4 Do not place mesh or lath.
 - Shallow angled saw cuts are permitted to aid in mechanical keying.
 - If larger, deeper fills (>2") are to be executed, review with Consultant as to placing threaded stainless steel pins.
 - Same pins must be kept back from the face of the M70 fill by at least 1½" and would only be intended to occur at the depth of the "peanut butter coat".
- .5 Water wash and rigorously brush the surface to be repaired.
 - If embedded iron/steel is found that cannot be removed, remove loose material at the exposed face within the area of repair and apply Corotech V160 Surface Tolerant Epoxy Mastic (or approved equal) in accordance with the manufacturer's specifications.
 - The above additional product is essential if this condition is encountered but would be an extra cost to the Contract.

Mixing:

- .1 The fill repair mortar (M70) is mixed at 5 to 5½ parts powder to 1 part water depending on temperature and humidity.
 - Add powder to the water slowly, mixing until at least 5 parts powder have been added, more in the event of higher temperatures, and the proper consistency of "damp sand" has been achieved.
 - Note that changes in water content will alter the final colour; maintain a consistent practice for colour consistency.

Application:

- .1 Mask the area around the repair.
- .2 Wet down the surfaces within the repair area, including shallow cut edges, fully.
 - After doing so, remove any free "puddled" water in the repair area, but leaving the surface "glistening" with moisture.
 - If delay is encountered in placing the mixed fill repair mortar (M70), repeat the above essential wetting procedure.
- .3 Apply the "peanut butter coat" to a thickness of ⅛", ensuring that the repair surface is still glistening with moisture.
 - The peanut butter coat varies from the fill coat and shall be of M70 mixed with water to a putty-like consistency.
- .4 The fill coat of M70 (the "wet sand" consistency ≈5:1 mix) shall be applied while the peanut butter coat is still wet.

- Fill above the masked perimeter of the repair area.
- Typical of all mortar tooling, wait for the M70 to reach an initial set that allows effective scraping of the over-fill using a screeding tool.
- Do not float or over-screed the fill.
- For matching bush-hammer finish, execute a simulated finish immediately upon screeding.
- Within 30-60 minutes for typical summer conditions, mist the repair with clean water.
- Remove masking and clean-up the perimeter of the area of repair on the stone.
 - Utilize clean water and a rubber sponge, in multiple stages to prevent an enduring halo-like staining effect.

.5 Curing:

- Maintain the repair in a shaded area, protected from direct sun and wind.
- Maintain the M70 repair by frequent misting, several times daily, for a period no less than 72 hours.
 - Note that this stage could require weekend work if the repair is not done early in the work week.
 - Covering with polyethylene will not be used in lieu of misting to maintain a controlled damp cure.

Clean-up:

- .1 Protect roof, walls, windows and building interior, as well as plants, grass and adjacent grounds from excessive water.
- .2 Clean stonework surfaces after repairs have been completed and mortar has set.
- .3 Clean stone surfaces of grout or mortar residue resulting from work performed without damage to stone or joints.
- .4 Clear site of debris, surplus material and equipment, leaving work area in clean and safe condition.

04 05 05 Selective Demolition of Masonry

GENERAL

Description:

- .1 This Section:

- outlines the procedures for the selective demolition of buttresses, stair cheek walls, chimneys and general removal and reconstruction;
 - outlines the basic goals for salvage, repairs and rebuilding;
 - makes note of the need for ensuring that the building remains watertight;
 - makes note of coordination with the roofing and flashing trades;
 - makes note of the need for lighting at all walk-through scaffold; and,
- .2 Edit engineering required to suite the project.
- sets out a requirement for the Contractor to provide a stamped engineering proposal for the safe staged demolition and reconstruction of buttresses and chimneys.

Related Work:

- .1 Section 04 03 04, Historic Replacement of Quarried Stone

References:

- .1 CSA A371 Masonry Construction for Buildings
- .2 Other:
- City of Kingston, Policy on Masonry Restoration in Heritage Buildings (April 2013) <https://www.cityofkingston.ca/documents/10180/20847/Policy+-+Masonry+Restoration+in+Heritage+Buildings/c2d8d166-e0b3-4a2a-8079-f359b418bc46>

Existing Conditions:

- .3 Make examination for confirmation of stone units noted for replacement, and/or repair as set out in Section 04 03 42, Historic Replacement of Quarried Stone.
- Allow to make a survey with the Consultant in advance of demolition.
 - The goal is to reuse existing historic stone to the extent reasonable.
 - Identify to the Consultant units that appear to merit an alternative approach for restoration.

Environmental Conditions, Protection:

- .1 Execute Work in a manner that controls the spread of masonry/mortar dust.

EXECUTION

Preparation:

- .1 Ensure that windows and doors are protected from damage and to permit ongoing safe use of doors where required under the Contract.
- .2 Utilize plywood to protect against bouncing of debris into areas impacting safe access to/from the building, impacting Owner equipment, vehicles, etc.
- .3 Ensure that windows are closed.
- .4 Coordinate with the Owner to communicate the necessity of window closure.
- .5 Coordinate with the Owner to communicate the necessity of not blocking open doorways.
- .6 Cover and protect all Owner equipment against impact damage, dust intrusion impacting operation, gumming up of coils by combined dust and precipitation, etc.
- .7 Ensure that air intakes and louvres are covered.
- .8 Covers for non-operation fans can be by covers or plywood but same must be removed before fans are returned to operation or significant damage could result to ducts, dampers, etc.
- .9 Protection can also be by Owner provided and directed self-adhesive backed filter material cut to fit.
- .10 The Owner must supply appropriate MERV 8 or similar material to ensure that air flow characteristics will not be unduly diminished.
- .11 Make review of the project Designated Substance Report with all crew to make them aware of any problems expected, to make them aware of known products of the work – such that they will better know when unexpected products are encountered for which assessment action by the Owner will be required.
- .12 Set-up scaffold around the chimneys and buttresses.
- .13 Protect roofing from damage using tarps, planks and plywood.
- .14 Walk-through scaffold must be provided with temporary lighting for night-time security.
 - Include secure electrical connection.
 - Provide side protection to prevent entry of demolition debris to the area of the walk-through scaffold.
 - If water is to be used in the Work on the walls above walk-through scaffold, provide tarps to direct water away.
- .15 Engineering (by/through Contractor):
 - Safety of all affected parties during demolition is of paramount concern/importance.
 - Prepare the safety plan for erection, use and dismantling of scaffold and elevated platforms.

Demolition - General:

- .1 Ensure that all safety measures are in place, wind secure, and free of projections that could cause harm/injury.
- .2 Neatly demolish wall areas noted on the Drawings, in marked-up photographs and as noted in the specifications in a process of dismantling unit by unit.
 - Number the stone units being removed in a manner that will not permanently mar the exposed stone surfaces.
 - Number the units in a manner that will endure a winter season in the event of carry-over to a following year.

- .3 Take all due care and required effort to preserve damaged stone units that can be salvaged for repair.
- .4 Make note of the Drawings and site conditions where existing coursing will be varied by changing 2 or more smaller stones to 1 larger stone, etc.
- .5 Make note of existing dimensions and prepare to reinstate the stonework to original dimensions.

Stairs:

- .1 Review with the Consultant stones of cheek walls, piers, treads, copings shown for replacement and/or repair and define the course of repairs most suitable after making detailed examination.
- .2 The inner (stair-facing) cheek walls are to be demolished and rebuilt due to the inevitable ravages of de-icing salts on the stones and mortar, and due to the copings no longer being at their original positions.
- .3 All removed treads at stairs are to be reviewed as to opportunity to reinstate same with reduced bedding joints.
- .4 It is common to find that age, weather and especially the use of de-icing salts have deteriorated the support of stair treads to a point of major repair and replacement being required. Do not reinstate treads without first repairing (often rebuilding) the concrete structure below. Also ensure that the concrete (new or repaired) is waterproofed. Provide a waterproofing Section. If concrete repairs are required, waterproofing that can go on fresh concrete is likely needed to maintain progress. Products like Tremco TREMproof 250GC are often suitable. Modified bitumen is rarely suitable due to the need to wait for substantial cure of new concrete.
- .5 A concrete repair specification Section is almost certain to be required for stair reconstruction if the treads are of stone.
- .6 Option Prices can be secured in advance by setting out potential chipping and repairing of concrete, and of complete replacement with reinforced concrete. Certainly, the waterproofing price should be defined in advance.
- .7 Make review of the substrate supporting the treads.
 - This can be stringers that support spanning treads over large voids, or stepped concrete slabs on piers, or stepped concrete slabs on grade.
 - Coordinate to review exposed structure to the stairs with the Consultant.

Buttresses:

- .8 Subject to a satisfactory proposal from the Contractor's engineer, the stonework is to be removed in a manner that assures the continued stability of the walls and the safety of all parties.
 - No Work is to be conducted outside of the parameters of the Contractor's engineering proposal – which proposal will be subject to review by the Consultant.

Chimneys:

- .1 Consultant to note if metal flashing elements are to be preserved for reinstallation, or discarded and later replaced.

- .2 Carefully remove metal cap and base flashings.
- .3 Demolition shall include the exterior stonework and all cores of stone/clay tile/clay brick or concrete masonry units.
- .4 During demolition, extreme mortar deterioration is expected to be found and care must be taken to undertake the work in a manner that ensures the continued stability of the stonework and the safety of all parties. .
- .5 Coordinate with the Owner as to plans for future use of flues in the chimneys.
- .6 Where the chimney bases rise above flat roofs, demolition is to carry on to within approximately 8" to 16" of the roof.
 - Same flashings shall only be removed when temporary waterproofing measures are in place.
- .7 Do not stack demolished brick and stone on roofs or scaffold; removed stone and masonry to be conveyed to grade immediately upon removal, unit-by-unit.
- .8 Protect the roof from accumulation of debris of the demolition.
- .9 Upon completion of the demolition stage, ensure that the chimney stubs and sides are watertight in a wind-secure manner.

Completion:

- .1 Upon completion of the demolition stage, leave the area of Work clean of debris.
- .2 In the event of delay in obtaining replacement stone units, ensure that the waterproofing protection is maintained watertight and wind-tight.

04 40 00 Indiana Limestone

GENERAL

Description:

- .1 Work under this Section of the Contract shall include all labor and material necessary to furnish and satisfactorily install Cut Indiana Oolitic Limestone in accordance with the Drawings and as specified herein.
- .2 Include all setting, anchoring, through-wall flashing, venting and drainage.

References:

- .3 Indiana Limestone Institute Of America, Inc. – "Indiana Limestone Handbook"
- .4 ASTM International:
 - ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - ASTM C144 – Standard Specification for Aggregate for Masonry Mortar.
 - ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - ASTM C568 – Standard Specification for Limestone Dimension Stone.

- ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - ASTM C97/C97 - Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone; 2015
 - ASTM C170/C170M - Standard Test Method for Compressive Strength of Dimension Stone; 2016
 - ASTM C99/C99M - Standard Test Method for Modulus of Rupture of Dimension Stone; 2015
- .5 Canadian Standards Association (CSA):
- CSA A23.1, Construction Materials and Methods of Concrete Construction.
 - CSA A179-04, Mortar and Grout for Unit Masonry.
 - CSA-A371-04, Masonry Construction for Buildings.
 - CSA-A370-04, Connectors for Masonry.
 - CSA-S304.1-04, Masonry Design for Buildings.

Qualifications:

- .1 The Contractor (firm) of this Section must have at least 10 years' experience in stone construction of similar types and project sizes.
- .2 The full-time working foremen and lead-hand(s) engaged in the Work shall have verified minimum 10-year experience as masons.
 - Provide verification of same in advance of commencing Work.
- .3 The Consultant reserves the right to approve the material supplier for cut stone before this portion of the work is awarded.
- .4 Stone and workmanship quality shall be no less than in accordance with Industry Standards and Practices as set forth by the Indiana Limestone Institute of America, Inc., Bedford, Indiana.
 - The stone supplier shall be a member in good standing of that organization.

Warranty:

- .1 To a broad extent, the limestone suppliers offer little by way of warranty while promoting the lasting appeal of their product yet holding out that it is a natural product and thus offering little in the way of assurances. The Consultant must assess the aspects of the stone products and stone installation that are key to this project. Anticipate considerable review to be required as to terms of coverage.
- .2 Provide a 5-year system warranty for all labour and material on the installed cut limestone panels against: cracking; spalling; breakage; warpage/bowing; contour scaling; dislodgment (of panels and/or anchorage assembly and components); deterioration/damage/corrosion to anchors/ties/supports; development of efflorescence, oil or rust stains due to inherent stone conditions and/or due to installation and/or due to improper mortar selection/mixing/installation; frost damage (except as a secondary result caused by an exclusion noted below); sealant induced staining; staining and/or

discolouration at fissures; mortar failure; sealant failure; protective coatings applied as part of the warranted stone system; and/or flashing failure.

- Exclusions: Damage caused by: acid rain; abuse (including impact; vandalism; run-down/spray/application of chemicals by the Owner); improper application of water by irrigation systems; water damage and/or staining due to roof/building leaks (excluding leaks of the warranted stone system); lightning strike; algae/lichen/fungus/moss/bacteria/pollen; ivy; tree branches/leaves; bird droppings.
- .3 Include all Permit, engineering, General Conditions (including but not limited to access, site safety and protection, environmental set-up and controls, equipment, cleaning), and coordination with the Owner for undertaking and completing comprehensive repairs and corrective measures.

Existing Conditions:

- .4 Report in writing, to Consultant areas of deteriorated existing masonry revealed during pre-start review.
- .5 Report in writing, to Consultant areas of deteriorated or damaged substrates.
- .6 Collect pre-construction photographic record of direct locations for the site set-up and work areas and conditions.
- Provide 2 copies of same photographic documentation to the Owner and Consultant.
 - Provision to be on USB stick or approved alternative.

Delivery, Storage and Handling

- .7 Deliver materials to job site in dry condition.
- Keep materials dry until use.
- .8 Maintain stone on non-staining skids.
- .9 Panels to be stored on edge.
- Panels to be gapped/spaced top prevent staining unless other written instructions are provided by the supplier.
- .10 Store under water-shedding breathable non-staining covers on pallets or platforms held above the ground.
- Polyethylene is not preferred due to the risk of excessive wetting of the stone from condensation.
 - If same is used, leave a vented space above the stone for air flow and monitor to ensure that excess wetting is not occurring.
 - Protect from water run-down, water/mud splashing.
 - Covers to be wind-tight.
 - Do not stack pallets.
- .11 Keep masonry materials free from ice and frost.
- .12 Do not concentrate storage of materials on any part of structure beyond design load.

- Do not load roof areas.
 - Do not load scaffold unless same allowance is shown on the approved scaffold shop drawings.
- .13 Deliver mortar materials in original unbroken and undamaged packages with the manufacturer's labels in place.
- .14 For products not bearing labels, provide Consultant with copies of weigh bills at on the day of arrival on site.
- .15 Remove unacceptable materials from site.

Environmental Conditions:

.1 General:

- Execute Work only as set out under CSA A371 and as augmented herein.
- Execute Work only for air temperatures between 5°C (41°F) and 35°C (95°F) for the 24 hours leading up to the time of Work, and for a period of no less than 72 hours after the placement of mortar.
 - Noted temperatures apply to both the substrate and air temperatures.
 - For conditions outside these limitations, extraordinary measures will be necessary.
- When temperature is 10°C (50°F) or less:
 - Store cements and sands for immediate use within heated enclosure.
 - Allow these materials to reach minimum temperature of 10°C (50°F) – i.e., in equilibrium with air temperature in enclosure.
 - Heat water to minimum of 20°C (68°F) and maximum of 30°C (86°F).
 - At time of use, the temperature of the mortar is to be a minimum of 15°C (59°F) and a maximum of 30°C (86°F).
 - Do not mix cement with water or with aggregate or with water-aggregate mixtures having higher temperature than 30°C (86°F).

Protection:

.1 Hot Weather Work:

- General:
 - Prepare and slake mortar during both mixing and while awaiting use in a continuously shaded location.
 - Set stone units promptly after placing mortar.
- During periods of Work, and for 72 hours following Work, when the air temperatures are at or above 38°C (100°F), or when the air temperatures are at or above 32°C (90°F) accompanied by winds greater than 13 km/hr, the spread of mortar shall not exceed 0.6m (2') and stones shall be set within 1 minute of placing the mortar.

- This is a stricter limitation than for brick and block due to the extra time that setting of stone units requires.
- .2 Cold Weather Work:
- Execute Work when ambient temperature is above 5°C (41°F) and has been for at least 24 hours before placing masonry, and is expected to be for at least 48 hours after completion of placing masonry.
 - When ambient temperature is below 5°C (41°F) exercise care to adhere to accepted industry practices and as set out under CSA A371 for Cold Weather procedures including heating the sand and/or the water to a minimum of 20°C (68°F), maximum of 70°C (158°F).
 - Prepare and maintain temperature of mortar between 5°C (41°F) and 50°C (122°F) until used.
 - Temperature of masonry units at time of mortar placement will be reviewed with the Consultant and aid in directing mortar temperature maximum.

Design:

- .1 The design Engineer should be an active member in marble and limestone industry associations.
- .2 The Designer must be an Engineer licenced in Ontario and having no less than 10 years' experience in stone and anchor design for similar projects.
- .3 Design anchors, ties, reinforcing and supports.
- .4 Design anchors to resist positive and negative wind pressures and other loads, and as required under the O.B.C.
- .5 Design to utilize stainless steel components and fixings.
- .6 Design to accommodate insulation thickness.
- .7 Design to provide protection against water entry, water run-down staining.
- .8 Design to including venting and weather sealing.
- .9 Provide mortar mix design suited to loading conditions, to stone colour(s), and to be non-staining.
- .10 The Consultant must show the locations on the Drawings. Keep spacing close enough that seasonal thermal cycling does not induce cracking and/or open joints.
- .11 Design layout of control joints and expansion joints.
 - Expansion joints to extend fully through the stone masonry and through the supporting members.
 - Include expansion joint fillers and sealants.

Submittals:

Samples:

- .1 Consultant to specify number of samples, such as duplicates, or number of each finish, each colour, each grade, etc.
 - The supplier or fabricator shall submit three (3) samples, for approval by the Consultant.

- The samples shall in general be typical of the grade, color and finish specified.
 - This sample and the standards established by the Indiana Limestone Institute shall form the basis of the Contract agreement.
 - Cavity wall vents:
 - Provide samples of proposed head joint vent/weep.
 - Provide one sample of each colour in the manufacturer's standard range.
 - Mortar Colour:
 - Review with Consultant indented colour range.
 - Prepare mortar samples on plywood and with the mortar set in joints between actual project stone samples (colour being key) to show joint size, tooling, profile, mortar colour.
 - Size of stone samples should be 2" thick, 8" long, 1" thick and spaced by the desired joint width.
 - Prepare noted samples for each colour of stone in use.
 - Prepare additional samples if colour is not approved.
- .2 Scaffold shop drawings:
- Submit scaffold shop drawings stamped by a professional engineer licenced in Ontario.
 - Include all tie-back to structure.
 - Include all areas ladders, toe kicks, hatches and railings.
 - Include all walk-through protection at entries/exits.
 - Scaffold shop drawings shall clearly set out loading limitations by deck, by bay, and gross or otherwise so as to ensure that the Contractor of this Section knows all relevant limitations.
- .3 Design:
- Submit design calculations for the Owner and Consultant records.
- .4 MSDS:
- Submit MSDS sheets for all products of the Work, neatly copied, current versions, in 3-ring binders.
 - Organize by specification Section.
 - Provide one (1) copy to the Owner and maintain another copy on site.

Mock-Up

- .1 Only after colour samples of mortar and sealant have been approved and all aspects of the stone grade, colour and finish have been resolved, prepare a sample mock-up in an area intended to be incorporated into the finished Work.

- Not all of the mock-up is likely suited to being incorporated.
- .2 Mock-up to be approximately 30 sq.ft. or as agreed upon by the Owner, Consultant and Contractor of this Section.
- .3 Mock-up to show condition of bearing, typical stonework, window sill and window jamb, slopes/washes to all projections, junctions at corners/mitres – or as agreed between the named parties.
- .4 Include:
 - metal flashings;
 - membrane flashings;
 - vents/weeps;
 - cavity mesh;
 - ties including fastening;
 - reinforcing;
 - insulation clips and insulation;
 - air seal and vapour barrier tie-in from wall to window surround;
 - representative jointing and finishing;
 - expansion joint;
 - control joint; and,
 - sealant to show colour match and joint profile.

PRODUCTS

Stone:

- .1 It is solely the role of the Consultant to select and specify the stone.
- .2 All limestone specified or shown on the Drawings shall be Indiana Oolitic Limestone, as quarried in Lawrence, Monroe, and Owen Counties, Indiana.
 - Other stone suppliers will be considered for approval as equal.
 - Stone for the project to come from a single quarry unless otherwise specified.
- .3 Where more than one grade is required, note locations of each using designations found on the Drawings.
- .4 Stone shall be of [select][standard][rustic][variegated] grade.
- .5 Where more than one colour is required, note locations of each using designations found on the Drawings.
- .6 Stone shall be of [buff][gray] colour.
- .7 Where more than one finish is required, note locations of each using designations found on the Drawings.
- .8 Stone finish shall be [honed][flamed][smooth][sandblasted][split faced][machine tooled][rock faced][tumbled][other – specify].

Mortar:

- .1 Mortar selection and mix is to be designed by the Engineer of this Section.
- .2 Mortar must be non-staining.

Flashing:

- .1 The Consultant needs to exercise care in selecting the flashing as bituminous products can contribute to staining if not selected for stability and if not effectively detailed and installed. Other products such as laminated copper, copper fabric and copper foil can be difficult to obtain, may lack adequate gauge, can be easily damaged, and can impart copper oxide staining.
- .2 Through wall flashing membrane of 1.0 mm SBS rubberized asphalt.
 - Bakor “Blueskin TWF” or approved equal.
- .3 Where Code requires the flashing to project beyond the face of the joint, specify a rigid metal flashing product to augment the membrane flashing. Specify weight/gauge. Specify lap sealant and or adhesive.
- .4 [Stainless steel][copper][lead-coated-copper]

Cavity Wall Vents/Weeps:

- .1 Cellular vents of UV stable polypropylene, $\frac{3}{8}$ ” wide, minimum 3 $\frac{1}{2}$ ” high and fitting the depth of the head joints.
 - Approved Product: Mortar Net Solutions “CellVent”, or approved equal.
- .2 Colour as selected by the Consultant.

Cavity Wall Mortar Nets:

- .1 90% open weave polyester mesh, 30” height, thickness to match cavity
 - Combine multiple thicknesses if required (e.g. 1” and 0.4” for a 1 $\frac{1}{2}$ ” cavity).
 - Approved Product: Mortar Net Solutions “WallNet”, or approved equal.

Ties, Reinforcing:

- .1 Per design by this Section – refer to 0 above.
- .2 Use only stainless steel ties, reinforcing and fasteners.
- .3 Consultant to ensure that clips and insulation are coordinated and specified in applicable Sections.
- .4 Insulation clips compatible with ties per design by this Section.

Fabrication of Stone:

- .1 Cutting and Setting Shop Drawings

- The cut stone supplier shall prepare and submit to the Consultant for approval, complete cutting and setting drawings for all of the cut Indiana Limestone work.
 - The mason/general contractor shall furnish all field dimensions necessary for fabrication.
 - Such drawings shall show in detail the sizes, sections, and dimensions of stone, the arrangement of joints and bonding, anchoring and other necessary details.
 - Ensure that the shop drawings show expansion and control joint positions, alignments and detailing.
 - All jointing as shown by the Consultant on the contract drawings shall be followed, unless modifications are agreed upon in writing, or indicated upon the approved shop drawings.
 - Variations proposed by the supplier must be clearly noted as variations or such will not be deemed to have been approved.
 - Record will be recorded of any variations with note as to cost variation under the Contract.
 - If the contract drawings do not show the intent of the jointing, it will be the fabricator's responsibility to establish the jointing in accordance with industry standards and practices.
 - Include samples, mock-ups or shop drawings in advance of executing Work.
 - The cutting and setting drawings shall be based upon and follow the Drawings and details prepared by the Consultant except where it is agreed in writing or shown on the approved shop drawings that changes be made
 - Each stone indicated on the setting drawings shall bear the corresponding number marked on an unexposed surface.
 - Provision for the anchoring, dowelling, and cramping of work, in keeping with standard practices, and for the support of stone by shelf angles and loose steel, etc., when required, shall be clearly indicated on the cutting and setting drawings.
- .2 To the extent possible, fabricate stones at corners and other visible junctions of uniform grade and colour.
- Shop drawings to make clear if corners are abutted/jointed stone sections, or pre-cut monolithic corner sections.
- .3 Fabricate stone with a blend of the naturally occurring variations in colour distributed broadly and no concentrated in any one area.

Carved Stone Fabrication:

- .1 All carving shall be done by skilled carvers in strict accordance with the spirit and intent of the approved shaded drawings, or from models furnished or approved by the architect.

- .2 The carver(s) shall be named and prequalified at the time of tender and shall be used in the work unless due to circumstances beyond the control of the parties to the Contract.
 - Alternative carvers must be named and proposed with their qualifications for consideration by the Consultant.
- .3 Coordinate with the Consultant to review stone block samples at the fabricator's shop in advance of commencing carvings.

EXECUTION

- .1 The following is abbreviated due to the requirements being highly variable depending on actual intended products and procedures.

Safety:

- .1 Ensure that all safety and access equipment is in place and that all safety equipment and procedures satisfy the Ministry of Labour.
- .2 Identify the Site Safety Officer to all parties to the Contract.
- .3 Coordinate for pre-start safety meeting, and regular staff/crew safety confirmation reviews.
- .4 Verify that all crew assigned to the project have all requisite training for the nature of the Work they will be doing, or could reasonably be asked to undertake.
 - Maintain proof of individual crew training on site and available for review.

Examination:

- .1 Make examination of all building and site conditions as could be impacted by the Work.
 - Record "before" conditions by photographs and provide same on a USB chip to the Consultant.
 - This is to be done before mobilizing on site.
- .2 Make examination of built-in items by other Sections and verify locations to be correct.
- .3 Where built-in items by other Sections must precede masonry Work of this Section, verify that same are in place or will be in place in a timely manner.
- .4 Confirm dimensions of existing conditions.
 - Confirm floor elevations, window sill and lintel elevations, etc., all as pertain to stone coursing and dimensions, etc.
- .5 Confirm plumbness of back-up wall.
 - Make review with the engineer of this Section of ties and reinforcing need to be revised.
- .6 Verify that all work of other Sections for back-up wall, vapour barrier, insulation, air barrier, etc., are in place as applicable.

Preparation:

- .1 Coordinate pre-start meeting with affected trades/Sections, Owner, and Consultant.

- Conduct meeting as set out per Section 01 31 19, Project Meetings.
- Review and coordinate schedule; update tender schedule where merited based on recent weather conditions, deliveries.
- Coordinate schedule of affected parties for regular site meetings.
- Coordinate for review of mock-ups.
- Coordinate for milestone inspections.
- Identify to affected parties all findings of the initial site examination per above.

Stone Setting (with mortar):

- .1 Mortar for setting is to be a 1:1:6 Type N or similar mix as specified by the design engineer of this Section – per 0 above.
- .2 Erect stone in accordance with erection or setting drawings.
- .3 Clean stone in advance of installation if there is accumulated dust or other debris on the stones; rinse.
- .4 Set stone with a consistent joint width.
- .5 Set stone with a minimum clear 1” cavity or otherwise as shown on the Drawings.
- .6 Do not cut holes for lifting/handling (such as by Lewis pins) without written directions from the design engineer of this Section – per 0 above.
- .7 Cutting and drilling needed for installation anchors shall be done during fabrication, or shall appear on the approved shops drawings as noted to be field made.
- .8 Obtain Consultant approval prior to cutting or fitting items not indicated on the Drawings and/or where appearance or strength of stonework may be impaired.
- .9 Neatly cut and fit around projections and penetrations using square or round openings to neatly fit equipment and other projections.
- .10 Install anchors and place setting buttons to support stone and to establish joint dimensions.
- .11 Ensure that Work remains watertight and protected during the course of the Work.
- .12 Flashings:
 - Execute flashings to the details presented on the Drawings.
 - Keep membrane flashings back 1” from the face of the stonework.
 - Where a projected flashing is required by Code, utilize a metal flashing to be lapped by the membrane.
 - Seal all junctions and laps by pressure rolling; turn-up at all end terminations.
- .13 All stone at joint faces should be pre-wetted with clean potable water in advance, and not merely “moments” before being installed.
 - Stone must be free of excess free water.
- .14 Use “buttons” or other supports for the stone during placing to line, level and plumb.
- .15 Except for expansion and control joints, joints to be sealed and weep/vent locations, fully fill all joints.
- .16 Keep back of stone clear of mortar droppings.

- Remove same as Work progresses – do let same accumulate on the Mortar Net.
- .17 As Work progresses, remove mortar droppings from the building surfaces and clean-up at grade.
- .18 Keep joints to be sealed open and clean.
- .19 Keep laying mortar back minimum $\frac{3}{4}$ " to allow for placing pointing mortar.
- Pointing mortar to be executed in a single stage following curing of the laying/setting mortar.
 - Keep laying mortar out of head joints receiving weep/vent inserts.

Erection Tolerances:

- .1 Consultant to confirm Division 1 Section reference.
- Refer to Section 01 40 00 - Quality Requirements: Tolerances.
 - Positioning of Elements: Maximum $\frac{1}{4}$ " from Indicated Position.
 - Maximum Variation from Plumb: $\frac{1}{4}$ " per story non-cumulative
 - Maximum Variation from Level Coursing: $\frac{1}{8}$ " in 3 feet; $\frac{1}{4}$ " maximum.
- .2 Coordinate to fill in stone and panels after removal of scaffold bracing in a manner that is secure and sound and leaving no trace of the bracing.
- Colour of installed stone units to match surrounding units.
- .3 Stone Pointing:
- Pointing mortar shall be 1:1:6 mix of white Portland, hydrated lime and white sand passing a #176 sieve.
 - Verify colour as part of sample submittals and mock-up.
- .4 After damp curing and adequate setting of laying and pointing mortar, remove all remaining mortar droppings and lightly power wash the walls.
- Ensure windows, openings, penetrations are all sheltered against water entry.
 - Unless another Section is responsible for window washing, clean all windows impacted by the stone installation Work.
 - Do not acid wash.
 - Do not leave mortar on glass surface – at risk of permanent damage due to etching.
- .5 Perform sealant work in accordance with requirements of Section 07 90 00.

Masonry Curing Procedures:

- .1 Protect all new masonry from rain, wind, and sun for a period of no less than 72 hours.
- .2 Covers must be wind secure.
- .3 Damp Curing of Bedding/Laying Mortar:
- Maintain dampness under jute/burlap covers for no less than 24 hours.

.4 Damp Curing of Pointing Mortar:

- For temperatures of less than 30°C (86°F) at the time of pointing mortar placement and for 48 hours following, maintain damp curing conditions utilizing wetted jute/burlap or equal.
 - Maintain dampness in jute/burlap through the curing period including weekends.
 - Ensure that burlap is wind secure and kept damp for at least 48 hours.
- For temperatures of 30°C (86°F) and less than 35°C (95°F) at the time of pointing mortar placement and for 72 hours following, maintain damp curing conditions utilizing wetted jute/burlap or equal, and with polyethylene covers to limit evaporation.
 - Maintain dampness in jute/burlap through the curing period including weekends.
 - Ensure that burlap and covers are wind secure and kept damp for at least 72 hours.
- For temperatures of more than 35°C (95°F) at the time of pointing mortar placement and for 72 hours following, maintain damp curing conditions utilizing wetted jute/burlap or equal, and with polyethylene covers to limit evaporation.
 - Ensure increased frequency of misting of the joints, and/or spraying of the jute throughout the course of the day.
 - Maintain dampness in jute/burlap through the curing period including weekends.
 - Ensure that burlap and covers are wind secure and kept damp for at least 72 hours.

.5 Maintain watertightness of the building during Work.

Cleaning:

- .1 Consultant to confirm Division 1 Section reference.
- .2 Refer to Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- .3 Remove excess mortar and sealant as work progresses, and upon completion of work.
- .4 Keep windows and other surfaces free of mortar droppings.
- .5 Clean soiled surfaces with non-acid cleaning solution.
- .6 Use non-metallic tools in cleaning operations.

Completion:

- .1 Upon completion wash affected windows and building surfaces, clean grade of residue of the Work.
- .2 Leave all horizontal ledges such as sills and projections, canopies, etc., free of mortar droppings and debris.
- .3 Clean up all debris, remove from the site.
- .4 Landscape to be restored to no less than original conditions as confirmed by record photographs.

- .5 Protect Work of this Section where at risk of damage by the Work of other Sections.
- Protect carved stone with secure wood covers or otherwise.
 - Provide signage as to risk of damage.