

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 04 03 08 – Historic - Mortaring
- .2 Section 04 05 10 – Common Work Results for Masonry
- .3 Section 04 05 19 – Masonry Anchorage and Reinforcing

**1.2 PRICE AND PAYMENT PROCEDURES**

- .1 Unit Prices
  - .1 Provide unit rates for each of the masonry repairs identified on the drawings, including grouting work. The unit cost for repair, includes all costs necessary to complete the specific repair, including additional scaffold, where required.

**1.3 REFERENCES**

- .1 Definitions:
  - .1 Sawcutting: the careful use of a power tool with a fine blade to cut the middle third of the mortar joint, in order to break the surface tension of hard mortar and facilitate the raking out process, without damaging the stone.
  - .2 Raking: removal of loose/deteriorated mortar to a depth suitable for repointing until sound mortar, but not less than a depth of 30 mm. It is assumed that the outer 75 mm of mortar consists of a very hard cementitious mortar, however, it may extend deeper in some areas.
  - .3 Backpointing: filling of masonry joints from which mortar is has been raked out to a point 30 mm from the stone face.
  - .4 Finishpointing: filling of masonry joints from which mortar has been raked out for a depth of 30 mm.
  - .5 Tooling: finishing of masonry joints using tool to provide final contour.
  - .6 Consolidation: strengthening masonry units to prevent deterioration (spalling).
  - .7 Descaling: the removal of loose portions of the masonry (usually spalled area) through impact with a bush hammer or similar device.
  - .8 Resurfacing: tooling and polishing of stone surface to renew it's texture and finish.
  - .9 Low-pressure water cleaning: water soaking of masonry using less than 350 kPa (50 psi) water pressure, measured at nozzle tip of hose.
- .2 Canadian Standards Association (CSA) International
  - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction.
  - .2 CSA A179-2014, Mortar and Grout for Unit Masonry.
  - .3 CAN/CSA A371-2014, Masonry Construction for Buildings.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 04 05 10 – Common Work Results for Masonry.

- .2 Samples:
  - .1 Provide labelled samples of materials used on project for approval before work commences.
- .3 Test and Evaluation Reports:
  - .1 Provide laboratory test reports certifying compliance of mortar ingredients with specifications requirements.

## **1.5 QUALITY ASSURANCE**

- .1 Masonry Contractor:
  - .1 Use single Masonry Contractor for masonry work.
  - .2 Masonry contractor must demonstrate at the time of Bid submissions that he/she has 10 years minimum experience with historic stone masonry work on projects of similar size and complexity, to Work of this Contract. This experience must be verified by References.
  - .3 Masonry contractor to have good level of understanding of structural behaviour of masonry walls when masonry work involves replacing or repairing stones which are part of structural masonry work.
- .2 Masons:
  - .1 Principal mason to have certificate of qualification with 10 years minimum experience in historic stone masonry work.
- .3 Appoint one thoroughly experienced, reliable and competent worker to be in charge of all mortar mixing for the duration of the project. The experience must include mixing mortar for a minimum of three projects similar to this project.
- .4 Mortar grouting: grouting activities should be undertaken by workers experienced in manipulation and mortar grouting methods.
- .5 Obtain approval from Departmental Representative for changes to qualified personnel.
- .6 Mock-ups:
  - .1 Construct mock-up in accordance with Section 04 05 10 – Common Work Results for Masonry.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
  - .2 Store cementitious materials and aggregates in accordance with CSA A23.1. Keep sand dry, in conformance with CSA A179, Clause 5.3.6. Sand that does not conform will be rejected.
  - .3 Keep material dry. Protect from weather, freezing and contamination.
  - .4 Ensure that manufacturer's labels and seals are intact upon delivery.
  - .5 Remove rejected or contaminated material from site.
- .2 Packaging Waste Management: remove for reuse, in accordance with local Waste Management laws.

**1.7 AMBIENT CONDITIONS**

- .1 Maintain masonry temperature between 10 degrees C and 25 degrees C for duration of work.
- .2 When ambient temperature is below 5 degrees C:
  - .1 Store mortar materials for immediate use within heated enclosure in accordance with Section 04 03 08 – Historic - Mortaring. Allow mortar materials to reach minimum temperature of 5 degrees C before use.
  - .2 Heat water to minimum 20 degrees C and maximum 30 degrees C.
    - .1 At time of use, temperature of mortar to be minimum of 15 degrees C and maximum of 30 degrees C.
    - .2 At time of repointing, surface temperature of stone to be a minimum of 10 degrees C.
- .3 Maintain sand temperature between 10 degrees C and 30 degrees.
- .4 Do not mix cement/lime with water or with aggregate or with water-aggregate mixtures having higher temperature than 30 degrees C.
- .5 Maintain mortar mix temperature between 10 degrees C and 30 degrees C.

**1.8 SITE CONDITIONS**

- .1 Existing Conditions
  - .1 Report in writing, to Departmental Representative, areas of deteriorated masonry revealed during work. Obtain Departmental Representative's approval and instructions for repair and replacement of masonry units before proceeding with repair work.
- .2 Protection
  - .1 At end of each working day, cover unprotected work with waterproof membranes. Extend membranes to 0.5 m beyond the perimeter of the work area and install securely to prevent finished work from drying out too rapidly.
  - .2 Protect adjacent finished work against damage which may be caused by on-going work.
  - .3 Cover all sills and projecting courses with rigid protection, secured into joints, for the duration of the work.
  - .4 Protect all exposed door frames, wall fixtures and any other existing surfaces which may be damaged by mortar stains. Damaged or stained material to be replaced at Contractor's cost.
  - .5 All methods of enclosure and protection to be approved by the Departmental Representative.
  - .6 Protect newly laid mortar from excessive exposure to rain and full sunlight until the surface is thumb-print hardened.
  - .7 Provide and maintain protection for masonry walls at all times when work is suspended, to prevent water from entering partially repointed masonry.
  - .8 Protection to consist of non-staining 6 mil polyethylene sheets, or tarpaulins over burlap, secured to prevent lifting in high winds.
  - .9 Provide protection boards to exposed corners and all openings such as doors which may be damaged by construction activities. Maintain protection for the duration of operations. Remove and dispose of protective materials as directed by the Departmental Representative.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Mortar: in accordance with Section 04 03 08 - Historic - Mortaring.
- .2 Proportions: in accordance with Section 04 03 08 - Historic - Mortaring.
- .3 Anchorage and Reinforcing: comply with Section 04 05 19 – Masonry Anchorage and Reinforcing.

**Part 3 Execution**

**3.1 GENERAL**

- .1 Perform work in accordance with CAN/CSA A371. Extent of raking out and repointing is as noted on the Drawings.
- .2 Work from the top of wall down, unless noted otherwise, or approved by the Departmental Representative.
- .3 Use manual raking tool unless otherwise specified, to remove deteriorated mortar and ensure that no masonry units are chipped/altered/damaged by work to remove mortar. Tools for cutting out must be narrower than the joint.
- .4 Tool and compact using jointing tool to force mortar into joint.
- .5 For backpointing in deep, narrow joints, fabricate long stainless steel packing tools, to force mortar into the joints and provide compaction.
- .6 Finish joints to follow specified and detailed profile of joints.
- .7 Use suitable approved jointing tool to form compacted tooled joints, as detailed. Tool length for finishpointing not to exceed 50 mm.
- .8 Do not sawcut or rake out mortar joints where ambient temperature is below 5°C in the Springtime or 0°C in the Fall, as the mortar in the joints may be frozen. Any attempt to remove frozen mortar will result in damage to the masonry. Damaged masonry resulting from removal of frozen mortar must be replaced at Contractor's cost.

**3.2 REPOINTING**

- .1 Procedure for testing: inspect joints visually for obvious signs of deteriorated masonry. Test deteriorated joints not visually observed as follows:
  - .1 Test for voids and weakness by using hammers or other approved means.
  - .2 Perform testing in co-operation with Departmental Representative, so that joints with unsound mortar can be marked and recorded.
- .2 Raking Joints
  - .1 Rake out all joints as noted on drawings.
  - .2 Rake unsound joints free of deteriorated and loose mortar, dirt and other undesirable material.
  - .3 Cutting out of joints is to be done with hammer and chisel, unless otherwise specified. Take great care so as not to damage masonry units adjacent to joints. Cut away from the arrises to prevent spalling of the masonry. The use of power tools is only permitted, as noted.
  - .4 Permission to use power tools will be based on the Contractor's ability to comply with the conditions noted below (sub-paragraph 6), as observed in the mock-up.

- .5 If these requirements are not complied with, the Contractor will be required to remove all mortar by use of hand tools, at no extra cost to the Departmental Representative.
  - .6 Where the use of power tools is permitted to remove existing mortar, proceed as follows:
    - .1 Grind the centre of the joint only, to a maximum width of half of the joint width. Mortar must remain on each side of the cut. The grinders must not touch the stone.
    - .2 For vertical joints, and discontinuous horizontal joints, stop sawcut 50 to 75mm from end of joint. Do not sawcut stone.
    - .3 Notify the Departmental Representative to inspect the grinding, prior to removing the remaining mortar.
    - .4 Remove the remaining mortar with hand tools.
  - .7 Include removal of all existing excess mortar that may have been applied to stone face due to overpointing. Do not damage arris or finish on stone face.
  - .8 Clean joints to full depth of deteriorated mortar, but in no case to less than 30 mm. Clean out voids and cavities encountered.
  - .9 Clean surfaces of joints by compressed air, without damaging texture of exposed joints or masonry units.
  - .10 Flush open joints and voids; clean open joints and voids with low pressure water and if not free draining blow clean with compressed air.
  - .11 Fine joints (less than 6 mm) need not be raked out more than 10mm, in order to reduce the danger of chipping the masonry edges. Provide "relief" cut using a special rotary grinding tool, equipped with a diamond sawcutting blade of small diameter (86 mm). When saw cutting vertical joints, stop sawcut 50 to 75mm from end of joint. Do not saw cut stone. Use flat-bladed quirks and light hammers, hack-saw blades or similar tools to rake out joints.
  - .12 Leave no standing water.
  - .13 Damaged stone includes widening of existing joints, nicks, gouges and chipped or scratched surfaces from cutting out tools, resulting from improper workmanship. Stone damaged as a result of careless raking, or saw cutting, shall be replaced at no cost to the Departmental Representative.
  - .14 Do not rake joints for more than 5 m in height, prior to backpointing, unless approved by the Departmental Representative.
  - .15 If masonry unseats or bond is broken, remove unit, chip back existing concrete wall to permit installation of at least 10 mm of mortar in collar joint behind stone and reset.
- .3 Backpointing
- .1 Prior to commencing backpointing, notify Departmental Representative to review masonry, make adjustments to stone repair requirements, identify all Dutchman repairs, stone replacement and stone removals.
  - .2 Where cut out joints are deeper than minimum raking out depths specified above, backpoint joints to bring mortar face to specified depth for raked out joints, in preparation for finishpointing. Where voids exist that conventional backpointing cannot fill, notify Departmental Representative for direction.
  - .3 Immediately prior to pointing, thoroughly wet joints in order to control absorption.
  - .4 Allow water to soak into masonry and mortar, leaving no standing water, but remaining wet.

- .5 For backpointing, fill all joints full with mortar, compacting firmly into joints to ensure positive adhesion to all inner surfaces. Place mortar in layers, maximum 50 mm thick, minimum 30 mm thick, allowing each layer to set to thumb print hardness before placing next layer. Fill joints to full depth of removals. Bring face of mortar in backpointed joint to specified minimum depth for raked out joints, measured from the arris of the masonry unit. Leave ready for final pointing.
  - .6 Form mortar square to stone face, and leave exposed stone each side of joint clean of mortar prior to mortar setting.
  - .7 For deep joints, provide stainless steel packing tools manufactured to permit the mason to compact mortar deep into the joints.
  - .8 Prevent mortar from being placed or smeared onto face of stone. Avoid mortar staining of masonry faces during backpointing.
- .4 Finishpointing
- .1 When all required repair and replacement work is complete, carry out finishpointing.
  - .2 Before finishpointing, wash walls to be finishpointed and allow to dry to damp-dry condition. Ensure that all dust, mortar particles, and other debris is removed from joints and wall surfaces before finishpointing.
  - .3 Dampen joints and completely fill with mortar. Fill the joints to approximately 1 mm behind arrises. Avoid feathered edges. Pack mortar solidly into voids and joints, to ensure positive adhesion to all inner surfaces.
  - .4 Where stone units have worn rounded edges, keep pointing back from face of stone, as detailed on drawings. If the width of the mortar joint will exceed 20 mm, stop work and notify the Departmental Representative for direction.
  - .5 Keep masonry damp while pointing is being performed.
  - .6 Do no pointing in freezing weather.
  - .7 Build up pointing in layers not exceeding 30 mm in depth. Allow inner layers to become thumbprint hard before applying subsequent layers. Pack and compress mortar into voids to fit approximately, but no less than 15mm thick. Maintain joint width.
  - .8 Remove excess mortar from masonry face before it sets. Finish jointing neatly as detailed.
  - .9 Allow mortar to set so that there is no excess water which will cause run off on stone faces, then tool to match approved mock-up joints. Tool head joints, followed by horizontal joints. Do not overwork the face of the joints. Ensure joints are uniform in appearance. Tool joints with one final pressing, once mortar is set, to thumb-pressed firmness. Final finish to expose aggregate texture will be completed using a stiff bristle brush which is gently struck, not wiped, against the surface of the finished joint.
  - .10 Retempering of Mortar
    - .1 Portland cement-hydrated lime mortars should only be retempered once, and should be used within 2 hours of adding water to the mix when the air temperature is less than 25 degrees C. (1½ hours for higher temperatures).
    - .2 Do not retemper pointing mortars by adding water. Retempering of mortar is only allowed by means of rewhipping it with a highspeed paddle mixer sufficiently to replasticeze the mix.

- .5 Curing
  - .1 Moist cure freshly pointed joints by spraying at intervals and covering with moist burlap enclosure and polyethylene sheeting for minimum of 7 days after finishpointing. Keep wall and burlap misted.
- .6 Protection
  - .1 Protect newly laid mortar from frost, rainfall or rapid drying conditions for 7 days.

### **3.3 RESETTING**

- .1 Prepare slot to receive stones. Clean back all loose and deteriorated core to sound material.
- .2 Clean back-up mortar down to sound concrete. Stop work and notify Departmental Representative if any defective concrete is found.
- .3 Fill collar joint behind stone, with mortar, just prior to resetting stone, unless detailed otherwise.
- .4 Install new stainless steel cramp anchors as detailed on drawings; two anchors per stone, top and bottom, anchored to concrete back-up.
- .5 Arrange dislodged masonry units in same location and orientation as originally set with water soaked hardwood wedges. Reset level, true and square with even mortar joints to exact original thickness.
- .6 Insert and compress firm mortar to within 30 mm of finishpointing surface. Allow mortar to set 24 hours minimum.
- .7 Pull out wood wedges when dried and shrunken.
- .8 Backpoint in layers and leave ready for finishpointing.

### **3.4 FIELD QUALITY CONTROL**

- .1 The Departmental Representative will inspect the quality of the work on a regular basis.
- .2 Notify Departmental Representative prior to sawcutting joints, so that the stone masonry can be recorded photographically. Provide clear access to all points of stone masonry to permit this photography to occur.
- .3 Provide Departmental Representative with a minimum of 48 hours of notice for required inspection.
- .4 Approval of raked out condition of joints, and approval of backpointing mortar after installation of first 75 mm of mortar for joints requiring backpointing to a depth of 200 mm or greater, and on completion of backpointing, must be received in writing by the contractor before the next procedure can proceed.
- .5 Where work proceeds to the next phase, without the approval of the Departmental Representative, all unapproved mortar will be removed at contractor cost.

**3.5 SCAFFOLDING ANCHORAGE**

- .1 At scaffold locations, as each level of work is completed and cured for a minimum of seven days, remove embedded scaffold anchors.
- .2 Reinstall anchors into alternate masonry joints adjacent to existing anchorage location, until scaffold removal is required.
- .3 Rake out and repoint joints affected by anchors, as detailed.
- .4 Repointed joints must be inspected by Departmental Representative, prior to removal of scaffold deck.
- .5 Upon final removal of anchors, repoint the joints where the anchor has been removed. Ensure mortar colour is uniform with previously repointed joints.

**3.6 CLEANING**

- .1 Clean surfaces of mortar droppings, stains and other blemishes resulting from work of this contract as work progresses and at the end of each working day.
- .2 Remove droppings and splashes using clean sponge and water. Do not use vinegar or chemicals, unless instructed in writing by Departmental Representative.
- .3 Do further cleaning, using stiff natural bristle brushes after mortar has attained its initial set and has not fully cured.
- .4 Remove all debris from stone faces, ledges and sills, as scaffolding is being removed.
- .5 Clean masonry with stiff natural bristle brushes and plain water only if mortar has fully cured.
- .6 Clean stone surface behind scaffold tie-backs, as they are removed.
- .7 Obtain approval of Departmental Representative prior to using other cleaning methods for persistent stains.
- .8 After final cleaning, notify Departmental Representative to complete a final inspection of the wall. Repair all noted deficiencies before dismantling scaffolding.

**3.7 PROTECTION OF COMPLETED WORK**

- .1 Protect adjacent finished work against damage which may be caused by on-going work.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 04 03 07 - Historic - Masonry Repointing.
- .2            Section 04 05 10 - Common Work Results for Masonry.

**1.2                ALTERNATES**

- .1            Obtain Departmental Representative's approval before changing manufacturer's brands or sources of supply of mortar materials during entire contract or other methods of mixing mortar specified elsewhere in this specification. This criterion will apply for the duration of the contract.

**1.3                REFERENCES**

- .1            American Society for Testing and Materials (ASTM)
  - .1            ASTM C109/C109M-13, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm Cube Specimens).
  - .2            ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.
  - .3            ASTM C185-08, Standard Test Method for Air Content of Hydraulic Cement Mortar.
  - .4            ASTM C207-06 (2011), Standard Specification for Hydrated Lime for Masonry Purposes.
  - .5            ASTM C270-14a, Standard Specification for Mortar for Unit Masonry.
  - .6            ASTM C780-14b, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
  - .7            ASTM C940-10a, Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
- .2            Canadian Standards Association (CSA)
  - .1            CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction.
  - .2            CSA A179-2014, Mortar and Grout for Unit Masonry.
  - .3            CAN/CSA A3000-2013, Cementitious Materials Compendium.

**1.4                ADMINISTRATIVE REQUIREMENTS**

- .1            Pre-Installation Meetings
  - .1            Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
  - .2            Scheduling of Work
    - .1            Submit work schedule indicating anticipated progress stages within time of final completion shown in bid document.
    - .2            Take measures necessary to complete work within approved schedule time. Schedule may not be changed without approval of Departmental Representative.

**1.5                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Submit in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations for:
    - .1 Aggregate. Include identification of aggregate source.
    - .2 Cement.
    - .3 Lime.
    - .4 Premixed products.
    - .5 Additives.
- .3 Samples:
  - .1 Provide samples in accordance with CSA A179.
  - .2 Submit two 50 mm x 50 mm size samples of mortar to demonstrate colour and texture.
  - .3 Submit sample of sand to demonstrate colour and gradation.
  - .4 Finish pointing samples to match finish pointing at the Administration Building A-1, from location identified by the Departmental Representative.
- .4 Action Submittals:
  - .1 Submit recordings of temperature and humidity weekly.

## **1.6 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Mortar preparation workers to have minimum of 5 years of experience in lime mortar preparation. This experience must be verified by References, to the approval of the Departmental Representative.
  - .2 Mortar to be mixed by same workers throughout project.
- .2 Certificates
  - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Testing Standards
  - .1 Conduct the required testing in accordance with the following standards:
    - .1 Flow and cube strength: to ASTM C 270.
    - .2 Vicat cone test: to ASTM C780.
    - .3 Cube strength: to CSA A179, Annex B.
    - .4 Flexural bond strength: to CSA A179.
- .4 Test reports:
  - .1 Submit test results during site work as directed by Departmental Representative as follows:
    - .1 Sieve analysis: sand, in accordance with CSA A179.
    - .2 Bulking analysis: sand in condition as delivered to site.
    - .3 Air content: mortar mix in plastic state.
    - .4 Vicat cone penetration: mortar mix.
    - .5 Mortar compressive strength: at 7, 28 and 56 days or otherwise required.

- .6 Flexural bond strength: test during mock-up using masonry units on site.
  - .7 Lime grout compressive strength: at 28, 56 and 112 days, or otherwise required.
- .5 Mock-ups:
- .1 Construct mock-up in accordance with Section 04 05 10 – Common Work Results for Masonry.
  - .2 For mortar colour, include three 500 mm long mock-ups of different mortar colours. Departmental Representative to select the colour to be used for the project.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
  - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store cementitious materials and aggregates in accordance with CSA A23.1/A23.2.
  - .3 Protect from weather, freezing and contamination.
  - .4 Remove rejected or contaminated material from site.
- .3 Waste Management and Disposal
  - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with local collection services.

## **1.8 SITE CONDITIONS**

- .1 Ambient Conditions:
  - .1 Execute work to CSA A179.
  - .2 Provide weather-tight enclosure to store materials and mix mortars, maintain air temperature above 10°C at all times.
  - .3 Maintain maximum/minimum thermometers and relative humidity gauges on site and in enclosures.
    - .1 Maintain a daily record of temperature and humidity.
    - .2 Locate gauges at upper reaches of enclosure, and within 600 mm of floor level at base of enclosure.
  - .4 Execute work when ambient temperature is above 5° Celsius. When ambient temperature is below 5° Celsius, cover and heat Work as directed by Departmental Representative.
  - .5 Prepare and maintain temperature of mortar between 5° Celsius and 30° Celsius until used.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Mortar and grout: to CSA A179.
- .3 Water: potable, clean and free from contaminants.
- .4 Sand: to CSA A179; Gradation to ASTM C144. Use well graded sand passing 4.75 mm down to 150 micron sieve where joints are greater than 6 mm. Use sand passing 1.18 mm down to 300 micron sieve where 6mm thick joints or less are indicated. In the event that the sand does not meet the gradation requirements, carry out additional sieving to meet requirements or provide alternate sand. Provide dry aggregate to CSA A179, Clause 5.3.6.
  - .1 Sharp, screened and washed pit sand, free of organic material, with final grading and colour to approval of Departmental Representative.
  - .2 Sand to be dried to 100% Standard Procter Maximum Dry Density (SPMDD). Keep sand dry throughout period of work.
- .5 Colour: dry powdered inorganic pigments, maximum quantity permitted in dry form will not exceed 8% of the total binder volume. Acceptable Material: Mortar pigment as manufactured by Rockwood Pigments. Colour of sand to match existing shades and tones.
- .6 Portland cement: to CAN/CSA A3000, non-staining, type GU.
- .7 Lime:
  - .1 Hydrated Lime:
    - .1 Hydrated, high calcium, Type "SA" to ASTM C207.
- .8 Casein Additive: Protein polymer to provide fluidity in grout.
- .9 Calcium chloride is not to be used for any mortar.

**2.2 MORTAR MIXES**

- .1 Proportion requirements
  - .1 Bedding mortar: type N based on proportion specifications. Range of compressive strength: 8.0 MPa to 13.0 MPa at 56 days.
    - .1 1:1:6 cement: lime: aggregate mix.
  - .2 Backpointing in vertical joints and facepointing mortar in all joints for stonework: type O based on proportion specifications. Range of compressive strength: 5.0 MPa to 8.0 MPa at 56 days.
    - .1 1:2:9 cement: lime: aggregate and pigments mix. Acceptable product by Daubois.
  - .3 Block Masonry: Non-loadbearing: type N based on Proportion specifications, CSA A179, Table 3.
- .2 Vicat Cone Penetration for Stonework: to ASTM C780.
  - .1 Finishpointing Mortar: 15-20mm.
  - .2 Bedding and Backpointing Mortar: 20-30mm.
- .3 Allowable air content for all Lime Mortars: 7% to 15%.

- .4 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour and not more than 2 hours, then remix with sufficient water to produce mortar of proper consistency for pointing.
- .5 Do not add air entraining admixture to mortar mix.

### **2.3 ALLOWABLE TOLERANCES**

- .1 If mortar fails to meet 60% of the specified mortar strength range at 7 days, but meets the 28 day compressive strength requirement, it is acceptable. If mortar fails to meet the 7 day compressive strength requirement, but its strength at 7 days exceeds two thirds of the value required for the 7 day strength, contractor may elect to continue work at his own risk while awaiting the results of the 28 day tests, or to take down the work affected.
- .2 The Departmental Representative reserves the right to reject mortar which falls more than 20% outside of the 56-day compressive strength range required, and to have the contractor remove it from the wall.

## **Part 3 Execution**

### **3.1 GENERAL PREPARATIONS**

- .1 Traditional Mortar:
  - .1 Prepare measuring boxes to ensure accurate proportioning of materials.
  - .2 Maintain separate measuring boxes for each component.
  - .3 Ensure sand is tested and volume corrected for bulking. To avoid bulking, use dry sand.
  - .4 Ensure testing equipment is ready and in working order.
  - .5 Apply Vicat cone test to ensure desirable performance of the mortar and record results.
- .2 Premixed Mortar:
  - .1 Follow manufacturer's written instructions.
  - .2 Prepare entire contents of bag. Mortar prepared using a portion of a bag will be rejected.
  - .3 Apply Vicat cone test to ensure desirable performance of the mortar and record results.

### **3.2 BULKING OF SAND**

- .1 Test sand for bulking:
  - .1 At start of work.
  - .2 After each new delivery of sand.
  - .3 After severe change in weather.
- .2 Verify moisture content in sand conforms to CSA A179.
- .3 The Departmental Representative reserves the right to reject sand if bulked volumes are excessive.
- .4 Test and adjust sand quantities for bulking:
  - .1 Obtain sample of sand which accurately reflects average condition of pile of damp sand, as follows:

- .1 Take 4 shovels full of sand, each from a different level of the pile, and mix thoroughly.
- .2 Place sand in a conical pile and divide into 4 quarters with a board. Remove 2 opposite quarters from pile, and combine remaining 2 quarters and mix thoroughly.
- .3 Repeat quartering and mixing procedure until a sample of size required for testing remains.
- .2 Fill a 1-litre capacity jar, about two-thirds full with damp sand to be tested. Drop sand in loosely. Do not pack it in. Level off surface, measure depth of damp sand (D).
  - .1 Carefully empty sand into another container, and half fill first container with water.
  - .2 Pour back about half of test sample of sand slowly into water so it is entirely saturated. Rod it thoroughly to remove air.
  - .3 Add rest of sand, rodding again to remove air and level off surface. Measure depth of saturated sand (S), which will be less than depth of damp sand.
  - .4 Calculate percentage bulking using formula:  $[(D-S) \times 100\%]/S =$  percentage bulking; where D = depth of damp sand, and S = depth of saturated sand.
- .3 Increase volume of sand by percentage bulking shown in test.

### **3.3 MIXING**

- .1 Prepare measuring boxes to ensure accurate proportioning of mortar ingredients. Each box to contain exact volume proportion for each specific mix ingredient.
- .2 Introduce approximately 75% of the total volume of water into the mixer, followed by 50% of the sand and all of the dry hydrated lime and any pigment. Mix for approximately 3 minutes or until the materials are thoroughly blended and no particles of white lime are apparent in the mix.
- .3 Allow to stand for 5 minutes.
- .4 Add the full volume of Portland cement, the remainder of the sand and water. Mix for further 3-5 minutes until thoroughly blended and mortar has reached consistency determined by Vicat Cone penetration testing.
- .5 Add just sufficient water to obtain workable consistency for setting units. Avoid too wet a mix which stains the face of the work. Vicat Cone penetration may be slightly greater for bedding mixes, but should not exceed maximum value specified by more than 20%.
- .6 Mix Characteristics:
  - .1 Pointing mortar: slightly stiffer than bedding mortar with a consistency such that the mortar can be hand-formed into a stiff ball.
  - .2 Record amount of water required to reach this consistency and use for subsequent mixes.
- .7 Adjust mix proportions based on percentage bulking shown in the test.
- .8 Mortar for reconstruction of dismantled masonry, or new construction, can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes.
- .9 Mixing by hand for repointing mortars must be pre-approved by Departmental Representative as follows:

- .1 Hand mixing must be carried out using high speed, 2500 Rpm drill, with paddle mixer attachment. Mixing to be completed in sufficiently small container so as to allow full contact of the paddle with the mortar during the mixing process, thus ensuring thorough incorporation of ingredients and air entrainment.
- .2 Submit masonry tools and container for approval prior to starting pointing work.
- .10 Prepare only enough mortar to be used within two hours. Do not re-temper mortar beyond this time.
- .11 Follow manufacturer instructions when premixed mortar is used.
- .12 Appoint one individual to mix mortar for duration of project. If this individual must be replaced, mortar mixing must cease until replacement individual is trained, and mortar mix is tested.
- .13 Ensure mortar does not contain elements detrimental to the original masonry or surrounding materials.
- .14 Provide a mortar mixing log and record type of mortar, time of mix, air temperature, location where installed in wall, Vicat Cone result, and tests taken by independent testing agency, where applicable.

### **3.4 COLOURED MORTARS**

- .1 Incorporate colour into mixes (buff pigments), using dry pigments not exceeding 8% of binder content by volume.
  - .1 Use clean mixer for coloured mortar.
  - .2 Add colouring additives to match approved samples of the colour for frontpointing mortar. Adjust mixes to comply with specified performance requirements.
  - .3 Provide for at least 2 different mortar pigments and an unpigmented mortar to test for matching the colour of the existing mortar joints in the project. The final and precise mixes and colours to be determined with the mock-up.

### **3.5 CONSTRUCTION**

- .1 Do masonry mortar and grout work in accordance with CSA A179 except where specified otherwise.

### **3.6 CLEANING**

- .1 Progress Cleaning
  - .1 Leave work area clean at the end of each day.
- .2 Upon completion, remove surplus materials, rubbish, tools, equipment and barriers.
- .3 Remove droppings and splashes using clean sponge and water.
- .4 Clean masonry with low pressure clean water and soft natural bristle brush. For sandstone, pressure should be between 276 kPa and 410 kPa. See Section 04 03 07- Historic - Masonry Repointing and Repair.

### **3.7 PROTECTION OF COMPLETED WORK**

- .1 Cover completed and partially completed work, not enclosed or sheltered at end of each work day.
- .2 Enclose and protect work using wetted burlap.
- .3 Cover with waterproof tarps to prevent weather from eroding recently laid material.

- .1 Maintain tarps in place for minimum of 1 week after laying.
- .2 Ensure that bottoms of tarps permit airflow to reach mortar in joints.
- .4 Anchor coverings securely in position.

**3.8 FIELD QUALITY CONTROL**

- .1 Inspection and testing of mortar will be carried out by a Testing Laboratory designated by the Departmental Representative, to CSA A179. The mortar testing company should have the capacity to provide Vicat Cone testing and test the air with a mortar test apparatus. A concrete test apparatus must not be used to test the air, as it is unsuitable for this application.
- .2 Departmental Representative will pay for cost of initial inspections and tests. Contractor will pay cost of re-inspecting and re-testing necessitated by failure to meet specification requirement on initial inspection/test.
- .3 Frequency of mortar testing will be specified by Departmental Representative.
- .4 Air content to ASTM C185, and penetration using Vicat Cone to ASTM C780 for mortars used in stonework, must be tested at the same frequency as strength tests to ASTM C109. Contractor to own and have on site, a fully functioning and well maintained Vicat penetrometer throughout the duration of the project work. Contractor to test every mix and record results in log.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 04 03 07 – Historic – Masonry Repointing.
- .2        Section 04 03 08 – Historic – Mortaring.
- .3        Section 04 03 42 – Historic – Replacement of Stone.
- .4        Section 04 05 10 – Common Work Results for Masonry.

**1.2                PRICE AND PAYMENT PROCEDURES**

- .1        Unit Prices
  - .1        Provide unit prices for each of the repairs identified on the drawings. The unit price for each repair will include all costs necessary to complete the specific repair, including additional shoring and scaffolding, removal and reinstatement of existing stone, all anchorage, mortar and grout work necessary to stabilize adjacent masonry.
  - .2        Allow for waste required to achieve desired size of Dutchman repairs.

**1.3                ALTERNATES**

- .1        Obtain Departmental Representative's written approval before changing procedures, manufacturer's brands, sources of supply of materials during entire contract.

**1.4                REFERENCES**

- .1        Definitions:
  - .1        Repair of Stone: mechanical or plastic repair, done to restore original appearance and function of partly deteriorated stones. Repairs include crack repair, Dutchman repair, fracture repairs and descaling.
  - .2        Restoration Mortar: material used to rebuild broken or deteriorated part of stone.
  - .3        Adhesive: material used to fasten broken/fractured stone elements by direct application at fracture interface and/or by application to added reinforcing elements such as dowels.
  - .4        Mortar: material used to re-bed the stone element being repaired and to repoint adjacent mortar joints.
  - .5        Consolidation: strengthening masonry units to prevent deterioration (spalling).
- .2        Reference Standards:
  - .1        American Society for Testing and Materials (ASTM)
    - .1        ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.
    - .2        ASTM A276-15, Standard Specification for Stainless Steel Bars and Shapes.
  - .2        Canadian Standards Association (CSA)
    - .1        CAN/CSA A3000-13, Cementitious Materials Compendium.
    - .2        CSA A179-2014, Mortar and Grout for Unit Masonry.

**1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations. Include:
    - .1 Application/installation instructions.
    - .2 Laboratory test reports certifying compliance of products with specification requirements.
    - .3 Manufacturer's material safety data sheets (MSDS) for safe handling of specified materials and products, in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.
  - .3 Samples:
    - .1 Submit adhesive and mortar samples for testing.
    - .2 Submit (3) 250 mm x 250 mm x 50 mm stone units, representative of proposed units for work. (This is only necessary, if samples not submitted for replacement stone).
      - .1 New Stone:
        - .1 Departmental Representative reserves the right to request results from tests by an independent testing agency to verify mechanical, physical and aesthetic properties of stone, at no additional cost to Contract.
      - .3 Submit (1) 300 mm x 300 mm x 100 mm stone sample, representing each stone repair type, for review by Departmental Representative. Samples to be completed within six weeks of award of Contract and once approved, to remain in site office for duration of project.
  - .4 Certificates:
    - .1 Submit upon request by Departmental Representative purchase orders, invoices, suppliers test certificates and documents to prove materials used in contract meet requirements of specification. Allow free access to sources where materials were procured.

**1.6 CLOSEOUT SUBMITTALS**

- .1 Record Documentation:
  - .1 Provide marked up set of drawings to provide referencing system identifying locations of stone repairs.
  - .2 Provide photographic record of dismantle and rebuilt stonework.

**1.7 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Masonry Contractor:
    - .1 Work of this Section: executed by contractor specializing in historic stone conservation work of this nature, using similar stone repair techniques, and with a minimum 10 year record of successful performance.
  - .2 Foreperson:
    - .1 Provide competent trade foreperson specializing in type of work required.

- .2 Experience: minimum 10 years of experience in conservation work similar to work of this Section. Must be present on site throughout Work.
- .3 Masons:
  - .1 Ensure all personnel working on the work of this section, engaged by the Masonry Contractor have minimum of 5 years of experience with historic masonry, and can pass a hands on test of skills administered by Departmental Representative where requested. Departmental Representative has right to reject any mason who does not demonstrate appropriate abilities or experience.
  - .2 All masons employed on this project throughout course of project must meet above requirements. Where, during course of project, masons leave work force, replacement masons must also meet requirements.
  - .3 Apprentices with a minimum of one year certification from a recognized Masonry Program, may work under the direction of a mason as noted above.
- .2 Mock-ups:
  - .1 Construct mock-up in accordance with Section 04 05 10 – Common Work Results for Masonry.
  - .2 Construct mock-up where directed by Departmental Representative.
  - .3 Prepare one mock-up in wall, and one mock-up in sample stone, as noted under Sub-article 1.5.3.3, for each stone repair type.
  - .4 Construct the following stone repair mock-ups:
    - .1 Crack repair
    - .2 Restoration Mortar repair
    - .3 Dutchman repair (carved)
    - .4 Dutchman repair
    - .5 Fracture repair
    - .6 In-situ fracture repair
    - .7 Consolidation repair
    - .8 Stone reset
  - .5 Select locations of mock-ups in consultation with Departmental Representative.
  - .6 Clean mock-up to demonstrate cleaning operations to Departmental Representative.
- .3 Consolidant Application:
  - .1 Request representation by manufacturer on site during preparation and application of test area for consolidant.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
    - .1 Identification with grade, batch and production date shown on container or packaging.

- .2 Store materials in a clean, dry enclosed area and supported free of ground. Maintain a minimum ambient temperature of 10 degrees C in storage area.
- .3 Packaging Waste Management: remove for reuse and return in accordance with Waste Management plan.

## **1.9 SITE CONDITIONS**

- .1 Ambient Conditions
  - .1 Maintain a minimum temperature of 10 degrees C during and 48 hours after repair, throughout thickness of stone.
  - .2 Allow materials to reach minimum temperature of 10 degrees C prior to use.
  - .3 Provide temporary enclosures to maintain specified temperatures. Take precautions to avoid overheating masonry.
  - .4 Remove work exposed to lower temperatures as directed by Departmental Representative.
  - .5 Refer to manufacturer's instructions for environmental requirements of products.
  - .6 Hot Weather Requirement
    - .1 Shade stones from direct sunlight with temporary cover.
- .2 Record and report to Departmental Representative, site conditions non-conforming to those specified before beginning work.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Use materials from same manufacturer throughout the Work.
- .2 Portland cement: to CAN/CSA A3000.
- .3 Sand: cleaned and graded in accordance with ASTM C144.
- .4 Water: clean and free of deleterious materials such as acid, alkali and organic material in accordance to CSA A179.
- .5 Dowels: stainless steel to ASTM A276, Type 304.
  - .1 Diameter: dependent on size and weight of each new stone insert and as noted on Drawings.
- .6 New stone:
  - .1 Similar mechanical, physical and aesthetic properties to existing stone. See Section 04 03 42 – Historic – Replacement of Stone.
  - .2 To approval of Departmental Representative.
- .7 Hairline Crack Filling: Dispersed Hydrated Lime (DHL) grout and shelter coat, pigmented to match stone colour to approval of Departmental Representative.
- .8 Consolidant: One component, tack free, breathable, acid resistant, low viscosity binder, suitable for use on deteriorated masonry. Acceptable products:
  - .1 Conservare OH100 Stone Strengthener, manufactured by PROSOCO, Inc, Kansas City, USA.
  - .2 System 95W Penetrating Consolidant, manufactured by Edison Coatings Inc., Plainville, CT, USA.

## **2.2 MORTAR MIXES**

- .1 Mortar: in accordance with Section 04 03 08 - Historic - Mortaring.
- .2 Restoration Mortar: for patching of stone; proprietary mix, pre-mixed, pre-bagged. Properties to be compatible with existing stone.

## **2.3 ADHESIVE MIXES**

- .1 Proprietary stone adhesive:
  - .1 Specially formulated for repair of broken stone units.
- .2 Adhesive mix: NHL 3.5 Hydraulic Lime and Casein. Mix proportions as recommended by manufacturer to obtain specified results.
  - .1 Submit samples for testing.

## **Part 3 Execution**

### **3.1 SITE VERIFICATION OF CONDITIONS**

- .1 Report in writing, to Departmental Representative, areas of deteriorated stone not identified in the documents.
- .2 Notify Departmental Representative to inspect the masonry and mark all Dutchman, new stone and stone removals on the masonry, prior to commencing backpointing of joints.
- .3 Obtain Departmental Representative's approval and instructions for repair and replacement of masonry units before proceeding with repair work.
- .4 Stop work in that area and report to Departmental Representative immediately any evidence of hazardous materials.

### **3.2 PREPARATION**

- .1 Obtain Departmental Representative's approval for repair methodology and tools to be employed prior to commencing work.
- .2 Do not clean or dress areas of deteriorated masonry until advised to do so by Departmental Representative. Consolidation is likely to be done first and once cured, a light cleaning, any dressing or repairs required, would be undertaken.

### **3.3 SPECIAL TECHNIQUES**

- .1 Temporary Marking and Recording:
  - .1 Mark stone, on face, before removal using marking product which can be completely erased when required without damaging masonry unit. Confirm with Departmental Representative as to the following preferred methods:
    - .1 Ball-point pen on diachylon, attached to stone.
    - .2 Waxless chalk directly on stone.
    - .3 Waterproof information card, securely tied to stone.
  - .2 Use numbering, marking, and positioning system shown on drawing or chart specifically prepared for accurate recording of stone location.
  - .3 Ensure that temporary marking will remain in use: resistant to weather, handling and cleaning until final marking of stones.
  - .4 Remove markings and adhesive without damaging units:

- .1 Brush with vegetable fibre brush: either dry or with water.
- .2 Use no solvent, acid or other chemical product.

### **3.4 PROTECTION**

- .1 Prevent damage to stone surfaces, mortar joints, and natural features which are to remain. Make good damage incurred.
- .2 Protect surrounding components from damage during work.
- .3 Take utmost care not to damage historic fabric. Make good damage incurred.
- .4 Obtain Departmental Representative's approval for repair technology.

### **3.5 CONSOLIDATION TREATMENT**

- .1 Mark locations designated for stone consolidation treatment, with removable marker.
- .2 Obtain approval of Departmental Representative prior to proceeding with treatment.
- .3 Use consolidation products as directed by manufacturer.

### **3.6 CRACK REPAIR**

- .1 Drill 5 mm diameter injection ports as per injection adhesive manufacturer's specifications.
- .2 Clean out void with compressed air and potable water until water runs clear. Final flushing to be with 10% ethyl alcohol solution.
- .3 Seal joints and cracks to manufacturer's specifications.
- .4 Complete injection procedure as per manufacturer's instructions. Keep surface of stone clean of spills. Clean off as work progresses.
- .5 Allow adhesive to harden.
- .6 Prepare DHL shelter coat using compatible pigments with the DHL grout. Pigment must match stone colour.
- .7 Inject shelter coat over crack fills. Apply in thin layers to build up to surface.
- .8 If the crack is wider than 3 mm, use repair mortar to fill and seal the opening or any voids along the crack length.

### **3.7 REPAIR OF A FRACTURED STONE**

- .1 Remove deteriorated portions of stones using low impact removal methods until sound surface is reached.
- .2 Remove elements which require minor repair, without losing pieces or worsening damage. Do not damage existing Work.
- .3 Drill 13 mm diameter holes, 60 mm long in each section at fracture, maximum spacing at 300 mm on centre. Provide minimum two holes per stone. Clean dust out of holes using acetone and cotton swabs.
  - .1 Fractures over 300 mm in length: require additional dowels per 200 mm length of fracture.
- .4 Align holes on each side of fracture.
- .5 Use minimum 2 dowels per fracture, for stones less than 600 mm high and one additional anchor for every 200 mm extra height.

- .6 Dampen stone surfaces prior to application of adhesive and ensure humidity, temperature, cleanliness and finish condition of stone is in accordance with adhesive manufacturer's instructions.
- .7 Insert 12 mm diameter dowels, 100 mm long, and apply specified adhesive to holes and interface. Clamp two parts of stone together. Allow adhesive to cure in accordance with manufacturer's instructions for 24 hours minimum.
- .8 Reinstall consolidated element into work and repoint using specified mortar, in accordance with Section 04 03 07 - Historic - Masonry Repointing. Joint profiles to match existing. If fracture lines up with vertical mortar joints above and below the fractured stone, rotate the stone 180°, if pattern on stone permits, and reinsert.
- .9 Repair surface of fracture to match the surrounding stone, as per Article 3.5 – Crack Repair.
- .10 Finish surface of fracture to match colour and profile of existing stone.

### **3.8 REPAIR OF FRACTURED STONE IN-SITU**

- .1 Drill 11 or 13 mm diameter holes, extend 60 mm beyond fracture, spaced at 300 o/c maximum. Minimum 2 per stone; alternate each side of fracture. Provide additional dowels per 200 mm length of fracture. Minimum length of hole to be 140 mm. Confirm dowel size with Departmental Representative, prior to drilling hole.
- .2 Clean dust out of hole with acetone and cotton swabs.
- .3 Dampen stone surfaces prior to application of adhesive. Insert 10 or 12 mm diameter stainless steel dowels, 100 mm long and apply anchor setting mortar to holes and joints. Confer with Departmental Representative to determine diameter of dowels. Allow to set for 24 hours minimum.
- .4 Drill injection ports and seal fracture as per Article 3.5 – Crack Repair.
- .5 Repair fracture as per Article 3.6 – Repair of a Fractured Stone.
- .6 Finish surface of fracture to match existing stone.

### **3.9 REFACING PARTLY DETERIORATED STONE WITH STONE SLAB (DUTCHMAN REPAIR)**

- .1 Remove decayed stone until sound surface is reached. Cut existing stone to achieve a square void in stone as much as possible, with minimum depth 65 mm.
- .2 Where Dutchman size exceeds 40% of the failed stone size, proceed to do full face Dutchman, unless noted otherwise by Departmental Representative. Where there is more than one Dutchman repair required on any single stone, proceed to do full face Dutchman, unless noted otherwise by Departmental Representative.
- .3 Select new stone to match surrounding stone of geological type and colour, free from defects and with bedding to match adjacent work. Where possible, salvage from existing weathered stone on site.
- .4 Cut new stone insert to exactly fit the cut in existing stone.
  - .1 Allow for thickness of stone adhesive.
  - .2 Allow for finished surface slightly projecting from existing masonry face.
- .5 Cutting tolerance for new stone: Allow 1 mm maximum joint tolerance on all sides, between the new stone section and the parent stone.
- .6 Dowels as mechanical fasteners:

- .1 Drill 11mm diameter holes, 60mm long at interface of existing and new stone slabs. Where stone depth on either side of the interface is less than 100mm, length of hole to be 60% of stone thickness.
- .2 Saturate stone surfaces to which adhesive is to be applied, prior to application of adhesive.
- .3 Insert 10mm diameter dowels, 100mm long into existing stone and apply specified adhesive to holes and interface. Allow to set for 24 hours minimum.
- .4 Where new or existing stone is less than 100 mm thick, length of dowel to be 50% of the thickness of stone on each side of the interface.
- .7 Dovetailed grooves as mechanical fasteners:
  - .1 Cut horizontal dovetailed grooves 12mm deep at interface of existing and new stone slabs. Cut stone shape by hand using tempered chisels ensuring that the edges are not plucked or spalled.
  - .2 Saturate stone surface, prior to application of adhesive.
  - .3 Apply specified adhesive to dovetailed grooves and interface of existing stone.
- .8 Dampen stone surfaces and fill dowel holes and/or dovetailed grooves of new stone slab with specified adhesive. Erect new stone slab into position. Secure stone temporarily to allow adhesive to set. Ensure joint between new and existing stone is filled solid and finished to match existing stone face.
- .9 Position face of Dutchman slightly proud and finish to original profile by rubbing back or tooling as required. Resurface new slab insert as required to make patch unobtrusive. Refer to Drawing for required tooling and finishing. Rubbing back marks on existing stone are not permitted.
- .10 Repoint with specified mortar. Profile of joints to match existing.

**3.10 REFACING PARTLY DETERIORATED STONE WITH RESTORATION MORTAR (INCLUDING VOIDS, CHIPS, OLD PATCHES)**

- .1 Prepare and repair eroded or damaged stone using the specified restoration mortar. Perform work in strict accordance with manufacturer's directions which must be on hand during work and shall supplement and take precedence over this specification. Repairs to match existing stone in colour and profile. The purpose of such work is required to improve water-shedding and to prevent further damage or erosion. Exact location and dimensions of repair will be chalked on stone by Departmental Representative.
- .2 Remove decayed stone until sound surface is reached. Cut out areas to be repaired using a toothed chisel so that back surfaces are grooved and a square connection is made between restoration mortar and sound stone. Feathering of mortar is not acceptable. Cut away spalled and loose stone to a minimum depth of 6mm, and minimum 12 mm or greater for the remainder, as per manufacturer's instructions.
- .3 After cutting, remove loose particles and clean space to be filled using water and brush so that all dust is removed. If surfaces to be restored, chalk or become powdery, remove dust using a vacuum cleaner.
- .4 Remove dust and thoroughly moisten surfaces, such that the surface retains humidity but with no standing water. Use only enough water to prevent the natural stone from extracting mixing water from the restoration mortar. Adjust amount of moisture to suit hardness and porosity of stone to be restored.
- .5 Mix restoration mortar in a plastic tub using a hand mixer. Wear a dust mask. Put water in tub first before adding dry material. The ratio of water to dry material will be as per manufacturer's directions.

- .6 Apply mortar to suit nature of stone being restored. Restore stone surfaces to match existing and bring to the same plane as adjacent existing stone surfaces that are not eroded.
- .7 Gradually build up new segment in layers, not exceeding 15 mm thickness. Fill in one lift without overworking with application tool.
- .8 Use quality art tools such as various sized spatulas and avoid excessive trowelling to prevent crazing.
- .9 Clean filling mortar residue from area surrounding patch: sponge as many times as necessary with clean water. Do this before patching material sets. Normal timing to cut and profile the repair mortar is when the fill is just resistant to finger pressure.
- .10 Undercut sound existing stone to provide keyed edge by drilling. Provide keys in back of cavity.
- .11 Remove laitance with stiff, near-dry fibre brush.
- .12 Form mortar to match profile of surrounding stone.
- .13 Finish patch surface to match adjacent stone surface, in colour and texture.
- .14 Moist cure restored surfaces for 4 days minimum. Apply moist cloth covered with plastic sheet. Maintain moisture in cloth by means of mist sprayer, for the entire curing period.
- .15 Refacing mouldings:
  - .1 Form face roughly to required shape with wood float leaving repair mortar proud.
  - .2 Chisel finish to final shape when mortar has set.
- .16 Repoint mortar joint with specified mortar. Joint profile to match existing. See Section 04 03 07 – Historic – Masonry Repointing.

### **3.11 SHARD REPAIR**

- .1 Retain all stone shards which become loose from stone arrises during removal of existing mortar. Identify and tag locations where shards have debonded.
- .2 Clean surfaces of detached segment of dust and dirt by scrubbing with water and brush if necessary.
- .3 Allow stone to dry.
- .4 Apply dab of polyester resin to dry, middle area surface of detached stone portion.
- .5 Working quickly, compress the two surfaces together to secure original fitting.
- .6 Cut away excess polyester resin while in the gel stage, just prior to hardening.
- .7 Proceed with crack repair as per Article 3.5 – Crack Repair.
- .8 Complete this work prior to backpointing.

### **3.12 DESCALING**

- .1 Descale the surface of the stone, by removing loose masonry portions by impact with approved tools, as directed by Departmental Representative.
- .2 Where only a portion of a stone face requires descaling, clean the entire surface and repair to ensure uniformity of colour.
- .3 Where scaling is deep (greater than 2mm), stop work and notify Departmental Representative. Repair or replacement may be required.

- .4 Where scaling is shallow (less than 2mm), bevel the edges of retained and firm surface plates to ensure water shedding.
- .5 Where descaling covers an area greater than 0.1 m<sup>2</sup>, notify Departmental Representative for direction, prior to proceeding, as an alternative repair or replacement may be required.

**3.13 RESURFACING STONE**

- .1 Finish surface of stone by rubbing and polishing to match existing.
- .2 Ensure uniformity of colour and finish by treating the entire face of the stone.
- .3 Where surface of stone is deteriorated, prepare surface of stone and apply consolidant as per manufacturer's instructions and approved mock-up.

**3.14 REGLETS**

- .1 Mark location of reglets on stone face with removable marker. Reglet location must be marked by the Contractor responsible for the installation of the metal flashings. Obtain approval of Departmental Representative, prior to proceeding to cut reglets in stone face.
- .2 Use straight edge to ensure reglet is cut in a straight line. Cut reglet to the dimensions specified. Do not overcut. Arris of stone at edges of reglet must be straight. Chipping of stone is not acceptable.
- .3 If stone is damaged during cutting of reglets, replace with new stone, at no cost to the Departmental Representative.

**3.15 JOINT REPAIR**

- .1 Do repointing work in accordance with Section 04 03 07 - Historic - Masonry Repointing.
- .2 Make good damage incurred to mortar joints.

**3.16 CLEANING**

- .1 Obtain Departmental Representative's approval of cleaning operations before starting cleaning work.
- .2 Protect vegetation and adjacent grounds from excessive water accumulation.
- .3 Clean stone work surfaces after repairs have been completed and mortar has set.
- .4 Clean stone surfaces of grout or mortar residue resulting from work performed without damage to stone or joints.
- .5 Clear site of debris, surplus material and equipment, leaving work area in clean and safe condition.

**3.17 PROTECTION OF COMPLETED WORK**

- .1 Protect finished work from impact damage for period of two weeks.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 04 03 07 - Historic - Masonry Repointing.
- .2 Section 04 03 08 – Historic – Mortaring.
- .3 Section 04 05 10 – Common Work Results for Masonry.
- .4 Section 04 05 19 – Masonry Anchorage and Reinforcing.

**1.2 STONE AVAILABILITY**

- .1 Confirm in writing at time of Bid closing, that sufficient quantity of stone type identified in the bid submission is available to complete the requirements of the project.

**1.3 PRICE AND PAYMENT PROCEDURES**

- .1 Provide unit prices for replacement of stone. The unit price for each replacement will include all costs necessary to complete the specific replacement, including additional shoring and scaffolding, removal and disposal of existing stone, consolidation of core, all anchorage, mortar and grout work necessary to stabilize adjacent masonry, and to install the new stone.
- .2 For quantity estimation of dressed quoin stones and jamb stones, measure long face only. Allow for waste required to achieve desired size of replacement stone.
- .3 Payment for this work will include all costs associated with supplying materials, and executing work as described herein and reflected in the contract.

**1.4 REFERENCES**

- .1 Definitions:
  - .1 Lewis: instrument inserted at top of stone as means of attachment in raising and lowering. Holds stone by means of keys or wedges fitted to dovetailed recess.
  - .2 Dogs: metal appliance for securing parts or members together by means of one or more projecting teeth or bent portions, lug, cramp.
  - .3 Fabricator: company having sufficient capacity to quarry, cut, and deliver stonework on schedule.
  - .4 Installer: company or person specializing in commercial stone work with 10 years documented experience. Employ skilled stone masons on site to do necessary field cutting as stones are set.
  - .5 Dressed quoin stones and jamb stones: Corner stone with two finished surfaces.
- .2 Reference Standards:
  - .1 American Society for Testing and Materials (ASTM)
    - .1 ASTM C97/C97M-2009, Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
    - .2 ASTM C170/C170M-2009, Standard Test Method for Compressive Strength of Dimension Stone.
    - .3 ASTM C616/C616M-10, Specification for Quartz-Based Dimension Stone.

## **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings for all new stone required, describing method of stone replacement, including removal, shoring and erection. Refer to Drawings for locations.
  - .2 Drawings to show all details for size, section, bedding, jointing, anchor or tying system and finish of stone. Base dimensions on accurate site measurements.
  - .3 Submit moulded and profiled work details in full size.
- .3 Samples:
  - .1 Submit samples of replacement stones for approval, prior to purchase of stone.
  - .2 Submit samples from original quarry or from quarry supplying replacement stone and samples of the existing stone salvaged on site, as follows:
    - .1 Two samples: representing full range of colour, pattern and inclusions.
    - .2 One: sized and dressed to match existing stone units.
    - .3 Five: 150 mm x 100 mm x 50 mm for compressive strength test to ASTM C170.
    - .4 One: 150 mm x 150 mm x 12 mm for porosity test to ASTM C97.
    - .5 Select samples from currently worked bed of quarry and accompanied by quarry certification.
    - .6 Samples should be representative of the full range of colour, visible markings, and finish to be supplied for the entire project. Indicate quarry bed or direction of bedding on samples.
    - .7 Submit the following samples to indicate required finishes:
      - .1 1 – 250 mm x 250 mm x 250 mm: pitched faced to match existing stone between piers.
      - .2 1 – 250 mm x 250 mm x 250 mm: smooth dressed to match stone on existing piers.
    - .8 Submit stone samples to the testing laboratory designated by the Departmental Representative, for conformance with applicable ASTM Standards, prior to fabrication.

## **1.6 QUALITY ASSURANCE**

- .1 Allow Departmental Representative access to mason's workshop for inspection of current work-in-progress.
- .2 Qualifications:
  - .1 Execute work by personnel experienced in conservation of historic masonry.
  - .2 Lead masons engaged by Masonry Contractor to have minimum of 10 years of experience with historic masonry. Remaining mason qualification as per Section 04 03 41 – Historic – Repair of Stone.
  - .3 Departmental Representative has right to reject masons who do not demonstrate appropriate abilities or experience.
  - .4 Masons employed on this project throughout course of project must meet above requirements. Where, during course of project, masons leave work force, replacement masons must also meet requirements.

- .3 Mock-ups:
  - .1 Construct mock-up in accordance with Section 04 05 10 – Common Work Results for Masonry.
  - .2 Prepare mock-up of stone colour and tooling of stone face, to be approved on site by the Departmental Representative prior to commencement of the stone fabrication.
  - .3 Allow one week for inspection of mock-up by Departmental Representative, before proceeding with replacement work.
  - .4 When accepted, mock-up may remain as part of finished work.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver finished stone to site in substantial, purpose made containers, packed to avoid chipping damage or soiling from any means.
- .2 Label each container to clearly indicate contents and location on wall.
- .3 Indicate on each stone, quarry bed or direction of bedding and location of stone on building, referenced to shop drawings. Mark stones where not exposed, with permanent markers.
- .4 Protect and store stones to facilitate their resetting.
  - .1 Store dismantled masonry units on wood pallets, protected from exposure to water, elements, and potential mechanical damage, fully covered under polyethylene.
  - .2 Ventilate shelter to keep condensation from forming on internal surfaces.
  - .3 Lay out storage so that each stone will have its numbered face visible, and be accessible or removable without having to move adjacent stones.
  - .4 Ensure contact between stones is avoided by placing protective, non-staining material between and around each stone.
- .5 Avoid excessive handling, and protect against chipping, damage, soiling or staining.
- .6 Damaged stone, and stone that is repaired prior to reaching site, will be rejected.
- .7 Packaging Waste Management: remove for reuse, in accordance with Waste Management plan.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Obtain new stone from a single quarry source acceptable to Departmental Representative.
- .2 Sandstone: to ASTM C616, class II; sandstone must meet the following minimum standards:
  - .1 Compressive Strength: 60 MPa to ASTM C170.
  - .2 Absorption: Maximum 4.4%.
  - .3 Density: 2250 kg/m<sup>3</sup> to ASTM C97.
  - .4 Sandstone, of uniform colour, texture and strength, free from holes, shakes, cracks or other defects. Colour to be approved by Departmental Representative.

- .3 Ensure single quarry source has resources to provide materials of consistent quality and matching existing stone. For compatibility, stone to have similar mechanical and aesthetic properties to the existing stone.
- .4 The following quarries supply sandstone:
  - .1 Hopewell Cape (Brunswick Limestone Supplier), Hillsborough, NB. Ph. 506-734-2777 or 506-866-5608.

## **2.2 STONE BEDDING PLANES**

- .1 Supply stone to be laid on its natural quarry bed, with the following exceptions:
  - .1 Arches: lay stones with bed at right angles to thrust.
  - .2 Projecting, undercut members and soffit stones: to be edge-bedded.
- .2 Face bedded stone will be rejected.

## **2.3 STONE FABRICATION**

- .1 Cut stone to shape and dimensions obtained from accurate measurements and profiles taken from existing stone, and full to square with joints as indicated.
  - .1 Dress exposed faces true.
  - .2 Allow for beds and joints to be the same as average joint thickness in location of new replacement stone, but not to exceed 20 mm thick, and at right angles to face.
- .2 Cut stones for anchors, cramps, dowels and support systems.
  - .1 Provide Lewis pin and clamp holes in pieces which cannot be manually lifted.
  - .2 Do not cut holes in exposed surfaces.
- .3 Fabrication of Replacement Stone
  - .1 Record profile of existing stone.
  - .2 Cut and carve new stone to match existing profile.
  - .3 Obtain approval of new carved stone by Departmental Representative, prior to installation.
- .4 Finish exposed faces and edges of stones to comply with requirements indicated on drawings for finish and to match approved samples and field-constructed mock-up. Install date stamp into stone as detailed.

## **2.4 FABRICATION TOLERANCES**

- .1 Fabricate dimension stone to the following tolerances:
  - .1 Unit Length: plus or minus 1.5 mm.
  - .2 Unit Height: plus or minus 1.5 mm.
  - .3 Deviation from Square: plus or minus 1.5 mm, with measurement taken using the longest edge as the base.
  - .4 Deviation from flat surface on any exposed face: plus or minus 1.0 mm.

## **2.5 EXISTING STONE**

- .1 Use hard, sound, and clean existing stone salvaged on site only with Departmental Representative's approval.

**2.6 MORTAR**

- .1 Mortar: in accordance with Section 04 03 08 - Historic - Mortaring.

**2.7 ACCESSORIES**

- .1 Anchors, cramps, dowels: Refer to Section 04 05 19 – Masonry Anchorage and Reinforcing.

**Part 3 Execution**

**3.1 SITE VERIFICATION OF CONDITIONS**

- .1 Report in writing, to Departmental Representative areas of deteriorated masonry not previously identified.
- .2 Obtain Departmental Representative's approval and instructions for repair and replacement of masonry units before proceeding with repair work.
- .3 Stop work in that area and report to Departmental Representative immediately evidence of hazardous materials.

**3.2 PREPARATION**

- .1 Prevent absorption of ground water and water accumulation on stone. Rest stones in their natural bedding during weathering.
- .2 Move and lift stone units using means to prevent damage. Submit stone units dropped or impacted to Departmental Representative for inspection and approval. Do not make holes or indentations for Lewises or dogs on any exposed faces of stone.
- .3 Indicate bedding planes of stone units. Duplicate bedding marks on usable pieces of cut stone.
- .4 Place safety devices and signs near work area as directed.
- .5 Install and remove temporary shoring or other supports as required.
- .6 Cover adjacent plant material and fragile surfaces.
- .7 Repoint backup masonry, install anchors and install mortar in collar joint as per Section 04 03 07 - Historic-Masonry Repointing.

**3.3 EXISTING STONE REMOVAL**

- .1 Remove existing deteriorated stone after obtaining approval from Departmental Representative.
- .2 Record photographically from all aspects, those areas allocated for dismantling, prior to start of work.
- .3 Using elevation drawings, accurately number each stone to be removed, and record its position. Numbering must correspond to the shop drawings.
- .4 Where existing stone is to be reset, mark stone on face, before removal, with marking product which can be completely erased when required, or label attached to stone, without damaging masonry unit. Method of marking to the approval of the Departmental Representative.
- .5 Use approved methods to loosen stones which will cause no damage either to stones or to other elements of the lock walls.

- .6 Do not use circular millstone or saw, pneumatic chisel, steel tools exerting concentrated pressure on edge of stone. Obtain Departmental Representative's approval for use of power tools before commencing work.
- .7 Loosen wet masonry only when temperature is above freezing point.
- .8 Remove loose material from deteriorated stones and clean by wet scrubbing with vegetable fibre brush unless otherwise instructed by Departmental Representative. Do not use high pressure water jet.
- .9 Place detached stones on wood surfaces during handling. Prevent contact with metal or vegetation.
- .10 Clean dust, mortar and stone fragments from slot.

### **3.4 RAKING JOINTS**

- .1 Remove mortar in accordance with Section 04 03 07 – Historic – Masonry Repointing.

### **3.5 CUTTING/SIZING OF STONE**

- .1 Use calipers, squares and levels to measure hole for new stone. Allow for mortar joints of thickness as noted in Article 2.3 – Stone Fabrication. Where existing joints are narrower than 4 mm, confirm joint thickness with Departmental Representative prior to cutting stone.
- .2 Provide 1:10 slope on top face of stone unit, sloping down to front face, except for stones where top face is exposed.

### **3.6 MOVING STONES**

- .1 Use straps, with stone edges protected, to lift stones to working level.
- .2 Move stones horizontally in wheelbarrows or on sleds.
- .3 Move large stones using nylon belts properly spaced to provide a safe and even bearing for the stone.
- .4 Slide stones into place on wood ramps.
- .5 Protect edges of stone from damage when hoisting and lifting from position. Use wood shims to isolate units from hoisting belts.
  - .1 Incorporate only undamaged stone in Work.

### **3.7 INSERTING REPLACEMENT STONE**

- .1 Clean stone by washing with water and natural fibre brush before laying.
- .2 Dampen surfaces of slot and apply bedding mortar.
- .3 Lay heavy stones and projecting stones after mortar in courses below has hardened sufficiently to support weight.
- .4 Prop and anchor projecting stones until wall above is set.
- .5 Set large stones on water soaked softwood wedges, to support stone in proper alignment until mortar has set. Remove wedges when dry, do not break off.
- .6 Insert and compress firm mortar to within 30mm of pointing surface. Allow mortar to set 24 hours.
- .7 Remove mortar dropping from face of stone before mortar is set. Sponge stone free of mortar along joints as work progresses.

- .8 Install stainless steel anchors to fix stone face plates as indicated. Provide minimum of two anchors per stone, top and bottom, unless noted otherwise.
- .9 Set stones plumb, true, level in full bed of mortar with vertical joints buttered and placed full except where otherwise specified. Completely fill anchor, dowel and lifting holes and voids left by removed edges.
- .10 Fill solid, all voids behind stone using specified mortar, except where noted.

**3.8 FILLING JOINTS/POINTING**

- .1 Fill joints and point: in accordance with Section 04 03 07 - Historic - Masonry Repointing.

**3.9 PROTECTION OF WORK**

- .1 Cover top of completed and partially completed wall, not enclosed or sheltered, with weatherproof coverings at end of each working day.
  - .1 Drape cover over wall and extend 0.5 m down both sides.
  - .2 Anchor securely in position.
  - .3 Prevent finished work from curing too quickly.
  - .4 Protect from drying winds. Pay particular attention at corners.
- .2 Protect adjacent finished work from marking or damage which may be caused by on-going work.
- .3 Provide temporary bracing of masonry work during erection until permanent structure provides adequate bracing.

**3.10 CLEANING**

- .1 Confirm acceptance of mock-up cleaning operations to demonstration from Departmental Representative before starting cleaning work.
- .2 Clean stone work surfaces after repairs have been completed and mortar has set.
- .3 Clean stone surfaces of adhesive or mortar residue resulting from work performed without damaging stone or joints.
- .4 Clear site of debris, surplus material and equipment, leaving work area in clean and safe condition.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 04 03 07 – Historic – Masonry Repointing and Repair.
- .2            Section 04 05 19 – Masonry Anchorage and Reinforcing.

**1.2                REFERENCES**

- .1            Canadian Standards Association (CSA International)
  - .1            CAN/CSA A371-14, Masonry Construction for Buildings.

**1.3                ADMINISTRATIVE REQUIREMENTS**

- .1            Conduct pre-installation meeting one week prior to commencing work of this Section, to:
  - .1            Verify restraints which must be adhered to, with respect to working on an occupied High Security Prison structure.
  - .2            Verify project requirements, including mock-up requirements.
  - .3            Verify substrate conditions.
  - .4            Co-ordinate products, installation methods and techniques.
  - .5            Sequence work of related sections.
  - .6            Coordinate with other sub-trades.
  - .7            Review manufacturer's installation instructions.
  - .8            Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
  - .9            Review warranty requirements.

**1.4                ACTION SUBMITTALS**

- .1            Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Product Data:
  - .1            Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, limitations and colours.
  - .2            Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS).
- .3            Samples:
  - .1            Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2            Provide samples as follows:
    - .1            One sample of stone to be used to replace existing stone, where stone has not been salvaged from site.
    - .2            One sample each of mortar and grout.
    - .3            One sample of each type of masonry anchorage proposed for use, supplemented by specific requirements in Section 04 05 19 - Masonry Anchorage and Reinforcing.
    - .4            One sample of each type of Restoration mortar.

- .3 Submit samples for testing to laboratories employing technicians certified/trained in procedures for testing masonry units.
- .4 The approved samples denote the standard of material to be used.
- .4 Shop Drawings:
  - .1 Provide drawings stamped and signed by Professional Engineer registered or licensed in the Province of New Brunswick.
  - .2 Where existing masonry becomes unsupported during construction, provide shop drawings detailing temporary bracing required, designed to resist lateral forces during installation.
- .5 Temporary Bracing:
  - .1 Submit stamped engineered drawings for temporary bracing.

## **1.5 INFORMATION SUBMITTALS**

- .1 Certificates: provide manufacturer's product certificates certifying materials comply with specified performance requirements and physical properties.
- .2 Test and Evaluation Reports:
  - .1 Provide certified test reports in accordance with Section 01 33 00 – Submittal Procedures.
  - .2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.
  - .3 Provide data for masonry units, in addition to requirements set out in referenced CSA Standards, indicating initial rates of absorption.
  - .4 For stone replacement units, submit test reports confirming compressive strength, density and porosity to requirements set out in referenced CSA Standards.
- .3 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.
- .4 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:
  - .1 Verification of compliance of work with Contract.
  - .2 Site visit reports providing detailed review of installation of work, and installed work.

## **1.6 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Manufacturer: capable of providing field service representation during construction and approving application method.
  - .2 Installer: experienced in performing work of this section; who has specialized in installation of work similar to that required for this project.
  - .3 Masons: company or person specializing in masonry installations with five (5) years documented experience with masonry work similar to this project.
    - .1 Masons employed on this project must demonstrate ability to reproduce mock-up standards.
  - .4 For heritage work: The principal stone mason and site superintendent engaged by the Masonry Contractor must have a minimum of ten (10) years of experience with historic masonry conservation similar to this project, and can demonstrate an ability to pass a hands-on test of skills, if so administered by the Departmental Representative. The Departmental Representative has the right to reject either of

these individuals, if their qualifications cannot be substantiated, or who does not demonstrate the appropriate abilities or experience on the following tasks:

- .1 Raking joints by hand.
  - .2 Cutting stone.
  - .3 Carving stone.
  - .4 Dutchman repairs.
  - .5 Pinning techniques.
  - .6 Restoration mortar/Consolidation repairs: repairs involving proprietary stone restoration mortar/consolidants shall be carried out by persons who have successfully completed the manufacturer's training course and have been certified by the manufacturer for the type of work required. Provide proof of accreditation by the manufacturer before work begins.
  - .7 Historical repointing.
- .5 All masons employed on this project must meet the above requirements. Where, during the course of the project, masons leave or become unavailable to perform their duties, replacement masons must also possess comparable experience equivalent to the masons being replaced.
- .6 Apprentices: Apprentices may work on the project provided their work is under the direct supervision of an experienced mason, at a ratio of no more than two apprentices for one experienced mason.
- .2 Mock-ups:
- .1 Masonry
    - .1 Construct mock-up panel of masonry wall construction, 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, jointing, coursing, mortar, reglets, stone repairs, tooling and workmanship.
    - .2 For repointing, mock-up must include examples of saw-cut joints, raked joints, backpointed joints and finishpointed joints for both horizontal and vertical applications.
  - .2 Water Cleaning
    - .1 Conduct tests on wall to determine effectiveness of low pressure wash cleaning methods, two hour time periods.
    - .2 Test patches to be 2m square.
    - .3 Start with lowest impact tests and stop testing at desired level of cleaning is achieved; stop testing immediately when damage is caused.
    - .4 Test pressure at each storey height to determine effect of "line drop" on effectiveness of water jets.
    - .5 Test brushing and spraying as alternative to pressure washing. Departmental Representative to review test results. Use method approved by Departmental Representative.
    - .6 Desired result and degree of cleanliness will be determined at mock-up, to the satisfaction of the Departmental Representative.
    - .7 Avoid saturation of stone. Excessive saturation of stone will result in activation of natural salts, with resultant efflorescence. Work with Departmental Representative to ensure this condition does not occur. This may involve reducing the length of exposure to continuous soaking.
  - .3 Mock-up used:
    - .1 To judge workmanship, aesthetics, substrate preparation, operation of equipment and material application.
    - .2 For testing to determine compliance with performance requirements.
  - .4 Construct mock-up where directed by Departmental Representative.
  - .5 Notify Departmental Representative 48 hours before commencing each mock-up.
  - .6 Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with work.

- .7 When accepted by Departmental Representative, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.
- .8 Start work only upon receipt of written acceptance of mock-up by Departmental Representative.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- .1 Only accept materials that have been delivered to site in original, unbroken, undamaged packages. Damaged packages are not to be accepted on site.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Storage and Handling Protection:
  - .1 Keep materials dry until use.
  - .2 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
- .4 Packaging Waste Management:
  - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

### **1.8 SITE CONDITIONS**

- .1 Weather Requirements: to CAN/CSA A371.
- .2 Site Environmental Requirements
  - .1 Cold weather requirements: Supplement Clause 6.7.2 of CAN/CSA A371 with following requirements:
    - .1 Maintain temperature of mortar between 5 degrees C and 30 degrees C until batch is used or becomes stable.
    - .2 Maintain ambient temperature between 5 degrees C and 30 degrees C and protect site from wind chill.
    - .3 Cover mortar less than 7 days old with tarpaulins, when temperature is forecast to fall below 5 degrees C, and insulated tarpaulins when temperature is forecast to fall below 0 degrees C.
    - .4 Provide heating of masonry work when the average air temperature falls below -4 degrees C.
    - .5 Maintain mean temperature of masonry above 0 degrees C for a minimum of 28 days, after mortar is installed.
    - .6 Do not repoint if the temperature is forecast to drop below -4 degrees C in the following 24 hours.
    - .7 Each unheated section of wall must be preheated in it's enclosure for a minimum period of 72 hours above 10 degrees C, before any mortar is applied.
  - .2 Hot weather requirements:
    - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
    - .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.
    - .3 Spray mortar surface at intervals and keep moist for minimum time required for curing as noted in Section 04 03 07 – Historic – Masonry Repointing, after installation.
    - .4 Provide hot weather protection against direct sunlight and wind, when air temperature exceeds 20 degrees C.

- .3 Maintain minimum/maximum thermometers and relative humidity gauges on site and in all enclosures and maintain a daily record of temperature and humidity. Submit along with record documentation.

## **1.9 PERFORMANCE**

- .1 The following will be considered deficiencies in the work, in addition to any failure to meet other provisions of these specifications:
  - .1 Mortar shrinkage cracks between units.
  - .2 Unfilled joints.
  - .3 Spalling of units or joints.
  - .4 Poor colour or texture blending of joints or units.
  - .5 Dusting, efflorescence of joints or units.
  - .6 Surface discolouration, discoloration, variance of colour or crumbling of mortar.
  - .7 Failure of anchors of built-in items.
  - .8 Sloppy fitting, or otherwise poor workmanship in levelling, bedding or jointing of units.
  - .9 Failure to match adjacent work or failure to match control test area.
  - .10 Failure to adequately cure the mortar.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Masonry materials are specified in Related Sections:

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.2 EXAMINATION**

- .1 Examine conditions, substrates and work to receive work of this Section.
- .2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.
  - .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .2 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval from Departmental Representative.
- .3 Verification of Conditions
  - .1 Verify that:
    - .1 Field conditions are acceptable and are ready to receive work.
    - .2 Commencing installation means acceptance of existing substrates.

### **3.3 PREPARATION**

- .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.

- .2 Protect adjacent materials from damage and disfiguration.
- .3 Provide temporary bracing of masonry work during and after erection, as required.
- .4 Bracing must be approved by Departmental Representative.
- .5 Winter Heating
  - .1 When average daily temperature is forecast to fall below -4 degrees C, provide winter heat and maintain 55% relative humidity level within the scaffold/housing enclosure.
  - .2 The use of open flame to provide heating is strictly forbidden.

### **3.4 INSTALLATION**

- .1 Masonry work in accordance with CAN/CSA A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

### **3.5 CONSTRUCTION**

- .1 Jointing:
  - .1 For joint finishing, see Section 04 03 07 - Historic-Masonry Repointing and Repair.

### **3.6 SITE TOLERANCES**

- .1 Conform to Clause 6.2 of CAN/CSA A371, unless otherwise noted.

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests, Inspection:
  - .1 Inspection and testing will be carried out by Testing Laboratory designated by Departmental Representative.
  - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.
  - .3 Departmental Representative will pay costs for testing.

### **3.8 CLEANING**

- .1 Perform cleaning after installation and when mortar has fully cured to remove construction dust and accumulated environmental grime.
- .2 Upon completion of installation and verification of performance of installation, remove surplus materials, rubbish, tools and equipment barrier

**3.9 PROTECTION**

- .1 Protect masonry, metal flashings, finished window frame surfaces and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 04 05 10 – Common Work Results for Masonry.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM A666-14, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .2 ASTM A1064/A1064M-15, Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - .3 ASTM C1242-15, Guide for Design, Selection, and Installation of Dimension Stone Anchors and Attachment System.
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA A371-14, Masonry Construction for Buildings.
  - .2 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction.
  - .3 CSA A370-14, Connectors for Masonry.
  - .4 CSA S304.1-14, Design of Masonry Structures.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets illustrating specified products to be incorporated into project.
  - .2 Provide two copies of Workplace Hazardous Materials Information System (WHMIS) - Material Safety Data Sheets (MSDS) in accordance with Section 01 35 30 - Health and Safety Requirements.
  - .3 Submit product data on helical anchors and stainless steel anchors.
- .3 Shop Drawings:
  - .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Provide shop drawings detailing anchorage details, lists and placing drawings.
  - .3 On placing drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
- .4 Manufacturer's Instructions:
  - .1 Provide manufacturer's installation instructions.

**1.4 QUALITY ASSURANCE**

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- .4 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 04 05 10 - Common Work Results for Masonry.

## **1.5 FIELD MEASUREMENTS**

- .1 Make field measurements necessary to ensure proper fit of members.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle masonry anchorage and reinforcing materials in original packaging until required for installation.
- .2 Packaging Waste Management:
  - .1 Separate and recycle waste materials in accordance with Waste Management plan.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Connectors: Stainless steel to CSA A370 and CSA S304.1.
- .2 Corrosion protection: to CSA S304.1, stainless steel to CSA S304.1 and CSA A370.
- .3 Helical Wall Ties: stainless steel helical anchors to Grade 304, sizes as shown on Drawings. Acceptable Manufacturer:
  - .1 Helifix
  - .2 Blok-Lok Spira-lok
  - .3 Thor Helical
- .4 Adhesive Anchors: stainless steel threaded rod anchors, Grade 304, with two part hybrid adhesive system, as used for Hilti type adhesive anchors (HY-70). Supply anchors as per Drawings.
- .5 Stone Anchorage: type 304 stainless steel conforming to ASTM A666. Supply anchors as per Drawings.
- .6 Wire Reinforcement: To CAN/CSA A371 and ASTM A1064, truss type.

### **2.2 FABRICATION**

- .1 Fabricate reinforcing in accordance with CSA A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Fabricate connectors in accordance with CSA A370.
- .3 Obtain Departmental Representative's approval for locations of reinforcement splices other than shown on placing drawings.
- .4 Ship reinforcement and connectors, clearly identified in accordance with drawings.

- .5 Anchor Lengths: Determine anchor lengths on site prior to fabrication. Allow for any and all stone removals required to confirm the required anchor lengths. Allow for any deviations in length due to irregularities discovered that must be compensated for such as anchor stone position, size, thickness.

### **2.3 SOURCE QUALITY CONTROL**

- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum 5 weeks prior to commencing reinforcement work.
- .2 Upon request, inform Departmental Representative of proposed source of material to be supplied.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 PREPARATION**

- .1 Prior to site measuring of anchors, obtain confirmation of proposed location of each anchor from Departmental Representative. Upon completion of measuring and confirming conditions to achieve successful installation, bring deviations or complications to the Departmental Representative for review.

### **3.3 INSTALLATION**

- .1 Supply and install masonry connectors and reinforcement in accordance with ASTM C1242, CSA A370, CAN/CSA A371, CSA A23.1 and CSA S304.1 unless indicated otherwise.
- .2 Prior to placing mortar, obtain Departmental Representative's approval of placement of reinforcement and connectors.
- .3 Supply and install additional reinforcement to masonry as indicated.
- .4 The use of expansion type anchors for temporary or permanent applications in stone masonry is prohibited.

### **3.4 HELICAL WALL TIES**

- .1 Install helical wall ties as indicated. Installation as per manufacturer's instructions. Repair mortar joint after installation as per specifications.
- .2 Pre-drill hole for anchor. Drill bit diameter to be one size smaller than the required anchor diameter.
- .3 Install anchors after backpointing has been approved by the Departmental Representative.
- .4 Do not mark face of stone with the drill. Damage as a result of careless use of the drill will be repaired at the Contractor's expense.

- .5 Ensure the head of the anchor will be completely covered by finishpointing mortar.
- .6 Where helical anchors are installed as the outer leaf of the masonry walls is being constructed, drill helical anchors into the backup concrete wall and lay in a bed of mortar joint in outer leaf, as reconstruction of the outer leaf proceeds.

**3.5 ADHESIVE ANCHORS**

- .1 Install adhesive anchors as per manufacturer's instructions.

**3.6 ANCHORS**

- .1 Supply and install stainless steel anchors as indicated.

**3.7 FIELD BENDING**

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars and connectors which develop cracks or splits.

**3.8 SITE QUALITY CONTROL**

- .1 Departmental Representative to inspect installation prior to installation of stones, where stone to be reset and prior to finishpointing.

**3.9 CLEANING**

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment and barriers.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 04 03 08 – Historic – Mortaring.
- .2 Section 04 05 10 – Common Work Results for Masonry.
- .3 Section 04 05 19 – Masonry Anchorage and Reinforcing.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA A371-2014, Masonry Construction for Buildings.
  - .2 CSA A165 Series-2014, CSA Standards on Concrete Masonry Units.
  - .3 CSA A179-2014, Mortar and Grout for Unit Masonry.
  - .4 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Product Data: provide product data, including manufacturer's printed data sheets and catalogue pages illustrating products to be incorporated into project for specified products.
- .3 Samples:
  - .1 Provide unit samples in accordance with Section 04 05 10 - Common Work Results for Masonry.
- .4 Manufacturer's Written Instructions: provide in accordance with Section 04 05 10 - Common Work Results for Masonry.

### **1.4 QUALITY ASSURANCE SUBMITTALS**

- .1 Test and Evaluation Reports: provide certified test reports in accordance with Section 04 05 10 - Common Work Results for Masonry.
- .2 Pre-Installation Meetings: conduct pre-installation meeting in accordance with Section 04 05 10 - Common Work Results for Masonry to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- .3 Mock-ups:
  - .1 Construct mock-ups in accordance with Section 04 05 10 - Common Work Results for Masonry supplemented as follows:
    - .1 Construct mock-up panel of exterior concrete unit masonry construction 1200 x 1800 mm.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle concrete unit masonry in accordance with Section 04 05 10 - Common Work Results for Masonry.

- .2 Packaging Waste Management:
  - .1 Separate and recycle waste materials in accordance with Waste Management Plan.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Standard concrete block units Type II: to CSA A165.
  - .1 Classification: H/15/A/M.
  - .2 Dimensions – Nominal: 200 mm wide x 200 mm high x 400 mm long.
  - .3 Dimensions: CCMPA Metric Modular; Nominal: 200 wide x 200 high x 400 mm long.
  - .4 Special shapes: provide square units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.

### **2.2 REINFORCEMENT**

- .1 Reinforcing steel: billet steel, grade 400, deformed bars to CSA G30.18, unless indicated otherwise.
  - .1 15M top course as noted on Drawings.
  - .2 15M dowels set at 400 mm o.c., embedded 450 mm into concrete and set in epoxy.
- .2 Horizontal joint reinforcement in accordance with Section 04 05 19 – Masonry Anchorage and Reinforcing.

### **2.3 CONNECTORS**

- .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

### **2.4 MORTAR MIXES**

- .1 Mortar and mortar mixes in accordance with Section 04 03 08 – Historic - Mortaring.

### **2.5 GROUT MIXES**

- .1 Grout and grout mixes as follows:
  - .1 Bond Beams: grout mix 10 to 12.5 MPa strength, but no stronger than concrete block at 28 days; 200-250 mm slump; mixed in accordance with CSA A179 fine grout, Table 5.
  - .2 Grout strengths in excess of the strength of the concrete block unit will be cause for rejection by the Departmental Representative.

### **2.6 CLEANING COMPOUNDS**

- .1 Use low VOC products.
- .2 Compounds to be compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

## **2.7 TOLERANCES**

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CSA A165.1, supplemented as follows:
  - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
  - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
  - .3 Out of square tolerance not to exceed 2 mm.
  - .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verify surfaces and conditions are ready to accept work of this Section.
- .2 Commencing installation means acceptance of existing substrates.

### **3.2 PREPARATION**

- .1 Protect adjacent finished materials from damage due to masonry work.

### **3.3 INSTALLATION**

- .1 Concrete block units:
  - .1 Bond: running.
  - .2 Coursing height: 200 mm for one block and one joint.
  - .3 Jointing: concave where exposed or where paint or other finish coating is specified.
- .2 Bond Beams:
  - .1 Regular concrete block unit, with upper half of web cut away to facilitate horizontal reinforcement. Core filled with grout. Install layer of building paper below to retain grout until set.

### **3.4 REINFORCEMENT**

- .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

### **3.5 CONNECTORS**

- .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

### **3.6 MORTAR PLACEMENT**

- .1 Place mortar in accordance with Section 04 03 08 – Historic – Masonry Mortaring.
- .2 Remove excess mortar from grout spaces.

### **3.7 GROUT PLACEMENT**

- .1 Install grout to requirements of CSA A179.
- .2 Work grout into masonry cores and cavities to eliminate voids.
- .3 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.
- .4 Do not displace reinforcement while placing grout.

### **3.8 CONSTRUCTION**

- .1 Construct concrete block unit masonry to CAN/CSA A371.
- .2 Cull out masonry units, in accordance with CSA A165 with chips, cracks, broken corners, excessive colour and texture variation.
- .3 Build in miscellaneous items such as bearing plates, bolts, anchors, inserts, sleeves and conduits.
- .4 Construct masonry walls using running bond, unless otherwise noted.
- .5 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .6 Install reinforcement in accordance with CAN/CSA A371.
- .7 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .8 Tamp units firmly into place.
- .9 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .10 Tool exposed joints concave; strike concealed joints flush.
- .11 After mortar has achieved initial set up, tool joints.
- .12 Bond Beams: Provide bond beams. Construct in accordance with CAN/CSA A371 and as detailed on Drawings.
- .13 Grouting: Ensure vertical cells are clear of mortar prior to grouting. Grout cells in accordance with CAN/CSA A371.

### **3.9 REPAIR/RESTORATION**

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

### **3.10 FIELD QUALITY CONTROL**

- .1 Site Tests, Inspection: in accordance with Section 04 05 10 - Common Work Results for Masonry.

**3.11 CLEANING**

- .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .2 Waste Management: separate waste materials for reuse and/or recycling in accordance with Waste Management Plan.

**3.12 PROTECTION**

- .1 Brace and protect concrete unit masonry in accordance with Section 04 05 10 - Common Work Results for Masonry.

**END OF SECTION**