
Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 04 03 06 – Historic works – masonry cleaning.
- .2 Section 04 03 08 – Historic works – Mortaring.
- .3 Section 04 03 41 – Historic works – Repair of Stone.
- .4 Section 04 03 42 – Historic works – Replacement of Stone.
- .5 Section 04 05 00 – Common Work Results for Masonry.
- .6 Section 04 05 19 – Masonry Reinforcement and Connectors.
- .7 Section 04 11 00 – Proprietary Grout Anchors.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A276-08a, Standard Specification for Stainless Steel Bars and Shapes
- .2 CSA International
 - .1 CAN/CSA A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - .2 CSA-A371-04, Masonry Construction for Buildings.
 - .3 CAN/CSA A179-04(R2014), Mortar and Grout for Unit Masonry.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submit documents and samples in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Submit two copies of WHMIS MSDS Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements for materials used for the work of this Section. Indicate VOC content.

1.4 QUALITY ASSURANCE

- .1 Refer to Section 04 05 00 - Common Work Results for Masonry.

1.5 MOCK-UPS

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control and Section 04 05 00 - Common Work Results for Masonry.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store cementitious materials and aggregates in accordance with CSA A23.1.
- .2 Store lime putty in plastic lined sealed drums.
- .3 Ensure that manufacturer's labels and seals are intact upon delivery.
- .4 Remove rejected or contaminated material from site.
- .5 Keep mortar sand in a dry and well ventilated area.

1.7 PROTECTION

- .1 At end of each working day, cover unprotected work with waterproof membranes. Membranes should extend to 1 meter over surface area of work and be tightly installed 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 Protect new works against frost during a period of 21 days.
- .4 All methods of enclosure and protection shall be to the approval of the Departmental Representative.
- .5 Newly laid mortar shall be protected from excessive exposure to rain, to frost and full sunlight for a period of 21 days or until the surface is fully cured.
- .6 Provide and maintain protection for masonry walls at all times when work is suspended to prevent water from entering partially repointed masonry.
- .7 Protection shall consist of protection sheets as described in section 01 54 24, secured to prevent lifting during windy conditions or storms.
- .8 Provide protection boards to exposed corners and all openings such as doors and windows that could be damaged by construction activities. Maintain protection for the duration of operations. Remove and dispose of protective materials as directed by the Departmental Representative

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous material; and regarding labelling and the provision of Material Safety Data Sheets.

1.9 TEMPERATURE AND RELATIVE HUMIDITY CONTROL

- .1 For the masonry works, maintain at all times a relative humidity of 50% and ambient temperature of 15 °C minimum and 25°C maximum or less in the scaffoldings and inside the building for the masonry works:
 - .1 Store mortar components intended for immediate use in heated enclosures, and let these materials reach a temperature of at least 12 °C before implementing them.

- .2 Heat and maintain the water at a temperature of at least 15 °C and at the most 25 °C.
 - .1 At the time of use, mortar temperature must be at least 15 ° and at the most 30 °C.
- .2 Install thermometers and relative humidity probes at every 2 levels in the exterior scaffoldings and at each 7 meters of distance from one to the other on the same storey of scaffoldings in exterior conditions. A thermometer and relative humidity probe must be installed in each interior room where masonry works are being held. Checking and temperature and relative humidity must be done at each hour even during to night (24 hours /24 and 7 days on 7 during all duration of masonry works.). The contractor must transmit all data of all thermometers and probes on a weekly basis in Excel format to Departmental representative. All readings under 15 °C and over 25°C must be highlighted in the Excel file.
- .3 Protection requirements are specified in Section 04 05 00 - Common Work Results for Masonry.
- .4 Obtain approval from Departmental Representative for methods of protection and fabrication of enclosures.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 04 05 00 - Common Work Results for Masonry

1.11 ACCEPTABLE PRODUCTS AND MATERIALS

- .1 Where a particular brand name is stipulated, see Instructions to Bidders for procedure for requesting approval of substitute materials and products

Part 2 Products

2.1 MATERIALS

- .1 Mortar and grout materials: to Section 04 03 08 – Historic works- Mortaring.

2.2 COLOURED LIME MORTAR

- .1 Coloured lime mortar: to Section 04 03 08 - Historic works - Mortaring.

2.3 GROUT INJECTION

- .1 Grout masonry in accordance with CSA-S304.1, CSA-A371 and CSA-A179, ASTM C348 and ASTM C940; control water content to conform to CSA A179, Clause 4.2.1.2 and Clause 4.3.1.5,

2.4 TEMPORARY SHIMS

- .1 High density plastic temporary shim with appropriate thickness for stone setting and/or where raking/ cleanout operations may loosen stone units.

Part 3 Execution

3.1 SITE VERIFICATION OF CONDITIONS

- .1 Report in writing, to Departmental Representative unexpected areas of deteriorated masonry revealed during work (ex. deteriorated substrate). Obtain Departmental Representative approval and instructions of repair and replacement of masonry units before proceeding with repair work.
- .2 Obtain written approval of Departmental Representative prior the commencement of the following operations:
 - *Once the raking out of mortar joints and preparation are completed;*
 - *Prior the grouting;*
 - *Prior the backpointing;*
 - *Prior the front pointing and/or repointing*

3.2 GENERAL

- .1 Perform work in accordance with CSA-A371. Extent of raking out and repointing is as noted on the Drawings.
- .2 Unless otherwise indicated by Departmental Representative, use manual raking tool to remove deteriorated mortar and ensure that no masonry units are Chipped/altered or damaged by work to remove mortar. Tools for cutting out must be narrower than the joint; provide and use dove-tailed tipped chisels.
- .3 Tool and compact using jointing tool to force mortar into joint.
- .4 Except where specified otherwise by Departmental Representative, finish joints as approved after mock-ups;
- .5 Use suitable and pre-approved jointing tools to place and form mortar in joints.

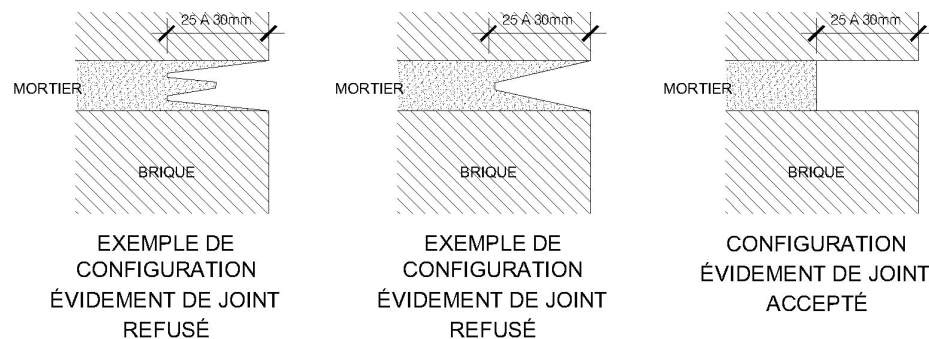
3.3 REPOINTING

- .1 Raking out brick and stone joints:
 - .1 Undertake works of raking out joints only when surface temperature reaches 15°C and more. Do not rake joints when mortar and/or stone /brick are below this temperature.
 - .2 IMPORTANT NOTE: Contractor must allow time and efforts necessary to rake out 100% of mortar joints of Annex 1913-1914 (East Wing) including the Quarter Master. The existing mortar is very hard and may reach up to 20 MPa. The formula in the original specifications of 1913 of this mortar is 1 part Portland cement for 3 parts sand. No extra cost or additional compensation will be granted to the contractor because the mortar is hard and that joints are difficult to rake out.

- .3 Do a clearing saw cut at the the centre of the joint, to a maximum depth that is equal to half of the joint width. Mortar must remain on each side of the cut. The grinding saw must not touch the stone/bricks. Use specialty rotary grinding saw of 86 mm diameter equipped with a 3mm thick cutting blade at the centre of the joints without damaging the ridges of stones/bricks.
- .4 All raking of remaining mortar works, following the clearing saw cut, must be done manually by using a hammer and a chisel. Damages to adjacent masonry elements will not be tolerated. The use of rotary saw is not accepted for raking the joints except for the clearing saw cut at the centre of the joint. The contractor must demonstrate to the Departmental Representative that he does not damage the stones/bricks before starting to use the rotary saw for the clearing saw cut.
 - .1 Only 3 masons will be appointed to the work of cutting mortar from joints with a rotary saw, and only after having proven by demonstration that their work is to the satisfaction of Departmental Representative by work mock ups .Notification must be given 15 days in advance of any intention of the Contractor to change an appointed mason for another.

The replacing masons must be trained and demonstrate the same capacities as their predecessors for the use of the rotary saw.
- .5 Clean joints to full depth of deteriorated mortar but in no case to less than 25 mm. Voids to fill in mortar joints can reach as deep as 250 mm. Clean all emptied joints and cavities of loose material voids as they are encountered. Fabricate tools, as necessary, to suit the execution of a specific problem as it is encountered in order to insure the all debris and loose mortar particles are removed.
- .6 Clean by compressed air, surfaces of joints without damaging texture of exposed joints.
- .7 Flush open joints and voids; clean open joints and voids with low pressure water and compressed air to remove all debris and dust.
- .8 Fine joints (less than 2 mm) need not be raked out more than 25 mm, in order to reduce the danger of chipping the masonry edges. It is possible that Departmental Representative may require the restoration of stone ridges with rotary saws to widen joints in certain situations. When saw cutting vertical widening joints, stop saw cut 50 mm from end of joint and finish manually in order to avoid cutting into adjacent stone/brick work.
- .9 Any stone/brick damaged as a result of careless raking, or saw cutting, shall be replaced at no cost for the Departmental Representative.
- .10 Unless otherwise approved by the Departmental Representative, do not rake the joints for more than three levels of scaffolding in height, in any area, prior to back pointing,
- .11 Install temporary shims in areas where raking or cleanout activities cause a stone unit to become loose.

- .12 After the raking/cleanout activities are completed but **before** the beginning of back pointing, the Departmental Representative will conduct an assessment of stone/brick repair requirements and will make the necessary adjustments to stone repair designations according to the specified quantity allowances on the drawings.



.2 Backpointing:

- .1 Where cut out joints are deeper than minimum raking out depths specified, back point joints to bring mortar face to specified depth for raked out joints, in preparation for finish pointing. Where voids exist that conventional back pointing cannot fill, most often met at vertical joints, notify Departmental Representative to receive his instructions.

In such instances, the following work shall be carried out:

- .1 Do back pointing to reach a depth of up to 250 mm. When mortar is firm, rake-out to prepare depth of back pointing such that 25 mm at face is empty for front pointing. Provide back pointing of 30% of mortar joints of exterior elevations of East Wing and 100% of exterior elevations of Central Building (non-dismantled masonry zones).
 - .2 Drill holes in top of joint to receive a 6 mm grout tube. Insert tube and seal with cloth. Inject grout under low pressure into deep cavity such that the full voided interior space around the stone unit is positively filled. See section 04 03 09 Historic works grout injection.
 - .3 Allow grout to firm up and thoroughly clean and rinse any grout spills from surface of stone in order to prevent staining. See section 04 03 09 Historic works grout injection.
 - .4 Allow grout to thoroughly cure and humidity in wall to dry before proceeding with frontpointing. See section 04 03 09 Historic works grout injection.
- .2 Immediately prior to pointing, thoroughly wet joints in order to control absorption at the following periods (do not saturate the joint with water):
- .1 The day before repointing
 - .2 The same morning as repointing
 - .3 15 minutes before repointing

- .3 Allow water to soak into masonry and mortar, leaving no standing water, but the joint surface remaining damp.
 - .4 For backpointing, fill all joints full with mortar, compacting firmly into joints to ensure positive adhesion to all inner surfaces. Place mortar in layers, max 30 mm thick; do not wait for it to cure before placing other layers. Bring face of mortar in backpointed joint to specified minimum depth from stone/brick face, measured from the ridges of the masonry unit.
 - .5 Leave mortar in joint square and of even depth measured from stone/brick edges. Where joints are wide, be certain to score the surface of the backpointing in order to assist bonding of the frontpointing when it is placed.
 - .6 Prevent mortar from being placed or smeared onto face of stone during pointing work.
- .3 Frontpointing :
- .1 Repoint 100% of surface mortar joints of all exterior walls of the Armoury (East Wing and non-dismantled zones of Central building). See drawings for repointing of interior walls. When all reassembly, stone repairs and brick/stone replacement works are completed, do surface repointing works as described in this section. Contractor will not be authorized to use the same mortar for backpointing as for frontpointing. The table at item 2.2 of section 04 03 08 must be respected and followed.
 - .2 Dampen joints and completely fill with mortar. Immediately prior to pointing, thoroughly wet joints in order to control absorption at the following periods (do not saturate the joint with water):
 - .1 The day before repointing
 - .2 The same morning as repointing
 - .3 15 minutes before repointing
 - .3 Do repointing with a little set back from surface to keep same width of joint. Avoid thin edges. Pack mortar solidly into voids and joints.
 - .4 Before repointing, wash walls to be repointed and allow to dry to damp, but not wet or soaked conditions. Ensure that all dust, mortar particles, and other debris are removed from joints and wall surfaces before repointing.
 - .5 Keep masonry damp while pointing is being performed.
 - .6 Do no pointing in freezing weather. See Section 04 05 00 - Common Work Results for Masonry.
 - .7 Firmly pack frontpointing mortar into joint being certain that full contact with backpointing and joint edges of stone is made. Fill joint with mortar to slightly overfill.
 - .8 Mortar must be recessed by approximately 1 mm (with a slope toward the bottom as described on the drawings) or as established during mock-up, such that the arrises of the edges are visible. Flush cut joints or overflowing joints will not be allowed.
 - .9 Final finish texture of the mortar joint will be completed using a stiff bristle brush which is struck, not wiped, against the surface of the finished joint.

- .10 Do not retemper pointing mortars by adding water.
- .11 Remove excess mortar from masonry face before it sets and clean thoroughly with water, brushes and thick cotton rags.
- .4 Protection:
 - .1 Protect newly laid mortar from frost, rainfall or rapid drying conditions such as wind for 21 days
- .5 Humid Curing (heated conditions):
 - .1 For the first seven days, the masonry to be maintained at a temperature above 12°C, and moist conditions near the surface of the masonry (not in contact) should be controlled using damp burlap covered with a 10 mils polyethylene membrane protection. The burlap canvas must not be in contact with the wall and must be kept at a distance of 75 mm. The burlap must be moistened by an irrigation system (perforated watering can at head of section) with timer so that the moistening of the burlap be done automatically at every 4 hours even during the night.
 - .2 The relative humidity level must be kept high (above 50 per cent) within the heated enclosure to avoid premature drying of the mortar (heating cold air has the effect of lowering its relative humidity). The polyethylene membrane must be maintained in good state with 300mm overlaps between sheets and without openings or ripping. Department representative may require to replace any section of burlap or polyethylene membrane if he judges they are not adequate.
 - .3 After seven days of humid curing, the fresh repointed masonry to be protected from weather conditions such as rain or snowmelt for a minimal period of 21 days.

3.4 RESETTING MASONRY UNITS

- .1 Empty carefully peripheral mortar joints by doing a clearing saw cut. If stone is still solid in the wall, drill deconsolidation openings 150 mm deep with a bit drill in the peripheral joint at every 50 mm without damaging the edges of the stone. If stone is not deconsolidated after the drillings, proceed with a parallel double blade rotary saw as Arbotech type. Gently remove stone to be reset.
- .2 Remove all loose debris and deteriorated mortar from exposed stone/brick core. Remove loose masonry elements and chip and clear away core masonry as necessary to allow stones to be rebuilt to fit.
- .3 Backpoint all mortar joints of the exposed brick/stone once facing stone is removed and up to to 100 mm depth.
- .4 Consolidate and parge 100% of exposed core with mortar - fill all the exposed cavities before reinstalling the facing stone.
- .5 Allow mortar to set 24 hours before proceeding with grout injection. Insert grout tubes along top joint. Inject grout by gravity around the reset stone or stones.
- .6 Install stone in it's original location.

- .7 Fix masonry units in correct location with water-soaked hardwood wedges.
- .8 Pull out wood wedges when dried and shrunken.
- .9 Proceed with frontpointing only once grout has cured and humidity related to the grout installation has subsided. Remove any salts and efflorescence that may have formed on surface of stone with a nylon bristle nylon brush prior to front pointing.

3.5 SUMMARY TABLE OF FRONTPOINTING AND BACK POINTING

- .1 Percentages of repointing in the below table apply unless otherwise indicated in the drawings dessins (ex: interior elevations).
- .2 Percentages of repointing in the below table are in addition to all works of stone repositionning, of replacement of stone/brick and of dismantling /rebuilding of the masonry which already include their own activities or de repointing.

LOCALISATION	EAST WING 1913-1914 Percentage of repointing	CENTRAL BUILDING 1885 INCLUDING THE TWO SQUARE TOWERS Percentage of repointing
Interior brick masonry Above ground	30% frontpointing 50% backpointing (50% of 30% frontpointing)	50% frontpointing 50% backpointing (50% of 50% frontpointing)
Exterior brick masonry Above ground (including the chimneys)		100% frontpointing 50% backpointing (50% of 100% frontpointing)
Exterior stone masonry underground level(foundations ext. side, ex: square towers)		100% frontpointing 100% backpointing (100% of 100% frontpointing)
Interior stone masonry underground level (excavated foundations interior side of wall)		100% frontpointing 50% backpointing (50% of 100% frontpointing)
Exterior stone masonry Above ground	100% frontpointing 100% backpointing (100% of 100% frontpointing)	100% frontpointing 50% backpointing (50% of 100% frontpointing)
Interior stone masonry Above ground	30% frontpointing 50% backpointing (50% of 30% frontpointing)	100% frontpointing 50% backpointing (50% of 100% frontpointing)

3.6 DETACHED STONE SHARDS

- .1 Should portions of stone crack and become detached, then the Contractor must reattach it immediately by following the specified procedures for shard repairs as described in section 04 03 41 Historic works – Repair of Stone.
- .2 In order to prevent loss of such portions of stone, the Contractor must ensure these loose portions of stone are retained, kept safe from loss and protected until such time that it is reattached to its original position.

3.7 GROUTING SECTIONS OF MASONRY WALL

- .1 Where stones are identified to be replaced and/or reset and where there is masonry dismantling, the Departmental Representative will identify the voids to be grout injected. Where indicated on drawings and where determined by the Departmental Representative that there are voids in the core of the wall, prepare and install specified grout.
- .2 Clean out voids with clean water followed by 10% ethyl alcohol solution until water runs clear. Ensure ambient temperature remains above 15°C for at least 48 hours after voids are cleaned out.
- .3 Fill joints and cracks with mortar set back 25 mm from front edge/arris of stone unit.
- .4 Install grout tubes in joints, in sufficient numbers to insure grout feeds to all areas of the core cavity to be covered (plan for 2 per 1000 cm²). Flexible plastic grout tubes (6 mm dia.) must reach at least 200 mm into where the void must be filled as determined by Departmental Representative.
- .5 Inject Hydraulic lime-based grout by gravity in a state sufficiently fluid to suit application condition. Gently vibrate to assist flow. Ensure voids are full through grout tubes.
- .6 Grout from the bottom of the wall opening and/or joint to the top.
- .7 Allow grout to set prior to proceeding with repairs, frontpointing, backpointing, substrate consolidation and stone setting.
- .8 Take great care not to allow the grout to seep inside the wall and damage the interior finishes such as historic plasters. Damages to the interior finishes caused by undue care must be repaired at the Contractor's expense.
- .9 Allow grout to firm up and thoroughly clean and rinse any grout spills from the surface of the stone to avoid staining.
- .10 Frontpoint joints and/or consolidate the substrate only after grout has cured and humidity from the operation has subsided.

3.8 FIELD QUALITY CONTROL

- .1 The Departmental Representative will inspect the quality of the work on a regular basis.
- .2 Notify Departmental Representative prior to removing mortar joints, so that existing conditions may be recorded. Provide clear access to all points of stone masonry to allow good photography of them.
- .3 Contractor must receive written approval and acceptance by Departmental Representative of raked out condition of back joints, before proceeding to the next procedure.
- .4 Provide the Departmental Representative with a minimum of 4 working days notice prior to required inspections.

- .5 Where work proceeds to the next phase without the approval of the Departmental Representative, the Contractor will remove all unapproved mortar at his own cost.

3.9 CLEANING

- .1 Clean surfaces of mortar droppings, stains and other blemishes resulting from work of this contract as work progresses on a daily basis.
- .2 Clean masonry with soft nylon bristle brush and clean water only. Chemicals are not to be used unless instructed in writing by Departmental Representative.
- .3 Remove all existing scaffolding embedded anchors and repoint masonry joints at anchor locations as scaffolding is removed.
- .4 Clean stone masonry to remove environmental soiling. See Section 04 03 06 – Historic works - Cleaning Masonry.
- .5 Remove all debris and residues from stone faces, window ledges, abutments and sills, progressively as scaffolding is being removed.

END OF SECTION