

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 04 03 07 – Historic Masonry Repointing and Repair.
- .2 Section 04 05 00 - Common Work Results for Masonry.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Federal Legislation
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .4 Mine Safety and Health Administration/National Institute for Occupational Safety and Health (MSHA/NIOSH) Standards

1.3 PERFORMANCE REQUIREMENTS

- .1 Clean all stone masonry surfaces in contract area, to remove surface soiling present on stone surface after completion of repointing, to restore stone as much as is feasible to its original appearance.
- .2 The intention is not to restore the original appearance of the stone but to remove an average of 50% of the thickness of the surface soiling from all stone masonry surfaces except in locations where more extensive cleaning is indicated.
- .3 Clean stones for purposes of removing stains and black soiling without damaging the surface of the stone either physically or chemically.

1.4 SUBMITTALS

- .1 Make the required submittals 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 - Health and Safety Requirements for cleaning materials. Indicate VOC content.
- .3 Submit details of proposed protection methods.
- .4 Submit schedule of cleaning work. Include interfacing of schedule with cleaning of masonry required in other sections.
- .5 Test Results: Submit two copies of test results describing cleaning methods used for cleaning of each test patch.

1.5 SAMPLES

- .1 Demonstrate machinery, tools and nozzles for approval by the Departmental Representative.
- .2 Submit samples of each cleaning material for approval by the Departmental Representative.

1.6 QUALITY ASSURANCE

- .1 Refer to Section 04 05 00 - Common Work Results for Masonry.
- .2 Regulatory Requirements: ensure work is performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial regulations.
- .3 Submit test results in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Submit 2 copies of test results describing cleaning method, water pressure at compressor, tools, nozzle size, dwell time, pressure, nozzle angle to be used during cleaning, media type, media size (aggregate) and distance from masonry surface, used for cleaning of each test patch.
- .5 Proceed with cleaning upon written approval by Departmental Representative concerning tested cleaning methods.
- .6 Tests shall be repeated at no additional cost until satisfactory results are achieved. Assume each test will need to be repeated minimum 4 times.
- .7 Record existing conditions, using photographs, before and after cleaning. Advise Departmental Representative of potential cleaning problems.

1.7 MOCK-UPS

- .1 General:
 - .1 Do mock-up tests in accordance with Section 01 45 00 - Quality Control and Section 04 05 00 - Common Work Results for Masonry.
 - .2 The location of the test patches will be identified by Departmental Representative once the scaffolding system and/or lift device is in place and/or on site.
 - .3 Allow for three (3) test patches for each type of cleaning specified herein and for each type of stones.
 - .4 Allow for 1.5 m² test patch for each type of cleaning specified herein.
 - .5 Notify Departmental Representative 2 weeks before commencing cleaning of each test patch. Obtain approval from Departmental Representative before commencing test.
 - .6 Conduct tests on building to determine effectiveness of low pressure wash cleaning methods.
 - .7 Determine effect of cleaning operations on surrounding historic material and plants.
 - .8 Stop work when cleaning has detrimental effect on surrounding material and plants.
 - .9 Proceed with cleaning after written instructions are received from the Departmental Representative.
 - .10 Protect masonry openings from water/chemical infiltration during cleaning.

- .1 (continued)
 - .11 Collect, neutralize and dispose of water and chemicals in accordance with contract requirements, applicable regulations and Canadian Environmental Protection Act, (CEPA).
- .2 Conduct test to determine effectiveness of 158.6 kPa water pressure, 4 hour time period. Under the direction of the Departmental Representative, conduct further tests at various water pressures, dwell time, concentration, nozzle types and spraying distances from wall surface until satisfactory results are achieved and approved by the Departmental Representative
- .3 Test pressure at each storey height determines effect of "line drop" on effectiveness of water jets.
- .4 Test brushing and spraying as an alternative to pressure washing. Consult Departmental Representative to review test results. Use method approved by Departmental Representative.
- .5 Test rust removal methods to establish effective poultice formulations and dwell times.
- .6 Test a variety of black atmospheric soiling removal methods to establish effective methods and to determine the degree of cleaning to be done.
- .7 For other cleaning methods, prepare mock-ups as prescribed under PART 3 - EXECUTION.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and Section 04 05 00 - Common Work Results for Masonry.

1.9 AMBIENT CONDITIONS

- .1 Do not use wet cleaning methods when there is threat of frost.
- .2 Do not use chemical cleaners when ambient temperature or surface temperature of materials is below 15°C.
- .3 Provide shading to wall to avoid cleaning in full, hot sunlight.
- .4 Do not clean if there is risk of chemicals spray being blown onto publicly accessible areas or if other materials will be damaged by the cleaning process.
- .5 Collect and dispose of used cleaning materials and products which accumulate in the area of the Work. Prevent run off and absorption of water, chemicals or abrasives into masonry or soil below the cleaning area.
- .6 Collection and disposal system must be approved by the Departmental Representative. Contractor to submit system information to the Departmental Representative for approval prior the commencement of the work

- .7 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.
- .8 Provide protection (dust, rain, and other elements) of the masonry and stone units after wet cleaning.

1.10 WORK SEQUENCE

- .1 Complete work within approved schedule time. Do not change Schedule without the written approval of the Departmental Representative.
- .2 Co-ordinate the cleaning work schedule with other work on site.
- .3 Perform cleaning following completion of replacement of stone and backpointing, and prior to carrying out front pointing, stone refacing treatments, surface consolidant treatments and mortar refacing treatments. Sequence subsequent applications to the approval of the Departmental Representative.
- .4 Allow the period of curing specified in the applicable sections prior to all cleaning operations.
- .5 Ensure that the pH is neutral in the stones within the recessed areas following the post chemical water wash. Contractor must submit a methodology to verify a neutral pH to the Departmental Representative for approval prior the commencement of the work.

1.11 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/Demolition Waste Management and Disposal and Section 04 05 00 - Common Work Results for Masonry.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Water: clean potable water free from contaminants. Treat water having high metal content before use in cleaning.
- .2 Air: free from oil or other contaminants.
- .3 Masking material: to approval of Departmental Representative.
- .4 Surfactant (detergent): non-ionic, type suitable for use on masonry.
- .5 Solvents: toluene, xylene, acetone, methyl ethyl ketone.
- .6 Asphalt and tar remover:
 - .1 Acceptable Material: Asphalt and tar remover as supplied by ProSoCo.
 - .2 Alternative Materials: Approved by addendum in accordance with Instructions to Tenderers.

- .7 Paint Strippers: For sandstone surfaces: Solvent paste containing no Methylene Chloride or Methanol:
 - .1 Acceptable Material: Safety Peel 1 paint remover as supplied by ProSoCo.
 - .2 Alternative Materials: Approved by addendum in accordance with Instructions to Tenderers.
- .8 Ethylene diamine tetra-acetic acid (EDTA) formulated for use as a ferric oxide (rust) removal agent.
- .9 Attapulgit or Diatomaceous clay (Fullers Earth): for use as poultice medium.
- .10 Class abrasive for micro-abrasive cleaning.
- .11 Acid solution cleaning products: Acceptable material to be approved by Departmental Representative only.
- .12 Alkaline solution cleaning products based on sodium hydroxide. Acceptable material to be approved by Departmental Representative only.

2.2 TOOLS AND EQUIPMENT

- .1 Use only brushes with natural or soft plastic bristles.
- .2 Use only scrapers of wood, or plastic.
- .3 Use water pumps fitted with accurate pressure regulators and gauges capable of being preset and locked at maximum specified levels. Water pumps to have rating of 0.3 kPa.
- .4 Use air compressors equipped with on-line oil filters to avoid spraying oil onto masonry.
- .5 Use gun equipped with pressure gauge at nozzle end.
- .6 Use plastic or non-ferrous metal piping and fittings.
- .7 Use nozzles that give nebulized droplet spray. Use nozzles with 12 mm opening.
- .8 Buckets.
- .9 Colourfast sponges resistant to solvents and chemicals.
- .10 4 ml polyethylene sheeting.
- .11 Small wedges.
- .12 Vacuum Cleaner designed for industrial use, Hepa type.

PART 3 - EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

- .1 Report to Departmental Representative conditions of deteriorated masonry or pointing not noted on Contract Drawings found before and during cleaning.
- .2 Obtain written approval of Departmental Representative before cleaning areas of deteriorated masonry.

3.2 PREPARATION

- .1 Place safety devices and signs near work areas as indicated and directed.
- .2 Seal or repair openings and joints where there is potential risk of water/chemical infiltration.
- .3 Cover surfaces not to be cleaned.
- .4 Dry brush or scrape accumulations from walls, ledges and cornices.
- .5 Cover and protect surfaces and non-masonry finishes in areas to be cleaned.
- .6 Chemical cleaning must be carried out before repointing work begins.

3.3 PROTECTION

- .1 Mask or seal vents, windows, and other openings, to prevent water entry or entry of air contaminated with chemical fumes.
- .2 Mask materials, including wood, glass and metal, adjacent to treatment areas.
- .3 Protect plants, gardens, shrubs from excessive watering and chemicals.
- .4 Ensure workers wear eye, head, and face protection, and protective gloves, coveralls, boots and filter mask to MSHA/NIOSH standard.
- .5 Protect cleaned surfaces which are to be painted from contact with rain and snow.
- .6 Protect rainwater leaders, eaves troughs and gutters from being blocked by residue.
- .7 Protect finished Work from damage until take-over.
- .8 Protect adjacent Work from spread of dust and dirt beyond work areas.
- .9 Protect operatives and other site personnel from hazards.
- .10 Maintain protection and heating after wet cleaning for a period of 10 days to allow the stone dry sufficiently before being exposed.

3.4 EXECUTION OF CLEANING

- .1 Moderate Pressure Water Cleaning:
 - .1 Pre-wet masonry surface when necessary. Work from top of wall downwards.
 - .2 Avoid prolonged wetting and excessive water penetration.
 - .3 Do not exceed maximum pressure at nozzle or have nozzle closer to masonry than approved by the Departmental Representative at tests.
- .2 Use brushing and scraping only to supplement water washing.
- .3 Soften and loosen heavy deposits with prolonged water spray, then brush. Remove thick incrustations with wooden or plastic scrapers.
- .4 Ensure finish pointing mortar is sufficiently cured prior to final cleaning. Any mortar joints damaged during final cleaning must be raked out, and finish pointing reinstalled.

3.5 CLEANING OF BLACK ATMOSPHERIC SOILING ON SURFACE OF STONE

- .1 The overall intent of masonry cleaning is to clean only as necessary without damaging the stones in order to halt deterioration.
- .2 For pricing purpose, allow for 50% cleaning of the thickness of the surface soiling on all masonry surfaces. Microabrasive systems will be use for that type of cleaning.
- .3 Methods, procedures, materials will be established early on in the project schedule following a period of mock-ups in the presence of the Departmental Representative. The accepted level of cleaning to the surface of the stones using various cleaning methods and chemicals will be determined by the Departmental Representative.

3.6 PAINT AND/OR CAULKING REMOVAL

- .1 Mechanical removal of paint and/or caulking will precede that of chemical removal.
- .2 Scrape surfaces with non-ferric scrapers to remove loose paint and/or caulking.
- .3 Beyond scraping of loose paint and/or caulking, a number of mock-ups using any of the following procedures and materials under the directions and supervision of the Departmental Representative will be carried out, with the aim of determining the best method and procedure to remove the paint and/or caulking without causing damage to the stones.
 - .1 Carry out a mock-up using a heat gun and scraper to determine the effectiveness of this method.

- .2 Carry out a mock-up using Methylene Dichloride based Paint Stripper in gel form.
 - .1 Work surface must be between 20°C and 25°C.
 - .2 Apply paint stripper liberally to surface of paint and/or caulking.
 - .3 Cover with plastic sheeting to avoid evaporation.
 - .4 Leave in contact for up to 30 minutes, making sure that surface is agitated frequently with a stiff brush, and the paint stripper is generously spread over the surface throughout the dwell time.
 - .5 Dwell time will be determined by calculating the maximum effect of the chemical within a given time. This will be determined by the Departmental Representative.
 - .6 Scrape all loosened paint and/or caulking and discard immediately following all Government Regulations for handling and disposal.
 - .7 Repeat procedure until natural surface of the stone is exposed.
 - .8 Rinse and scrub by hand with hot water.
 - .9 When surface is completely dry, approximately 4 days after rinsing, remove final traces of paint and staining with low-pressure micro-abrasive.
 - .10 Confine all dust from micro-abrasive cleaning to the working area, vacuum and discard from site.
- .3 Carry out mock-ups using peel away paint removal systems.
 - .1 When surface is completely dry, approximately 4 days after rinsing, remove final traces of paint and staining with low pressure micro-abrasive.
 - .2 Retain all dust from micro-abrasive cleaning to working area, vacuum and discard from site.
- .4 Install air extraction and filter system for all chemical procedures described above where chemical fumes are emitted, and maintain throughout work once the prescribed method to remove paint and/or caulking is determined by Departmental Representative.
 - .1 Fumes originating from any of the paint removing procedures will not be tolerated and must be extracted and filtered at the contained location of work.
 - .2 The Contractor must prove the effectiveness of the extraction system by carrying out air quality tests on a daily basis.
 - .3 Failure to provide adequate extraction and filtering equipment will lead to an immediate demand from the Departmental Representative to stop work until the problem is corrected and at no extra cost to the Contract for delays or equipment improvement.

3.7 SURFACTANT CLEANING

- .1 The following method will be used to clean all light or loosely bonded forms of soiling.
- .2 Dry brush with stiff bristle brush all surfaces to remove accumulated loose dirt, suctioning the dirt with a vacuum as it loosens.
- .3 Provide protection, troughs and all installations necessary to ensure cleaning solution does not spill, drip or in any other way make contact with adjacent wall or floor surfaces not included in this intervention.
- .4 Liberally wet the surface of the soiled stones with the surfactant and warm water solution, temperature 37°C to 43°C. Concentrations of the surfactant and water solution will be determined by the Departmental Representative.
- .5 Brush aggressively by hand using a stiff bristle brush. Do not allow to dry. Work on maximum surface areas which are manageable any one time. Brushes must be of various shapes and sizes to allow easy and certain contact with all shaped surfaces of the stones being cleaned.
- .6 Discard surfactant solution as soon as it becomes dirty and replace with fresh solution.
- .7 Once surface is clean and to the satisfaction of the Departmental Representative, rinse the surface of the cleaned stones by applying liberally with hot water keeping certain to collect all spillage of the rinse water.
- .8 Any damage of adjacent wall surfaces such as mortars, glass, metals, finish coatings, will be replaced or repaired to the Departmental Representative's satisfaction at the expense of the Contractor.

3.8 REMOVAL OF ORGANIC GROWTH

- .1 Apply proprietary solution of quaternary ammonium-based biocide in accordance with manufacturer's written instructions, using hand-held spray applicator.
- .2 Apply flood coat. Penetrate masonry surface.
- .3 Mask and protect adjacent masonry during application.
- .4 Re-perform removal procedure as necessary.

3.9 CLEAN-UP

- .1 Rinse off masonry to the satisfaction of the Departmental Representative.
- .2 Rinse from bottom to top and from top to bottom.
- .3 Upon completion, check the pH levels of stone where chemicals have been used during the cleaning process. If pH levels are not neutral, flush with water. Continue flushing as necessary until pH level of wall surface achieves a neutral pH value of 7 to 8.5.

- .4 Collect and dispose of cleaning materials and clean up work area as work progresses.
- .5 Collect and dispose of chemicals and hazardous waste in accordance with applicable hazardous waste legislation.
- .6 Carefully scrape residue into plastic bags and remove. Remove and dispose of droppings.
- .7 Upon completion, clean and restore areas used for work to condition at least equal to that previously existing.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 04 05 00 – Common Work Results for Masonry.
- .2 Section 04 03 08 – Historic Mortars.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A276-08a, Standard Specification for Stainless Steel Bars and Shapes.
- .2 Canadian Standards Association (CSA)
 - .1 CSA A23.1-04/A23.2-04 (R2010), Construction Materials and Methods of Concrete Construction.
 - .2 CSA-A371-04 (R2014), Masonry Construction for Buildings.
- .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 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 04 05 00 - Common Work Results for Masonry.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Store cementitious materials, lime and aggregates in accordance with CSA A23.1 in dry heated shelter. Temperature of all materials for mortar preparation should be minimum 12 degrees Celsius and 25 degrees Celsius maximum.
- .2 Ensure that manufacturer's labels and seals are intact upon delivery.
- .3 Remove rejected or contaminated material from site.

1.7 PROTECTION

- .1 At end of each working day, cover unprotected work with waterproof membranes. Membranes should extend to 0.5 m 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 All methods of enclosure and protection shall be to the approval of the Departmental Representative.
- .4 Newly laid mortar shall be protected from excessive exposure to rain and full sunlight for a period of 28 days or until the surface is fully cured.
- .5 Provide and maintain protection for masonry walls at all times when work is suspended to prevent water from entering partially repointed masonry.
- .6 Protection shall consist of 6 mm polyethylene sheets, tarpaulins or burlap, secured to prevent lifting during windy conditions or storms.
- .7 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.
- .2 When temperature is 10°C or less:
 - .1 Store lime, cements and sands for immediate use within heated enclosure. Allow these materials to reach minimum temperature of 12°C.
 - .2 Heat water to minimum of 20°C and maximum of 25°C:
 - .1 At time of use, temperature of mortar to be minimum of 12°C and maximum of 30°C.
 - .2 At time of repointing, surface temperature to be minimum of 10°C.
- .3 Protection requirements are specified in Section 04 05 00 - Common Work Results for Masonry.
- .4 Obtain approval from Departmental Representative for methods of enclosure and protection.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 04 05 10 - Common Work Results for Masonry.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Mortar materials: to Section 04 03 08 - Historic Mortars.

2.2 TEMPORARY SHIM

- .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:
 - .1 Once the raking out of mortar joints and preparation are completed;
 - .2 Prior to backpointing or bedding pointing;
 - .3 Prior to 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 Use manual raking tool to remove deteriorated mortar and ensure that no masonry units are chipped/ altered/ damaged by work to remove mortar, unless otherwise specified. Tools for cutting out must be narrower than the joint; procure and use dove-tailed tipped chisels.
- .3 Tool and compact using jointing tool to force mortar into joint.
- .4 Finish joints as approved after mock-ups; except where specified otherwise.
- .5 Use suitable and pre-approved jointing tools to place and form mortar in joints.

3.3 REPOINTING

- .1 Raking joints:
 - .1 Rake out all joints.
 - .2 Rake unsound joints free of deteriorated and loose mortar, dirt and other undesirable material.
 - .3 All cutting out of joints is to be done with hammer and chisel, unless otherwise specified. Damage masonry units adjacent to joints will not be tolerated. The use of rotary grinders is not acceptable, unless demonstrated to the Departmental Representative to be harmless to stone and of real benefit to assisting with joint removal.
 - .4 Where grinders are deemed appropriate by the Departmental Representative to remove existing mortar, proceed as follows:
 - .1 Grind the centre of the joint only, to a maximum depth that is equal to half of the joint width. Mortar must remain on each side of the cut. The grinders must not touch the stone. Joints whose widths are less than 6 mm must be "relief" cut using specialty rotary grinding tools equipped with a diamond cutting blade of small diameter (86 mm).
 - .1 Alternative Equipment: as approved by addendum in accordance with Instructions to Tenderers.

3.3 REPOINTING (continued)

.4 (continued)

- .2 For vertical joints, and discontinuous horizontal joints, stop sawcut 50 to 75 mm from end of joint. Do not cut into stone.
- .3 The Contractor must notify the Departmental Representative to inspect the grinding, prior to removing the remaining mortar with hand tools.
- .4 The remaining mortar must be removed using hand tools.
- .5 Permission to use power tools will be based on the Contractor's ability to comply with the above conditions, in the mock-up.
 - .1 Only one mason will be appointed to the work of cutting mortar from joints with a grinder, and only after complete satisfaction of his/her work has been approved by demonstration. Notification must be given well in advance of any intention of the Contractor to change this appointed mason for another.
- .6 If the Contractor is found not to comply with these requirements, he will be required to remove all mortar using hand tools (non-powered), at no extra cost to be charged.
- .5 Clean joints to full depth of deteriorated mortar but in no case to less than 25 mm. Note that voids in vertical joints can reach as deep as 250 mm. Clean all voided 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 / dust.
- .8 Fine joints (less than 4 mm) need not be raked out more than 10 mm, in order to reduce the danger of chipping the masonry edges. When saw cutting vertical joints, stop sawcut 50 to 75 mm from end of joint and finish by hand in order to avoid cutting into adjacent stonework.
- .9 Any stone damaged as a result of careless raking, or saw cutting, shall be replaced at no cost to the Departmental Representative.
- .10 In no area can the joints be raked for more than four levels of scaffold in height, prior to backpointing, unless approved by the Departmental Representative.
- .11 Temporary shims to be installed where raking and cleanout activities cause a stone unit to become loose.
- .12 After the raking/ cleanout activities are complete but prior the commencement of back pointing, the Departmental Representative will conduct an assessment of stone 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, backpoint joints to bring mortar face to specified depth for raked out joints, in preparation for finish pointing. Where voids exist that conventional backpointing cannot fill, most often met at perpendicular joints, notify Departmental Representative. In such instances, the following work shall be carried out:
 - .1 Place backpointing to reach a depth of 100 mm. When mortar is firm, rake to prepare depth of backpointing such that 25 mm at face is empty for frontpointing.
 - .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.
 - .3 Allow grout to firm up and thoroughly clean and rinse any grout spills from surface of stone such that staining is prevented.
 - .4 Allow grout to thoroughly cure and humidity in wall to dry before proceeding with frontpointing.
 - .2 Immediately prior to pointing, thoroughly wet wall surface in order to control absorption.
 - .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, minimum 12 mm thick, allowing each layer to set to thumb print hard before placing next layer. Bring face of mortar in backpointed joint to specified minimum depth from stone face, measured from the arris of the masonry unit.
 - .5 Leave mortar in joint square and of even depth measured from stone arris. 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 When all required stone repair and replacement work is complete, carry out repointing.
 - .2 Dampen joints and completely fill with mortar. If surface of masonry units/stone has worn rounded edges, keep pointing back from surface to keep same width of joint. Do not feather edges. Pack mortar solidly into voids and joints.
 - .3 Before repointing, wash walls to be repointed and allow to dry to damp, but not wet, conditions. Ensure that all dust, mortar particles, and other debris are removed from joints and wall surfaces before repointing.
 - .4 Keep masonry damp while pointing is being performed.
 - .5 Do no pointing in freezing weather. See Section 04 05 00 - Common Work Results for Masonry.
 - .6 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.

- .7 Allow mortar to set to thumb-pressed firmness, pack by pressing with slicker one last time, and then cut mortar to match approved mock-up. Mortar must be recessed by approximately 1 mm or as established during mock-up, such that the arris edge is visible. Flush cut joints or over-pointing will not be allowed.
 - .8 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.
 - .9 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 replasticize the mix.
 - .10 Remove excess mortar from masonry face before it sets and clean thoroughly with water, brushes and thick cotton rags.
- .4 Curing:
- .1 Moist cure freshly pointed joints by covering with moist heavy and tight woven burlap and polyethylene sheeting for minimum of 7 days. Keep wall and burlap misted and burlap completely covered with a polyethylene draped lining to prevent drying.
- .5 Protection:
- .1 Protect newly laid mortar from frost, rainfall or rapid drying conditions such as wind for 28 days.
- .6 Curing (heated conditions):
- .1 For the first seven (7) days, the masonry surface is to be maintained at a temperature above 12°C and relative humidity of 80%, and moist conditions near the surface of the masonry (not in contact) should be controlled using damp burlap covered with a plastic membrane protection.
 - .2 After seven days of curing, the fresh repointed masonry to be protected from weather conditions such as rain or snowmelt for a minimal period of 28 days.

3.4 RESETTING

- .1 Gently remove stone to be reset.
- .2 Remove all loose debris and deteriorated mortar from exposed core. Chip and clear away core masonry as necessary to allow stones to be rebuilt to fit.
- .3 Backpoint all mortar joints of the exposed surface to 25 mm depth.
- .4 Consolidate and parge 100% of exposed core with mortar - fill all the exposed cavities.
- .5 In conditions where the back of the stone cannot be properly filled with mortar, proceed with grout injection. Insert grout tubes along top joint. Grout the reset stone or stones under low pressure. Refer to Section 04 03 08 – Historic Mortars for specification for grout.
- .6 Install stone.
- .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 that may have formed on surface of stone with a stiff bristle nylon brush prior to front pointing.

3.5 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 before condition can be recorded. Provide clear access to all points of stone masonry to permit this photography to occur.
- .3 Approval of raked out condition of joints, and approval of backpointing mortar, must be received in writing to the Contractor before the next procedure can proceed.
- .4 Provide the Departmental Representative with a minimum of 48 hours' notice for 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.

3.6 CLEANING OF WORK IN PROGRESS

- .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 stiff, non-ferrous bristle brushes and clean water only. Chemicals are not to be used unless instructed in writing by Departmental Representative.
- .3 Remove all existing embedded anchors and/or repoint masonry joints at anchor locations as scaffolding is removed.
- .4 Remove all debris from stone faces, ledges and sills at the end of each work day.
- .5 Clean all flashed surfaces at end of work. Use either a gentle masonry cleaner and/or hot water at a low pressure with a nylon or natural fiber brush.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 04 05 00 – Common Work Results for Masonry.
- .2 Section 04 03 07 – Historic Masonry Repointing and Repair.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C207-06(2011), Specification for Hydrated Lime for Masonry Purposes.
 - .2 ASTM C348-14, Test Method for Flexural Strength of Hydraulic-Cement Mortars.
 - .3 ASTM C940-16, Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced Aggregate-Concrete in the Laboratory.
 - .4 ASTM C144-11, Standard Specification for Aggregate for Masonry Mortar.
 - .5 ASTM C780-15a Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005), includes Update No. 1 (2014).
 - .2 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 - Health and Safety Requirements for materials used for the work of this Section. Indicate VOC content.
- .3 Samples (coloration)
 - .1 Colour matched samples for mortar type 2 and in quantity and size in accordance with CSA A179M.
 - .2 Prepare samples to represent same exposure conditions of building. Fully cure minimum 3 days.
 - .3 Submit two 100 mm diameter size samples each type of mortar.
 - .1 Colour for mortars will be determined by placing trial colours in the joints of the wall where they will be placed, tamped, cut and cured as per specification.
- .4 Additional cubes for testing. Provide additional series of cubes for long term testing by Departmental Representative as follows:
 - .1 For all mortar types: up to 5 sets of cubes from selected mortar batches as directed by Departmental Representative.

1.3 SUBMITTALS (continued)

.4 (continued)

- .2 Prior to the mixing or preparation of mortars submit for approval to the Departmental Representative:
 - .1 Aggregate.
 - .2 Cements.
 - .3 Lime.

1.4 MORTAR TESTING

- .1 Submit test reports to Departmental Representative.
- .2 Test results to show that properties are appropriate to particular mortar mix.
- .3 Test reports required prior to commencement of work:
 - .1 Sieve analysis of proposed sand.
 - .2 Bulking analysis of proposed sand in condition as delivered to site and after any change in environmental conditions.
 - .3 Air content of mortar mix in plastic state.
 - .4 Vicat cone penetration of mortar mix.
 - .5 Compressive Strength of mortar at 7 and 28 days, a minimum of 35 days prior to commencing work, or as directed by Departmental Representative.
- .4 Test reports required following commencement of work:
 - .1 Bulking analysis of sand upon delivery and following any change in environmental conditions, or upon request by Departmental Representative.
 - .2 Air content of mortar mix on a daily basis at discretion of Departmental Representative.
 - .3 Vicat cone penetration measurements on each mortar batch for first three days, followed by daily tests at discretion of Departmental Representative.
 - .4 Compressive strength of mortar at 7 and 28 days, and daily strength tests at discretion of Departmental Representative.
- .5 Mock-up: provide colour matched samples on building for final acceptance of materials.
- .6 Refer to Section 04 05 00 - Common Work Results for Masonry for other quality assurance requirements.
- .7 Any mortar found and identified by the Departmental Representative as to be original mortar, to be tested in laboratory for material composition by the Contractor.

1.5 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.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 04 05 00 - Common Work Results for Masonry.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Use same brands of materials, suppliers and source of aggregate for entire project.
- .2 Mortar and grout: in compliance with CSA A179.
- .3 Aggregate: to CSA A179. Use well graded aggregate passing 4.75 mm down to 300 microns sieve where joints are greater than 6 mm. Use aggregate passing 1.18 mm down to 300 micron sieve where 6 mm thick joints or less are indicated. Colour of sand to match existing. Contractor shall custom prepare the aggregate to suit any adjustment requests of the Departmental Representative.
 - .1 Grading of sand: sieve analysis for mortar joints greater than 6 mm in width:

SIEVE SIZE	PERCENTAGE BY WEIGHT PASSING EACH SIEVE	PERCENTAGE BY WEIGHT RETAINED ON EACH SIEVE
4.75 mm	100	0
2.36 mm	90	10
1.18 mm	70	20
600 microns	50	20
300 microns	30	20
 - .2 Grading of sand: sieve analysis for mortar joints greater than 6 mm in width:

SIEVE SIZE	PERCENTAGE BY WEIGHT PASSING EACH SIEVE	PERCENTAGE BY WEIGHT RETAINED ON EACH SIEVE
1.18 mm	90	10
600 microns	70	20
300 microns	40	30
- .4 Colour: dry powdered inorganic pigments, maximum quantity permitted in dry form will not exceed 8% of the total binder volume.
 - .1 Acceptable material: Mortar pigment as manufactured by Rockwood Pigments.
 - .2 Alternative Materials: Approved by addendum in accordance with Instructions to Tenderers.
- .5 Sand: to CSA A179 and ASTM C144
 - .1 Sand to be sharp, screened and washed siliceous pit sand, free of any organic material, graded as specified, colour to match sand from original and/or existing mortar.
 - .2 Sand is to be dried 100% and kept dry throughout period of work.
- .6 Water: potable or from approved non-potable supply.
- .7 Lime:
 - .1 Lime Type 1: Hydrated lime: ASTM C 207, type SA, containing air entrainment agent.
- .8 Portland Cement: CSA-A3000, white, non-staining, normal, type GU for sandstone.
- .9 Stone dust (colour matching): Dorchester sandstone dust produced from clear buff sandstone. Ground to pass 600-micron sieve and free from soluble salts and other deleterious material.

2.2 PROPERTIES AND ALLOWABLE TOLERANCE

- .1 Above-grade repointing mortar for stonework:
 - .1 Back pointing and bedding for stonework: use Type O, 1:2¹/₂:8 Portland cement-lime-aggregate mix; compressive strength 1.5 MPa to 3.5 MPa at 28 days.
 - .2 Front pointing stonework: use Type O, 1:2¹/₂:8 white Portland cement-lime-aggregate mix; compressive strength; 1.5 MPa to 3.5 MPa at 28 days.
 - .3 If the cement hydrated lime-sand mortar fails to meet the 7 day compressive strength requirements, but meets the 28 day compressive strength requirement, it is to be accepted. If the 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, the General Contractor may elect to continue work at his own risk whilst awaiting the results of the 28 day tests, or to take down affected work.
- .2 Mortar for levelling top surfaces of projecting elements prior to installation of flashing, use 1:2¹/₂:8 white Portland cement-lime-aggregate.
- .3 Vicat Cone Penetration of mortar mix in plastic state;
 - .1 Front pointing Mortar; 18-22 mm
 - .2 Bedding Mortar; 20-35 mm
- .4 Allowable air content for all lime/cement mortars; 8% to 12%. Air content of plastic mix, using meter designed to record air content of mortar to EN 459-2.

2.3 MORTAR TYPES AND PROPORTIONS

- .1 Proportion lime mortar by volume:
 - .1 Backpointing and bedding mortar:
 - .1 Mortar Type 1: Type "O", one part white Portland cement, two and one half part hydraulic lime type 1 and eight parts sand (1:2¹/₂:8).
 - .2 Frontpointing mortar:
 - .1 Mortar Type 2: Type "O", one part white Portland cement, two and one half parts hydraulic lime type 1 and eight parts sand (1:2¹/₂:8).
 - .3 Surface Repair Mortar:
 - .1 Proprietary premixed mortar for sandstone surface repairs: Jahn M 70 from Cathedral Stones or Neostone from Daubois.
 - .4 DHL and Sheltercoat:
 - .1 Dispersed Hydrated Lime for fine fissure injection and Sheltercoat for top finish of the fissures.

- .5 Grout: premixed injection grout based on natural hydraulic lime.
 - .1 For interior use formulated for the consolidation or reinforcement of voids in massive masonry. Grout to present very high fluidity allowing it to coat and pass through spaces in order to solidify the mass.
 - .2 Grout to be applied by injection or gravity.
 - .3 Compressive strength: 2 MPa at 7 days to 3.5 MPa at 28 days.
 - .4 Shrinkage 0.27% and water vapour transmission 30 perms.

2.4 MIXES

- .1 Coloured mortars: 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 The Contractor to allow 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.
- .2 Pointing and bedding mortar:
 - .1 Correct water content and proper consistency for pointing will be established using a Vicat Penetrometer.
 - .2 Mixes throughout project will be regularly monitored with the Vicat Penetrometer during the duration of project to insure the consistency remains constant.

PART 3 - EXECUTION

3.1 MANUFACTURERS' 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 CONSTRUCTION

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

3.3 MIXING - GENERAL

- .1 Prepare measuring boxes to ensure accurate proportioning of mortar ingredients.
 - .1 Each box to contain exact volume proportion for each specific mix ingredient.
- .2 Begin by mixing dry ingredients in a bucket for approximately 2 minutes, then add mix to predetermined quantity of water in a mixing bin/bucket. Whip-mix for approximately 5 minutes. Let rest for 5 minutes. Final whip-mix ingredients for a final approximate 3 minutes. The mortar should easily form when spun by hand into a ball.

3.3 MIXING – GENERAL (continued)

- .3 Water content for mortar to be determined by Vicat penetration testing.
- .4 Record water quantities and use for subsequent mixes to help ensure uniformity of all subsequent mixes.
- .5 All mortar used for rebuild areas of wall building can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on fossil fuels are not permitted because of fumes.
 - .1 Mixing by hand for repointing mortars must be pre-approved by the Departmental Representative and must be carried out using a 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 mixing tools and container for approval prior to starting pointing work.
- .6 Thoroughly clean all mixing boards and mechanical mixing parts between batches.
- .7 Mortar must be weaker than the units it is binding.
- .8 Mortar must not contain elements detrimental to the original masonry or surrounding materials.
- .9 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.4 MIXING - CEMENT/ LIME/ SAND MORTAR

- .1 Load mixer with 75 percent of total water volume required. Add 50 percent of sand required and full volume of dry hydrated lime and any colouring additives. Mix for approximately 3 minutes or until materials are thoroughly blended, without particles of white lime apparent in mix.
- .2 Allow mix to stand for 5 minutes.
- .3 Pre-mix Portland cement with sufficient quantities of water to attain slurry mixture.
- .4 Add full volume of Portland cement slurry and remaining volumes of sand and water. Mix for 3 to 5 minutes until thoroughly blended and mortar has reached consistency determined by Vicat Cone penetration test.
- .5 Add sufficient water to obtain workable consistency for setting units to comply with specified allowable tolerances.
- .6 Blend stone dust and/or colouring additives with sand, as required. Maintain specified grading.
- .7 Use mix within two hours.

3.5 MIXING - PROPRIETARY PREMIXED SURFACE REPAIR MORTAR

- .1 Begin by mixing dry ingredients in a bucket for approximately 2 minutes.
- .2 Add mix to predetermined quantity of water in a mixing bin/bucket with a digital timer.
- .3 Whip-mix for approximately 3.5 minutes.
- .4 Let rest for 5 minutes.
- .5 Final whip-mix ingredients for a final approximate 3 minutes.
- .6 The mortar should easily form when spun by hand into a ball.

3.6 CLEANING

- .1 Upon completion of mortar work, remove surplus materials, rubbish, tools and equipment.
- .2 Remove mortar droppings using clean cotton cloth or sponge and water. Do not smear onto adjacent surface and causing lime streaking on stone.
- .3 Clean masonry with low-pressure clean water and soft natural bristle brush. 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 with waterproof covering at end of each work day. Anchor 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.
- .2 The Departmental Representative will pay for cost of initial inspections and tests. Contractor shall pay cost of re-inspecting and re-testing necessitated by failure to meet specification requirements on initial inspection/test.
- .3 Frequency of mortar testing will be specified by Departmental Representative.
- .4 Air content for all lime mortars, and penetration using Vicat cone penetrometer for mortars used in stonework, must be tested at the same frequency as strength tests, or more frequently as required by the Departmental Representative.
 - .1 Contractor is to own and have on site a fully functioning and well maintained Vicat penetrometer throughout the duration of the project work.
 - .2 Contractor to record in a logbook Vicat cone penetrometer results one batch per day minimum that meets specification requirements.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

- .1 Section 04 03 06 - Cleaning Historic Masonry.
- .2 Section 04 03 07 – Historic Masonry Repointing and Repairs.
- .3 Section 04 03 08 – Historic Mortars.
- .4 Section 04 03 42 – Historic Replacement of Stone.
- .5 Section 04 05 00 - Common Work Results for Masonry.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A276/A267M - 16, Standard Specification for Stainless Steel Bars and Shapes.
- .2 Canadian Standards Association (CSA):
 - .1 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 DEFINITIONS

- .1 Repair of Stone: any repair, other than cosmetic, i.e. superficial, and replacement, done to restore original appearance and function of partly deteriorated stones.
- .2 Grout: material used as adhesive to fasten broken/fractured stone elements by direct application at fracture interface and/or by application to added reinforcing elements such as dowels.
- .3 Repair Mortar: material used to rebuild broken or deteriorated part of stone.

1.4 ALTERNATIVES

- .1 Change of manufacturer's brands, sources of supply of materials during entire contract must be approved by Departmental Representative.

1.5 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples of patching mortar and stone adhesive proposed for use.
- .3 Submit three full-size stone units, representative of the units proposed for the work.

1.6 SUBMITTALS

- .1 For each set of photographs, submit to the Departmental Representative:
 - .1 A complete set of digital files on CD, clearly identified with the project name and the location.
 - .2 A complete set of hardcopies of the photographs, as follows:
 - .1 200 mm x 250 mm format
 - .2 Neatly label each photograph with a number system corresponding to the key drawings prepared for the marking of the stonework.
 - .3 Bind each set of photographs in a three-ring binder clearly identified with the project name and the location.
 - .4 Include a copy of relevant key drawing(s) in each binder.

1.7 QUALITY ASSURANCE

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

1.8 MOCK-UPS

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

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials to protect them from damage, extreme temperature, and moisture in accordance with Section 01 61 00 - Common Product Requirements and Section 04 05 00 - Common Work Results for Masonry.
- .2 Deliver and store material in the manufacturer's original, unopened containers with the grade, batch, and production date shown on the container or packaging.
- .3 Store materials in a dry enclosed area and supported free of the ground. Maintain a minimum ambient temperature of 10°C in the storage area.
- .4 Use materials from the same manufacturer throughout the Project.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Refer to 04 05 00 - Common Work Results for Masonry.
- .2 Maintain temperature at 10°C or above during and 7 days after repair, throughout thickness of stone.
- .3 Choose epoxy resin compatible with humidity and temperature condition of stone as specified by manufacturer.

1.11 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data for each product proposed for use. 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 the safe handling of the specified materials and products, in accordance with WHMIS requirements.

1.12 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/Demolition Waste Management and Disposal and Section 04 05 00 - Common Work Results for Masonry.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Use materials from same manufacturer throughout project.
- .2 Acceptable Materials: Where materials are specified by trade name, refer to the Instructions to Tenderers for procedure to be followed in applying for approval of alternatives.
- .3 For approval of alternative materials, thorough lab testing shall be required to establish equivalent performance levels. An independent testing laboratory, acceptable to the Departmental Representative, shall be utilized. The cost of lab testing shall be paid by the Contractor.

2.2 MATERIALS

- .1 Materials for mortar and grout, see Section 04 03 08 - Historic Mortars.
- .2 Water: clean and free of deleterious materials such as acid, alkali and organic material in accordance with CSA-A179.
- .3 Dowels and threaded rods, 2 to 26 mm diameter to ASTM A276, Stainless Steel Grade 304.
- .4 Deformed wire: stainless steel or equivalent non-corrosive metal, 2 mm diameter.
- .5 Stone slabs: to have similar mechanical and aesthetic properties to existing.
- .6 Epoxy Resin Gel: low viscosity, UV stable, capable of setting and curing in wet conditions.
 - .1 Acceptable products:
 - .1 Sikadur 35 Hi-Mod LV: for pressure injection of cracks (crack filler).
 - .2 Sikadur 31 Hi-Mod Gel: Epoxy resin adhesive for sealing of cracks (cap seal).
- .7 Acrylic Resin:
- .8 Acetone solvent. Industrial grade.
- .9 Methyl Ethyle Ketone (MEK) solvent.
- .10 Hot glue cartridges with electric gun dispenser.
- .11 Modelling clay.

2.2 MATERIALS (continued)

- .12 Plumber's adhesive tape.
- .13 Burlap, untreated and non-staining.
- .14 100% cotton rags.
- .15 Hardwood wedges: free of tannins, various lengths and thickness.
- .16 Backer-rod: Polyethylene rope to accommodate all joint width snugly.
- .17 Syringes: 30 ml and 60 ml volumes, with twisted attachment for standard needles.
- .18 Catheters: 60 ml volume capacity.
- .19 Needles for syringes: size numbers 14, 16, 21.
- .20 Plumber's 6 mm and 12 mm clear tubing.
- .21 De-ionised water.
- .22 Repair mortar for wide cracks: Refer to Section 04 03 08 – Historic Mortars.
- .23 Dispersed hydraulic lime (DHL) injection grout and shelter coat: Refer to Section 04 03 08 - Historic Mortars.
- .24 Microballoon, polyester spheres. Colour tan.

2.3 EQUIPMENT

- .1 Supply the following smaller specialized tools and equipment:
 - .1 Small 18.5 volt cordless drills of good quality.
 - .2 Small 100 mm grinders.
 - .3 Tungsten Carbide tipped drill bits of 2 - 6 mm for drilling small holes.
 - .4 Lightweight, quick-release clamps of various sizes.
 - .5 Strap clamps.
 - .6 Plunge-type core drill, capable of coring hole of 6 mm.
 - .7 Metal artist spatulas of various sizes.
 - .8 Carbide-tipped scribe for marking cut lines on stone.
 - .9 Neoprene carvers mallet, small size (130 mm diameter).
 - .10 Small carbide-tipped chisels of sizes 6 mm to 12 mm, dovetail-shaped.
 - .11 Carborundum rubbing of fine, medium, and coarse grain.
 - .12 Epoxy injection pump:
 - .13 Grout injection tanks set up for low pressure injection into joints.
 - .14 Submersible blender such as supplied in kitchen stores.
 - .15 Rotary saw dremil:
 - .16 Diamond cutting blades, turbo style, 86 mm.

2.4 MORTAR MIXES

- .1 Mixes, see Section 04 03 08 - Historic Mortars.

- .2 Mix restoration repair mortar in small quantities as needed. Mix by hand and small paddle on electric drill (2500 rpm).

2.5 SOURCE QUALITY CONTROL

- .1 Retain purchase orders, invoices, suppliers test certificates and documents to prove that materials used in contract meet requirements of specification.
- .2 Produce above upon request by Departmental Representative and allow free access to sources where materials were procured.

PART 3 - EXECUTION

3.1 EXAMINATION, MARKING & RECORDING

- .1 For each section of stonework, prior to starting stonework removal or repair, examine the condition of the stonework to verify the exact scope of the work.
- .2 Designate a set of drawings to be used as key drawings and mark them up to provide a referencing system to identify locations of repair and replacement of stone.
- .3 Mark the stone, on the face, using marking product which can be completely erased when required without damaging masonry unit:
 - .1 Ball-point pen on diachylon, attached to stone; or
 - .2 Waxless chalk directly on stone.
- .4 Mark the stone using a numbering, marking, and positioning system keyed to the prepared key drawings.
- .5 Ensure that temporary marking will remain in use, resistant to weather, handling and cleaning until the completion of the work or final marking of stones designated for removal.
- .6 When marking is complete obtain the Departmental Representative's acceptance and agreement with respect to the scope of work. Should the agreed upon scope of work be found to vary substantially from that indicated on the drawings, changes in the Contract Price will be made, with resulting credits or expenditures to the Contract Price accruing to the Departmental Representative.
- .7 Ensure that markings and adhesive are removed without damaging units by brushing with a vegetable fibre or nylon brush used either dry or with water. Use no solvent, acid or other chemical product.
- .8 When stones are removed for repair or replacement, transfer temporary markings to a face which will not be visible in the final assembly using permanent markers.
- .9 Make a complete photographic record of the condition of the wall prior to commencement of work.

3.2 PREPARATION

- .1 Remove decayed section of stones until sound surface is reached. Obtain Departmental Representative's approval for methodology and tools to be employed before commencing this work.

3.3 PROTECTION

- .1 Prevent damage to building, landscaping, pavement, which are to remain. Make good any damage.
- .2 Take utmost care not to damage historic fabric. Make good any damage.

3.4 REMOVAL OF CAULKED SEALANTS

- .1 All caulking and sealants are to be removed along the joints between existing flashings and masonry, and at all other locations where caulking has been used to seal mortar joints. Refer to Section 04 03 06 - Cleaning Historic Masonry.

3.5 DUTCHMAN REPAIRS

- .1 Location and dimension of cutting required to remove deteriorated stone will be marked and agreed upon by the Departmental Representative prior to cutting.
- .2 Only stones marked on drawings or otherwise marked out by the Departmental Representative shall be cut into for purposes of inserting a Dutchman.
- .3 Adjacent masonry units must not be cut into, displaced, or in any way damaged while cutting or removing masonry units.
- .4 Departmental Representative shall approve methods and tools used for cutting out purposes.
- .5 Cutting out shall follow precise incised lines (scribed) which are squared and following right angles.
- .6 Cut out deteriorated portion to a minimum of 100 mm behind wall or arris line.
- .7 Smooth the bottom and side surface of the prepared cavity to receive the new stone.
- .8 Cut new stone to dimension to fit prepared cavity snug. A tolerance of 1.0 mm will be allowed between Dutchman insert and host stone joints. This includes backside joint.
- .9 Smooth, tool or carve surface to match adjacent exterior surface of the cavity.
- .10 Provide attachment of inserted Dutchman to cavity by inserting two stainless steel rods (12 mm dia.) into back side for Dutchmen smaller than 300 mm x 300 mm, and up to four rods (12 mm dia.) for Dutchmen larger than 300 mm x 300 mm, set in epoxy. The drilled holes shall reach 75 mm into connecting surface. The holes must be thoroughly cleaned before epoxy is injected.

- .11 Insert Dutchman flush with original surface. It must be aligned with a joint of even width of 1 mm maximum surrounding it. Use slurry of DHL to fill cavity joint around Dutchman. Thoroughly soak stone surfaces prior to applying the slurry.
- .12 Allow slurry and resin for anchors to set thoroughly. Wipe all slurry spills from surface to insure against lime staining.
- .13 Top-fill joints flush with colour matched layer of DHL shelter coat using a syringe and needle with spatula to press flush.

3.6 STONE PLUGS

- .1 Insert stone plugs to repair holes left by the removal of existing anchors and anchors required for the current work.
- .2 Remove existing deteriorated plugs and insert new stone plugs as specified herein.
- .3 After removal of anchor or old deteriorated plug, core-drill a hole in the stone, generally 25 mm dia. but large enough to include the removal of all irregular edges to the existing hole.
- .4 Insert a matching cylindrical stone plug. It must be aligned with a joint of even width of 1 mm maximum surrounding it. Use slurry of adhesive grout to fill cavity joint around Dutchman. Thoroughly soak stone surfaces prior to applying the slurry.
- .5 Allow slurry to set thoroughly. Wipe all slurry spills from surface to insure against lime staining.
- .6 Top-fill joints flush with colour matched layer of DHL shelter coat or hydraulic lime slurry using a syringe and needle with spatula to press flush. Use stone dust for colour matching.

3.7 DRESS BACK STONE

- .1 Where surface of stone is scaling or disaggregating, gently rub using hand-held carborundum blocks, and pluck with small hand-held tools.
- .2 Should the surface display significant thin-plate exfoliation or similar condition, larger hand held tools shall be applied to the surface to remove them. Strict caution must be used to avoid aggressive removal of material from the surface.
- .3 Bevel the edges of retained and firm surface plates to ensure water shedding.
- .4 If required by Departmental Representative, stitch the bevelled edge and inject/shelter coat/fill any fissure along the bevelled line.

3.8 FISSURE REPAIRS

- .1 For wide fissures (i.e. over 4 mm), face up the crack with hot glue in order to retain the grout to the injected areas of the fissure. Inject the DHL through ports placed along the length of the fissure a maximum of 100 mm apart. For small fissures (i.e. less than 4 mm), mix grout with de-ionized water to consistency that allows easy flow from a #12 and/or #16 hole size needle attached to a syringe containing the DHL deep injection grout to fill deep recesses and DHL shelter coat to fill the top surface of the fissure, and pigmented to match the stone colour.

3.9 PIN AND FILL REPAIR

- .1 Departmental Representative will mark location for stitches.
- .2 Drill small holes as marked by Departmental Representative to a minimum depth of 50 mm beyond line of crack being stitched.
 - .1 Hole diameters and depths shall be determined by the Conservator.
- .3 Clean hole thoroughly, first blowing out with forced air from compressor, followed by flushing with acetone. Allow solvent to evaporate.
- .4 Install stainless steel dowels as noted on drawings, and as directed by Departmental Representative.
- .5 Inject with epoxy, adjusting viscosity with micro-balloons to prevent unnecessary flow into unwanted voids.
- .6 Once epoxy is set, drill out cured epoxy from top 12 mm of hole and fill with a colour matching repair mortar.
- .7 Complete repair of crack (following item 3.8 above) using DHL injection grout and DHL shelter coat.
- .8 Where the crack is wider than 4 mm or where voids are considered too large along the edge of the crack, then mortar repairs (following item 3.14 below) shall be carried out.

3.10 SHARD REPAIR

- .1 This refers to detached portions of stone detail which become detached, usually at corners and under such circumstances as when mortar joints are cut away during repointing procedures, etc. Allow for 75 shard repairs to be executed in the project.
- .2 Clean detached surfaces of dust and dirt by scrubbing with water and brush if necessary.
- .3 Apply small dab of polyester resin to dry, middle area surface of detached portion.
- .4 Working quickly, squeeze the two surfaces together to secure original fitting together.
- .5 Cut any squeeze out of polyester resin while in the gel stage just prior to hardening.

- .6 Proceed with repair as for fissure repair described in 3.8 above (Fissure Repair)

3.11 DEEP CRACKS REPAIR IN STONE

- .1 Drill stitch holes as marked and directed by Departmental Representative. For fragile detached portions such as corners, it is preferable to core the 1/4 holes required for the stitch. Thoroughly clean all dust from drilled holes. Cut and insert stainless steel rod such that it sits countersunk to surface by 20 mm. Plug holes with sandstone cored plug of same diameter as the drilled holes. Insert with epoxy paste or approved equivalent, such that the hole is fully sealed. With masonry tools, gently work the surface of the core plug down to surface contour of sandstone such that the core plug is as invisible as possible.
- .2 Loose materials must be cleaned from crack and also from the adjacent surface of the sandstone.
- .3 Seal the immediate edges of the crack with the acrylic resin or approved equivalent. This will provide a releasing agent and removable buffer to the quick-set cement.
- .4 Apply masking tape to surface outside the acrylic resin so as to insure further protection of the stone surface from spills and or staining.
- .5 Roll modelling clay into long rolls and push into top surface of cracks. Fully seal entire length of cracks so as to prevent any epoxy resin from escaping onto face of the sandstone.
- .6 Insert port guides and injection ports along the crack, using a quick-setting cement to seal the ports to their positions.
- .7 Inject the epoxy resin under pressures of between 50-80 psi.
- .8 Purge the injection gun and equipment away from building.
- .9 After the epoxy is cured, the cement seal and modelling clay removed, use MEK (methyl ethyl ketone) solvent to remove the acrylic resin from the surface.
- .10 Final fills to the top surface of the cracks shall be completed by using a mixture of AC 33 acrylic resin thickened with fine-sieved stone dust (>300 microns). The stone dust shall be made from crushing waste portions of original stone. Departmental Representative shall provide recipe during time of the work.

3.12 STONE WITH FRACTURES THAT THREATEN TO DIVIDE THE STONE

- .1 Where possible, the following procedure shall be carried out prior to removing a broken stone from the wall. This is a preventative measure against complete division.
 - .1 From the joint sides or, only if necessary, through face of the stone, drill holes to a depth of 100mm beyond line or fracture. Departmental Representative will mark line for drilling these holes.

3.12 STONE WITH FRACTURES THAT THREATEN TO DIVIDE THE STONE (continued)

.1 (continued)

- .2 Clean holes using vacuum with small diameter attachment to reach to bottom of hole. Follow this with a cotton swab wetted with Acetone.
- .3 Do not allow dust or moisture to enter the hole once it has been cleaned.
- .4 Fractures that might allow bleeding out of injected epoxy must be sealed first by micro grouting using DHL injection grout.
- .5 Inject holes with sufficient epoxy resin, thickened to control viscosity, to allow stainless steel rod to be inserted without spilling onto surface of the stone.
- .6 Any spills must be cleaned immediately from surface using appropriate solvent.
- .7 Complete repair of crack following item 3.6 above using DHL injection grout and DHL shelter coat.
- .8 Where the crack is wider than 4 mm or where voids are considered too large along the edge of the crack, then mortar repairs (following item 3.14 below) shall be carried out.

3.13 FRACTURED STONES

- .1 Divided portions of broken stone shall be reattached along broken surfaces.
- .2 Drill 2 parallel holes of suitable diameter on one broken surface, marking angle of drill direction on outside of stone with chalk.
 - .1 Holes shall be 100 mm deep without drilling through the stone.
- .3 Raise this portion of stone and lower onto exact position of second broken half of stone. Once together, tap stone to loosen dust from drilled hole. Extend chalked lines marking angle of drill on second, undrilled portion of stone.
- .4 Lift up originally drilled half. Location of corresponding holes to be drilled in second portion shall be marked by small piles of drilling dust.
 - .1 Mark these locations and drill holes to a minimum of 100 mm depth without drilling through the stone.
- .5 Thoroughly clean holes using vacuum cleaner and small attachments that fit to bottom of hole. Following this, wipe hole with cotton swabs that have been wetted with acetone.
- .6 Fill holes with gel form epoxy resin sufficiently to allow for stainless steel threaded rod to be inserted without spillage onto broken surfaces.
- .7 A thin coating of DHL injection grout is brushed onto the broken surfaces just prior to bringing the two portions firmly together. Be certain to pre-wet the interfaces surfaces before applying DHL injection grout.
- .8 Restrain position using clamps placed to provide compressive pressure between portions.
- .9 Complete repair of crack (following item 3.8 above) using DHL injection grout and DHL shelter coat.

- .10 Where the crack is wider than 4 mm or where voids are considered too large along the edge of the crack, then mortar repairs (following item 3.14 below) shall be carried out. Tool the joint if required to match the existing surface.

3.14 RESTORATION MORTAR REPAIR

- .1 Where deterioration is localized, restoration mortar repairs can be returned to a flush or otherwise weatherproof surface where previously a void or localized loss had occurred. It is therefore crucial that the properties of the proprietary premixed surface repair mortar and the preparation of the cavity to which it is applied match the surface of the stone with regards to colour and texture.
 - .1 A restoration mortar repair will be judged as failed if it is cracked and/or sounds hollow to tapping.
- .2 The locations for restoration mortar repairs will be marked out by the Departmental Representative.
- .3 Cut out deteriorated portion to form a cavity, making certain that the shoulders of the perimeter are slightly under cut so that the bottom of the cavity is of a greater surface area than the cavity opening at the exposed surface of the stone.
 - .1 Depth of cavity to be 20 mm unless the substrate is not sound, in which case, cut depth to sound substrate depth.
- .4 If cavity is overhanging, prepare an armature for the mortar to be secured against the pull of gravity. Armature shall be formed from 1 mm stainless steel wire shaped into a "staple", the two turned ends of which are to be placed into predrilled holes of 10 mm depth and secured with epoxy paste. Be certain that the armature is set no closer to the surface than 10 mm.
- .5 Clean cavity thoroughly with pressurized air and dampen.
- .6 Apply slurry of restoration mortar first. Then, using small spatula-type tools, press the repair mortar into the cavity. If the cavity is deeper than 25 mm, place the repair mortar in two lifts. The mortar should over-fill the cavity by a slight amount.
- .7 Protect the repair mortar with moistened burlap for several hours. When it just yields to thumb pressure, the mortar is ready for cutting and/or shaping and texturing.
 - .1 The time it takes before the cutting can take place will vary and depend on ambient temperature and humidity.
- .8 Apply and fix in place moistened burlap over which is placed a fixed sheet of plastic to control rapid evaporation. Maintain in place for 7 days.
- .9 Mist periodically over a 5 days period.

3.15 CLEANING

- .1 Demonstrate cleaning operations to 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 grout or mortar residue resulting from work performed without damage to stone or joints.
- .4 Clear site of debris, surplus material and equipment, leaving work area in clean and safe condition.

3.16 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 SECTIONS

- .1 Section 04 03 07 – Historic Masonry Repointing and Repair.
- .2 Section 04 03 08 – Historic Mortars.
- .3 Section 04 05 00 - Common Work Results for Masonry.
- .4 Section 04 05 19 - Masonry Reinforcement and Connectors.

1.2 QUALITY ASSURANCE AND STANDARDS

- .1 Refer to Section 04 05 00 - Common Work Results for Masonry.
- .2 All new stones to be conform to the following standards.
 - .1 ASTM C616/C616M - 15, Standard Specification for Quartz-Based Dimension Stone (for sandstone).
 - .3 ASTM C97/C97M -15, Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.
 - .4 ASTM C99/C99M – 15, Test Method for Modulus of Rupture of Dimension Stone.
 - .5 ASTM C170/C170M – 16, Test Method for Compressive Strength of Dimension Stone.
- .3 The contractor to provide the laboratory test reports and results on the purchased stones to the Departmental Representative for approval.
 - .1 All tests identified above at Article 1.2.2 to be performed for each type of stone in the project (see paragraph 2.1) and the results to be submitted to the Departmental Representative for approval.
 - .2 Where test results do not match the requirements, the stone will not be accepted.

1.3 STONE QUALITY CONTROL FROM THE DEPARTMENTAL REPRESENTATIVE

- .1 Contractor to provide samples and stone test data sheets of the replacement stone(s) for Departmental Representative approval prior to commencement of the work. Samples to be sufficiently sized to compare with existing stone.

1.4 SUBMITTALS

- .1 Make required submittals in accordance with Section 04 05 00 - Common Work Results for Masonry.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 04 05 10 - Common Work Results for Masonry.
- .2 Deliver materials to job site in dry condition and in purpose made containers, packed to avoid chipping, damage or soiling, and protected from frost.
- .3 Label each container to clearly indicate contents and location on building.
- .4 Mark each stone quarry bed or direction of bedding and location of stone on building referenced to submittals. Use concealed permanent markings.

- .5 Handling:
 - .1 Avoid excessive handling; protect against chipping damage, soiling or staining.
 - .2 Repairing stone damaged during handling is not permitted.
 - .3 Do not use Lewis pins to move stones. Lift stones only by straps or chains with edges protected.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/ Demolition Waste Management and Disposal and Section 04 05 00 - Common Work Results for Masonry.

PART 2 - PRODUCTS

2.1 NEW STONE

- .1 Stone Types: supplied by the Contractor
 - .1 Type 1: Rock-faced: Dorchester sandstone, buff colour.
 - .2 Type 2: Dressed stone: Wallace sandstone, buff colour.
 - .3 Contractor to confirm stone replacement volume.
 - .4 Contractor to provide stone sample to match stone colour with existing sandstone for both Type 1 and Type 2.
- .2 Select new stones as follows:
 - .1 Free of seams, cracks or other imperfections impairing structural integrity.
 - .2 Free of excessive mottling or piebald markings, clay spots, coal streaks, iron banding, or foreign substance impairing appearance.
 - .3 Maintain continuity of colour and texture of existing units to be replaced or to match adjacent units, as applicable.
- .3 Anchors, cramps, dowels: to Section 04 05 19 - Masonry Reinforcement and Connectors.
- .4 Fabrication:
 - .1 Cut stone to shape and dimensions obtained from measurements and profiles taken from existing stone.
 - .2 Cut stone to lay on its natural quarry bed. Lay arch stones at right angles to thrust.
 - .3 Dress beds and joints same thickness as existing and at right angles to face.
 - .4 Hand tool finish stone to final size and profile. Match appearance and profile of existing stone. Machine split stones are not acceptable.
 - .5 Match finish variations to existing stone and to approval of Departmental Representative.
 - .6 Cut stone pieces to within tolerances exhibited by similar existing stones.
 - .7 Cut, dress, rub stones to accommodate existing materials and work of other
 - .8 Retain and store stone off-cuts for re-use as wall core material.
 - .9 Dress backs of stone to match original shape and keying into the core of wall.

2.2 GENERAL PHYSICAL PROPERTIES REQUIRED

- | | | | |
|----|--|--|------|
| .1 | DORCHESTER SANDSTONE PROPERTY STANDARDS | | |
| .1 | Density, min. kg/m ³ | | 2240 |
| .2 | Absorption by weight, max. % | | 4.4 |
| .3 | Saturation coefficient | | 0.61 |
| .2 | WALLACE SANDSTONE PROPERTY STANDARDS – TYPE II | | |
| .1 | Density, min. kg/m ³ | | 2260 |
| .2 | Absorption by weight, max. % | | 4.0 |
| .3 | Compressive strength, min. MPa | | 67 |

2.3 ANCHORS, TIES, AND MORTAR

- .1 Anchors, cramps, dowels: refer to Section 04 05 19 – Masonry Reinforcement and Connectors.
- .2 Mortar: refer to Section 04 03 08 – Historic Mortars.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Prevent absorption of ground water and exposure to rain. Rest stones in their natural bedding.
- .2 Handling:
 - .1 Move and lift stone units using means to prevent damage.
 - .2 Submit stone units dropped or impacted to Departmental Representative for inspection and approval.
 - .3 Do not make holes or indentations for Lewises or dogs on face or top side of stone.
 - .4 Fill holes after moving and lifting.
- .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 shoring and supports as required.

3.2 CUTTING/SIZING OF STONE

- .1 Use callipers, squares and levels to measure hole for new stone.
- .2 Site trim by cut-sizing new stone with joint widths not more than:
 - .1 Rock-face stone: 6 mm or as existing on building.
 - .2 Cut stone: 6 mm.
- .3 Joint between cut and rubble: min 8 mm and max 12 mm.

3.3 MOVING STONES

- .1 Use approved methods to move stones horizontally and to lift stones to working level.
- .2 Move, handle and set stones without causing damage.

3.4 RESETTING MISALIGNED STONES

- .1 Where indicated, re-set misaligned stone. Construct and brace temporary supports for arches to resist loads.
- .2 Remove stone units as necessary.
- .3 Re-set stones true to line and install dowels and cramps.
- .4 Remove supports.

3.5 RE-LAYING OF STONE

- .1 Prepare wall to receive stone.
- .2 Obtain Departmental Representative's approval of cleaning of core before commencing inserting stone.
- .3 Mortar fill deep voids of cores to match typical detail in maximum 50 mm lifts. Build up thicknesses with stone pieces set in mortar to replace original bonding pattern of core to facework.
- .4 Reconstruct masonry to ensure full embedding of grouted portion of anchors.
- .5 Drill and set anchors as specified in applicable Sections. Allow period of curing as specified in applicable sections prior to drilling.
- .6 Cut stones for connectors and support systems. Set connectors to face stone in appropriate sequence.
- .7 Clean stone by washing with water and natural fibre brush before laying.
- .8 Thoroughly dampen surfaces of core and apply mortar.
- .9 Set stones plumb, true and level in full bed of mortar and with vertical joints filled full except where otherwise specified. Set stones in same orientation as removed stones with even joint widths.
- .10 Erect face stones ahead of core. Fill core with mortar and stone pieces. Size and position to interlock with face stones as found.
- .11 Lay heavy stones and projecting stones after mortar in courses below has hardened sufficiently to support weight.
- .12 Prop and anchor projecting stones until wall above is set.
- .13 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.
- .14 Remove mortar dropping from face of stone before mortar is set. Sponge stone free of mortar along joints as work progresses.
- .15 Fill all voids around connectors with mortar type as specified.

3.6 FINISH POINTING

- .1 Rake back mortar joints and leave ready for finish pointing.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 04 03 07 - Masonry Repointing and Repair
- .2 Section 04 03 08 - Historic Mortars.
- .3 Section 07 92 00 – Joint Sealing.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA):
 - .1 CSA-A179-04(R2014), Mortar and Grout for Unit Masonry.
 - .2 CSA-A371-04(R2014), Masonry Construction for Buildings.
- .2 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).

1.4 SUBMITTALS

- .1 Submit documents and samples as specified in related Sections.
- .2 Product Data: submit manufacturer's printed product literature, specifications and data sheet for each product:
 - .1 Indicate date of manufacture of product and shelf life.
 - .2 Indicate initial rate of absorption, saturation coefficient and compressive strength of bricks.
 - .3 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.
 - .4 Indicate VOC's for epoxy coatings and galvanized protective coatings and touch- up products for masonry reinforcement and connectors.
 - .5 Indicate VOC's for joint fillers and lap adhesives.
- .3 Table of anchors, cramps and dowels; include dimensions, shapes and assemblies for standard and non-standard items.
- .4 Shop drawings: submit drawings for non-standard anchors, cramps and dowels.
- .5 Stone cutting schedule; submit document indicating size of each block; quantity and sizes to be cut from each block, and marking number of each cut piece related to each block.
- .6 Samples; submit:
 - .1 One of each type of masonry accessory, anchor and reinforcing.
 - .2 One of each mortar constituent in 500 ml plastic container with screw top lid.
 - .3 Three of each type of stone, sized and dressed to match existing stone units with direction of bedding marked. Indicate visible markings and finish.
 - .4 One of each type of cleaning material in 250 ml container with safety screw caps.
 - .5 One of each type of proprietary product including mortars, anchors and consolidation materials.

- .7 Scheduling: Submit dates indicating critical stages in masonry work. Include supply date, completion of shop fabrication and delivery to site.
- .8 Manufacturer's Instructions: Submit manufacturer's installation instructions.
- .9 Test Reports: Submit certified test reports showing compliance of materials with specified performance characteristics and physical properties.

1.5 QUALITY ASSURANCE - EXECUTION

- .1 Perform work under the review of the Departmental Representative.
- .2 Perform work in accordance with established procedures for historic masonry conservation and The Standards and Guidelines for the Conservation of Historic Places in Canada.
- .3 Shoring and cradling, and other temporary framing work needed to support the structure shall be designed by a qualified structural engineer, familiar with historic masonry structures and licensed to practise in the Province of New Brunswick. Drawings to be stamped and signed by the aforementioned engineer.

1.6 QUALITY ASSURANCE - MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 45 00 – Testing and Quality Control, as described herein and as specified in the applicable other Sections of the Specifications.
- .2 Construct mock-ups under supervision of Departmental Representative to demonstrate a full understanding of specified procedures, techniques and formulations are achieved before work commences. Contractor to carry out two mock-ups per stone repair type, as listed in Item 1.6.3, or as many mock-ups as required to attain Departmental Representative approval for each stone repair type.
- .3 Construct mock-ups to illustrate:
 - .1 Stone repair: Construct a mock-up of a representative sample of each type of repair. Include also a mock-up for new reglet.
 - .2 Backpointing and repointing: Construct mock-up 1.5 m x 1.5 m to demonstrate raking out, backpointing and repointing procedure as per the following (imp: locations of all the tests to be identified by the Departmental Representative once the scaffold is set up):
 - .1 Raking out of joints
 - .2 Backpointing of joints. One test for each type of stonework and mortar type (Type 1), including junctions at differing stonework and methodology to meet environmental requirements for mortar curing.
 - .3 Front pointing of joint. One test for the type of mortar (Type 2) and each type of stonework, including junctions at differing stonework and methodology to meet environmental requirements for mortar curing.

- .2 (continued)
- .3 Sealant: Construct mock-up to show location, size, shape and depth of joints complete with back-up material, primer, caulking and sealant. Mock-up will be used to judge workmanship, substrate preparation, operation of equipment and material application.
- .4 Backup wall, connectors and accessories.
- .5 Allow samples to cure at least 5 days before obtaining the Departmental Representative's approval for colour match. Samples shall be viewed from a distance of approximately 3.6 m.
- .6 When accepted, mock-ups shall demonstrate the minimum standard for this work. Accepted mock-ups may remain as part of the finished work.
- .7 Mock-up will be used:
 - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
 - .2 For testing to determine compliance with performance requirements.
 - .3 Quality and degree of finish required.
- .8 Construct mock-up where indicated by Departmental Representative.
 - .1 Coordinate and sequence activities accordingly.
- .9 Allow 72 hours for inspection of mock-up by Departmental Representative before proceeding with work.
- .10 Repeat mock-up until satisfactory results are obtained to satisfaction of Departmental Representative (above and beyond the mock-up quantities mentioned in the specifications).
- .11 When accepted by Departmental Representative in writing, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work.

1.7 QUALITY ASSURANCE - REVIEWS

- .1 Make mason's workshop accessible to Departmental Representative for review of current work-in-progress.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to job site in dry condition.
- .3 Storage and Protection:
 - .1 Keep materials dry until use except where wetting of bricks or stone is specified. Protect from freezing and contamination.
 - .2 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
- .4 Do not use materials which have exceeded manufacturer's recommended shelf life.

- .5 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 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 22 – Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .4 Unused metal materials are to be diverted from landfill to a metal recycling facility as approved by Departmental Representative.
- .5 Unused or damaged masonry materials must be diverted from landfill to a local facility as approved by Departmental Representative.
- .6 Identify hazardous and related materials which cannot be reused, are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from the Provincial Ministries of Environment and Regional Levels of Government.
- .7 Safely store materials defined as hazardous or toxic waste, including emptied containers and application apparatus, in containers or areas designated for hazardous waste and dispose of contaminants in an approved legal manner.
- .8 Place materials defined as hazardous or toxic in designated containers.
- .9 Handle and dispose of hazardous materials in accordance with applicable federal, regional and municipal regulations.
- .10 Do not dispose of unused materials into sewer systems, into lakes, streams, onto ground or in other location where they will pose health or environmental hazard
- .11 Fold up metal banding, flatten, and place in designated area for recycling.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Execute all mortar work when surface temperature is above 10°C, ambient temperature is between 12°C and 25°C and relative humidity (RH) is greater than 50% during installation.
 - .1 Curing conditions for repointing mortars: maintain for a period of 7 days, 80% humidity.

- .2 When ambient conditions do not meet requirements prescribed herein, provide enclosure system around curing area to ensure that stated environmental conditions are maintained for curing period. Take precautions to avoid overheating masonry.
 - .1 The use of heated temporary enclosures to maintain temperatures above 12°C in cold weather is subject to the written approval of the material manufacturer and the Departmental Representative.
 - .2 Submit enclosure system for approval from Departmental Representative in accordance with Section 01 33 00 - Submittal Procedures.
 - .3 Remove work exposed to lower temperatures as directed by the Departmental Representative.
- .4 Hot Weather Requirements:
 - .1 Protect repair mortar from direct sunlight and wind when the ambient air temperature exceeds 21°C.
 - .2 Use protection methods acceptable to the Departmental Representative.
 - .3 Keep repaired area humid for a period of 7 days for a proper cure.
 - .4 Do not use or prepare mortar when the ambient air temperature is above 30°C at the location of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Refer to related sections for stone, brick, related materials, accessories and material preparation procedures.
- .2 Burlap: clean, non-staining, free of printed matter, to Departmental Representative's approval.
- .3 Plumber's hemp: asbestos-free, oil-free jute rope.
- .4 Modified Vicat cone penetrometer.

2.2 SOURCE QUALITY CONTROL

- .1 Retain purchase orders, invoices, suppliers test certificates and documents to prove that materials used in contract meet requirements of specification.
- .2 Produce above upon request by Departmental Representative and allow free access to sources where materials were procured.

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 SITE VERIFICATION OF CONDITIONS

- .1 Report in writing, to Departmental Representative, areas of deteriorated masonry revealed and not conforming to specified requirements of the Work.
- .2 Once the scaffold is set up, providing access to all walls areas, obtain Departmental Representative's review, approval and instructions for each specified repair and replacement of masonry units before proceeding with repair work.
- .3 Obtain Departmental Representative's review and approval after the raking out of the mortar joints and prior the backpointing / repointing work. See section 04 03 07 for complementary information.

3.3 PROTECTION

- .1 Take necessary precautions to ensure that existing masonry carved stone units are not damaged during work. Provide protection of these elements. Submit protection measures to Departmental Representative for approval.
- .2 Provide safe containment, collection and removal of sandstone and sandstone dust.
- .3 Ensure workers are informed of hazards and trained in procedures prior to commencing work. Ensure workers wear protective clothing during work on sandstone.
- .4 Where cutting out of sandstone produces sandstone dust particles, take the following measures.
 - .1 Use wet techniques to eliminate dust.
 - .2 Work in sealed enclosure and maintain a negative vacuum system complete with NIOSH approved vacuum and filters.
 - .3 Prevent transmission of airborne dust particles beyond sealed enclosure.
 - .4 Remove residual dust particles daily from sealed enclosure. Maintain work areas in dust- free condition.
 - .5 Prior to commencing work, provide temporary materials and take necessary measures, to prevent ingress of dust into building. Immediately remove dust entering building and make corrective measures to Departmental Representative's approval, before continuing work.

3.4 PREPARATION

- .1 Inspect site with Departmental Representative and verify extent and location of mortar types prior to commencing installation.
- .2 Support:
 - .1 Construct shoring, cradling, and temporary framing work to support structure parts during removal and resetting operations, in accordance with approved drawings. Drawings to be stamped and signed by engineer experienced with historic masonry structures and registered in Province of New Brunswick.
 - .2 Leave work in safe condition when work is not in progress.

- .3 Take utmost care not to damage historic fabric. Make good any damage.
- .4 Seal and protect openings, doors, windows, and adjacent areas to prevent damage and spread of construction dust, water or other materials into the building.
- .5 Cover sills and projecting courses with rigid protection, secured into joints, for duration of work.
- .6 Prevent scaffolding, hoists or construction equipment from bearing directly against masonry or roof. Provide lumber or plywood with padding of sufficient thickness to prevent damage.
- .7 Obtain Departmental Representative's approval prior to proceeding, for:
 - .1 Extent and type of stone to be replaced, repaired or removed.
 - .2 Methodology and tools to be employed before commencing work.

3.5 INSTALLATION

- .1 Do masonry work in accordance with CSA - A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .3 Lay out coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- .4 Prevent materials from entering or penetrating wall cavities of building. Report findings of materials to Departmental Representative before continuing with work.

3.6 CONSTRUCTION

- .1 Remove, repair and replace masonry as indicated.
- .2 Jointing:
 - .1 Allow joints to set just enough to remove excess water, then finish joint as specified.
 - .2 Finish stone joints as specified in Section 04 03 07 – Masonry Repointing and Repair.
- .3 Cutting:
 - .1 Cut out for new flashing, and other recessed or built-in objects.
- .4 Building-In:
 - .1 Build in items required to be built into masonry.
- .5 Support of loads:
 - .1 Use grout to CSA A179 where grout is used in lieu of solid units.
- .6 Interface with other work:
 - .1 Cut openings in existing work as indicated on drawings (ex: reglets for new flashing).
 - .2 Make good existing work. Use materials to match existing.
 - .3 Dismantling and reinstallation of existing metal flashings to match existing. Ensure surface and finish not damaged during work.

3.7 SITE TOLERANCES

- .1 Tolerances in notes to Clause 5.3 of CSA-A371 apply.

3.8 FIELD QUALITY CONTROL

- .1 Testing on all types of mortars in the project (bedding mortar, front pointing mortar and backpointing mortar) shall be carried out by a Testing Laboratory designated by the Departmental Representative and engaged by the Contractor.
 - .1 The laboratory tests shall occur once a week (1 test on each type of mortar) during the entire grouting and mortaring operations throughout the project on all types of mortars and grouts. The tests shall be done with on-site fresh samples and shall include the expansion analysis of sand (bulking) – only required if sand is not bagged, the compressive strength at 7 days and 28 days, air entrainment percentage, Vicat cone testing (mortar only) and compressive strength.
- .2 Contractor to submit the log book of ALL Vicat cone testing done on site to the Departmental Representative on a weekly basis. Information to be submitted in Microsoft Word document and indicate the locations on the building where the mortar has been used and what mortar mix has been tested.
- .3 Prepare and update a register including a drawing of elevations on which the positions of 'data loggers' will be marked as well as dates of beginnings of humid curing of mortars for a given sector. Update and transmit data logger results once a week to Departmental Representative.
- .4 Inspection and tests of mortar will be done in compliance with CSA A179 standard. Departmental Representative must visit the laboratory before its hiring by the contractor to ensure that equipment and testing processes meet the standards and the specification requirements.
- .5 Contractor will pay for costs of initial mortar tests (plan for two tests per type of mortar). Contractor must pay and perform tests on all types of mortar used once a week for the whole duration of masonry works.
- .6 Air content for all mortars containing lime and Vicat cone penetration tests for the mortars used in stone and brick works must be tested at the same frequency as testing for resistance and compressive strength, or more often according to requirement of Departmental Representative.
- .7 Contractor must possess and have on the site a Modified Vicat cone penetrometer functional and well maintained for the whole duration of works of the project. Two individuals must be approved to perform Vicat test. If for some reason, those two individuals are not available to do so, mortar work must stop until new workers are reviewed and approved by Departmental Representative.

3.9 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.10 PROTECTION

- .1 At end of each working day, cover unprotected work with waterproof membranes. Membranes should extend to 0.5 m over surface area of work and be tightly installed to prevent finished work from drying out too rapidly.
- .2 Protect masonry and other work from marking and impact damage. Protect completed work from mortar droppings. Use non-staining coverings.
- .3 Maintain protection for minimum three weeks.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 04 03 41 – Historic Repair of Stone.
- .2 Section 04 03 42 – Historic Replacement of Stone.
- .3 Section 04 05 00 - Common Work Results for Masonry.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A580/A580M-15, Standard Specification for Stainless Steel Wire.
 - .2 ASTM A666-15, Standard Specification for Annealed or Cold- Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- .2 Canadian Standards Association (CSA):
 - .1 CSA-A179-04 (R2014), Mortar and Grout for Unit Masonry.
 - .2 CSA-A370-14, Connectors for Masonry.
 - .3 CSA-A371-14, Masonry Construction for Buildings.
 - .4 CSA-S304-14, Design of Masonry Structures.
 - .5 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction / Test methods and standard practices for concrete, Includes Update No. 1 (2015).

1.3 SUBMITTALS

- .1 Submit documents and samples in accordance with Section 04 05 00 - Common Work Results for Masonry.

1.4 QUALITY ASSURANCE

- .1 Submit test reports and certificates in accordance with Section 04 05 00 - Common Work Results for Masonry.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/ Demolition Waste Management and Disposal and Section 04 05 00 - Common Work Results for Masonry.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Connectors including wall ties, anchors, dowels and cramps: to CSA- A370 and CSA-S304.
- .2 Resin: two part epoxy resin system, low viscosity, high modulus, moisture insensitive, UV stable (non- yellowing).

- .3 Dowels for Pinning across Cracks: stainless steel to ASTM A580, type 316, nominal 2 to 6 mm diameter, threaded, size to Departmental Representative's approval.
- .4 Dowels for Setting Stone: stainless steel to ASTM A580, Type 316, from 6 to 13 mm diameter, threaded, size to Departmental Representative's approval.
- .5 Cramps: stainless steel to ASTM A666, type 316, standard hooked bar or strap anchor, nominal 6 mm thickness x 25 mm, length and design to suit application.
- .6 Grout: non-shrink hydraulic lime-based in accordance with CSA-S304, CSA-A371 and CSA-A179.

2.2 FABRICATION

- .1 Fabricate connectors in accordance with CSA-A370.

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 GENERAL

- .1 Install masonry connectors in accordance with CSA-A370, CSA-A371, CAN/CSA-A23.1 and CSA-S304.1 unless indicated otherwise.
- .2 Prior to placing mortar and grout, obtain Departmental Representative's review of placement of connectors.
- .3 Install dowels in stone with resin.
- .4 Install cramps in stone with grout.

3.3 BONDING AND TYING

- .1 Bond, tie and place anchors in walls in accordance with CSA-S304, CSA-A371 and as indicated.

3.4 GROUTING

- .1 Grout masonry in accordance with CSA-S304, CSA-A371 and CSA-A179 and as indicated.

END OF SECTION