

PART 1 GENERAL

1.1 Related Sections

- .1 Section 04 03 07 - Heritage - 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 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 "50% clean" is understood to mean a level of cleaning that removes enough soiling to prevent detrimental changes in the masonry's hygrothermal characteristics, but stops short of removing all traces of patina. This is essentially a visual evaluation, rather than the actual quantification of the amount of surface soiling removed as the term might suggest. On the Centre Block in particular, comparison with existing conserved masonry is important, as this project should contribute to, rather than diminish, the overall aesthetic harmony of the building. The south facade is the main reference, however the Library and the upcoming Pavilion project should also be considered. Establishing the acceptance standard will be done through a series of mock-ups. Assuming microabrasive cleaning is used, control of the level of cleaning will be achieved by adjusting nozzle dimension, pressure delivery, distance and dwell time of nozzle as well as abrasive type and size selection. The cleaning procedure is applied to 100% of the building exterior face.
- .3 Clean stones for purposes of removing stains and black atmospheric 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.

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- .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, angle of the nozzle 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 or video tape, 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 is in place.
 - .3 Allow for 10 cleaning test patches for the dark deposited atmospheric dirt generally distributed throughout the surface of the exterior tower masonry cleaning for each type of stones
 - .4 Allow for 6 test patches for each other type of cleaning specified herein and for each type of stones.
 - .5 Allow for 1.5 m2 test patch for each type of cleaning specified herein and 2m2 for Black Atmospheric Soiling Cleaning.

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- .6 Notify Departmental Representative 2 weeks before commencing cleaning of each test patch. Obtain approval from Departmental Representative before commencing test.
 - .7 Conduct tests on building to determine effectiveness of low pressure wash cleaning methods.
 - .8 Determine effect of cleaning operations on surrounding historic material and plants.
 - .9 Stop work when cleaning has detrimental effect on surrounding material and plants.
 - .10 Proceed with cleaning after written instructions are received from the Departmental Representative.
 - .11 Protect masonry openings from water/chemical infiltration during cleaning.
 - .12 Collect, neutralize and dispose of water and chemicals in accordance with contract requirements, applicable regulations and Canadian Environmental Protection Act, (CEPA).
- 1.2 Conduct test to determine effectiveness of 158.6 kPa water pressure, 4 hour time period. Under the direction of the Masonry Conservator 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.
- 1.3 Test pressure at each storey height determines effect of "line drop" on effectiveness of water jets.
- 1.4 Test brushing and spraying as an alternative to pressure washing. Consult Departmental Representative to review test results. Use method approved by Departmental Representative.
- 1.5 Test rust removal methods to establish effective poultice formulations and dwell times.
- 1.6 Test micro-abrasive cleaning methods. Conduct low-pressure tests, starting at 158 kPa, to determine methods and procedures to be used. Under the direction of the Masonry Conservator conduct further tests at various pressures, media type, dwell time, concentration, nozzle types and spraying distances from wall surface until satisfactory results are achieved and approved by the Departmental Representative.
- 1.7 Test a variety of Black Atmospheric Soiling removal methods to establish effective methods and to determine the degree of cleaning to be done.
- 1.8 Test a variety of pigeon dirt removal methods as specified in PART 3 - EXECUTION, to establish the most effective method.
- 1.9 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.

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- .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 to be to the approval of the Departmental Representative.
 - .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 stone refacing treatments, surface consolidant treatments and mortar frontpointing 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 Using pH strips, ensure that the pH is neutral in the stones within the recessed areas following the post-chemical water wash.
- .6 Contractor to submit a methodology to verify a neutral pH to the Departmental Representative for approval prior to the commencement of the work.

1.11 Waste Management and Disposal

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

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: proprietary suppliers.
- .7 Paint Strippers:

- .1 Gel form, with active ingredient Methylene Dichloride
- .2 Stripper systems such as Peel Away, non caustic type.
- .8 Ethylene diamine tetra-acetic acid (EDTA) formulated for use as a ferric oxide (rust) removal agent, in poultice form.
- .9 Attapulgate or Diatomaceous clay (Fullers Earth): for use as poultice medium.
- .10 Crushed glass abrasive for micro-abrasive cleaning.
- .11 Acid solution cleaning products: Consideration of proposed material to be approved by Departmental Representative only.
- .12 Alkaline solution cleaning products based on sodium hydroxide. material to be considered and approved by Departmental Representative only.

2.2 Tools and Equipment

- .1 Use only brushes of various shapes and sizes with natural or plastic bristles to suit type of work being performed.
- .2 Use only scrapers composed of wood, or plastic.
- .3 Use water pumps fitted with accurate pressure regulators and gauge 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 delivery 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, rigid white plastic of various volumes from 2 litre up to 20 litres.
- .9 Undyed, uncoloured sponges resistant to solvents and chemicals.
- .10 4 6 ml polyethylene sheeting.
- .11 Small wood wedges to suit location use.
- .12 Micro-abrasive cleaning of general wall surfaces: Micro-abrasive low pressure cleaning system, capable of delivery 30-100 micron dry abrasive through a 2 mm vortex nozzle at maintainable pressures of 140 - 160 kPa.
 - .1 Acceptable equipment:
 - .1 JOS or Rotek system.
 - .2 Alternative equipment: Approved by addendum in accordance with Instructions to Tenderers.
- .13 Micro-abrasive cleaning of sculpted wall surfaces and localized touch up cleaning such as at window surrounds: Micro-abrasive low pressure cleaning system, capable of delivery of 100 micron aggregate through a pencil nozzle of 1 mm orifice at maintainable pressures of 70 - 275 kPa.
 - .1 Acceptable equipment: COMCO micro-abrasive system.
 - .2 Alternative equipment: Approved by addendum in accordance with Instructions to Tenderers.
- .14 Heavy duty electric heat gun. Heat generated from electric coils. No open flame.
- .15 Vacuum Cleaner designed for industrial use, HEPA type for dry situations. Vacuum cleaner of industrial construction for wet suction use.
- .16 Sharp tungsten tipped chisels, both mallet headed and pneumatic air gun headed.
- .17 Pneumatic air guns for masonry chisels with appropriate compressor for air supply.

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- .18 Nozzle-type steam cleaning equipment, with operating pressure of 320 kPa, and steam temperature of 120°C.

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 dust, abrasive or 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 or micro-abrasive 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 scaffolding 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.

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- .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 misted spray system, then brush. Remove thick incrustations with wooden or plastic scrapers.
 - .4 Ensure masonry is cleaned after removal of scaffolding to eliminate possible staining on stone from tie-backs.
 - .5 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. Damage is defined as pitting, attrition, colour alteration to the front pointed mortar face.

3.5 Cleaning of Black Atmospheric Soiling on Surface of All Stones Walls

- .1 The overall intent of masonry cleaning is to clean only as necessary without damaging the stones in order to halt deterioration.
- .2 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 micro abrasive systems and chemicals will be determined by the Departmental Representative.
- .3 Equip workers with protective respiratory equipment to protect against dust particles and hazardous air pollutants.
- .4 Conduct localized low pressure micro abrasive cleaning / resurfacing for stone repaired with dutchmen and stone plugs, new stone surfaces, and where indicated, using specified equipment and materials, and methods in accordance with the approved mock-up.
- .5 Where feasible, treat new stones in the shop prior to installation.
- .6 For the treatment of stones in situ, provide tarped enclosures to prevent the spread of dust particles and hazardous air pollutants beyond the application area.
- .7 Upon completion, thoroughly vacuum the treated surfaces and adjacent surfaces to remove residual dust. Ensure that the pores of the stone are free from residual dust. Thorough rinsing with medium pressure water (600 psi) will be necessary.
- .8 For pricing, allow for 50% cleaning. Refer to note 1.3.2 above. Assume micro-abrasive systems will be used.
- .9 Schedule: 100% of exterior masonry

3.6 Cleaning of Black Atmospheric Soiling on decorative sculpted Berea stone by Masonry Conservator:

- .1 In deep cut recessed areas of the sculpted surface elements, first use steam cleaning to assist removal of localized soiling that is thick deposited
- .2 Obtain Departmental Representative's approval for wall areas to be steam cleaned.
- .3 Carefully use small nylon bristle brushes and wooden scrapers in addition to steam cleaning to remove soiling from specific areas.

Use of stainless steel brushes will only be permitted where it is shown, to the approval of the Departmental Representative, that no damage will occur to the stone.

- .4 If necessary, supplement cleaning system with poultice cleaning as specified, to localized areas containing soluble salts and resistant atmospheric soiling.
- .5 General cleaning of all stone wall surfaces as described above. Proceed with general cleaning of stone with specialized micro-abrasive system, such as the COMCO cleaning equipment provides.
- .6 Schedule: 5.4 m².

3.7 Cleaning of Bird Soiling and Staining

- .1 No single method will remove this soiling, however, the Contractor shall provide the means and equipment to clean difficult stains as may be necessary.
- .2 Remove all thick deposits with non-ferrous trowels and remove from work site immediately.
- .3 Carry out trial cleans using wet poultices of solvents mixed with diatomaceous clay, paper pulp, and/or methylene dichloride based stripper. Leave on surface for 2 hours, covered to prevent drying. Remove. Vigorously scrub surface of stone with stiff bristle brush while blotting softened dirt with cotton rags soaked in the chemical. Use steam and hot water under medium pressure (800psi) to thoroughly rinse the surface. If method is successful, continue on remainder of affected surface.
- .4 Should chemical removal of pigeon-related soiling fail to work sufficiently, carry out trial cleaning using a low pressure micro-abrasive cleaning system. Should method be successful, continue cleaning affected areas to approved level of cleanliness. Over-cleaning and damage to stone must be avoided.
- .5 Schedule: 10 m².

3.8 Removal of Bitumen and Tars

- .1 Scrape and remove thick deposits with a scraper of wood or high density plastic. Assist this dry removal using CO₂ freezing of surface if necessary and according to instructions given by the Departmental Representative.
- .2 Apply poultice of proprietary tar removal product.
- .3 Take appropriate care to strictly retain the tar to the affected area. Do not let the stain transfer or bleed to other areas of the masonry.
- .4 Should the above mentioned procedures and methods fail to satisfactorily remove tar adhesions, then a combination of mechanical (sharp chisel on air pneumatic driven hammer) and micro-abrasive cleaning equipped system to be used.
- .5 Schedule: 1 m².

3.9 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.

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- .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 and all traces of paint and caulking are gone.
 - .8 Medium pressure hot water and steam rinse complimented with scrubbing by hand and bristle brushes.
 - .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.
 - .11 For protection, catch any drips of material by draping a 6ml polyethylene sheet below the work area. Trap all chemical drips and discard immediately following all Government Regulations for handling and disposal.
 - .3 Carry out mock-ups using Paint Removal systems such as Peel-Away following manufacturer's instructions.
 - .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 Government of Canada for delays or equipment improvement.
- .5 Schedule: 1m².

3.10 Removal of Salts from Stone and Wall Surfaces Using Fuller's Earth Clay Poultices

- .1 Brush and vacuum all loose salt efflorescence from the affected surface of stones.
- .2 Soak the affected stone units by wetting with intermittent nebulized water misting system.
 - .1 Thorough soaking of the stones is necessary for poultice removal of damaging soluble salts
 - .2 Intermittent misting to ensure thorough and effective soaking must be carried out over a period of 12 hours prior to applying the clay poultice.
 - .3 Trap all water runoff for this intervention in troughs so as to ensure wetting and rinsing water is contained to the work surface only.
- .3 Mix Fuller's Earth clay in a bucket with sufficient amount of potable water to create a wet but cohesive consistency. The Departmental Representative will determine the correct consistency for the clay poultice mixture.
- .4 Apply clay poultice to the affected surface of wall to a thickness of 6 mm.
- .5 Cover with polyethylene for 24 hours, remove and allow poultice to dry at a controlled atmospheric temperature between 18°C and 24°C and a relative humidity of 65%.
- .6 When the poultice has thoroughly dried after approximately 10 days, remove the poultice by scraping with wooden scrapers directly into disposable bags and remove from site.
- .7 Brush and vacuum the surface thoroughly.
- .8 Rinse with a medium-pressure (800psi) water rinse.
- .9 Allow wall area to wait 3 days before repeating the procedures, maintaining temperature between 18°C and 24°C and humidity at 65% during this waiting period.
- .10 Repeat procedure above for a minimum of 3 times, or as requested by the Departmental Representative.
- .11 Poulticing is completed after rebuilding, backpointing, and cleaning, but before final pointing
- .12 After final post-treatment rinse, check pH using pH strips.
- .13 Schedule: 130 m².

3.11 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. Leave on surface for 24 hours. Medium pressure rinse to remove biologic growth from

- surface. Let surface thoroughly dry. Reapply again to thoroughly soak the stone surface and leave without rinsing.
- .3 Mask and protect adjacent masonry during application.
 - .4 Re-perform removal procedure as necessary.
 - .5 Schedule: 50 m².

3.12 Copper stain removal

- .1 Poultice preparation:
 - .1 Add 70g of ammonium chloride to 570 ml of concentrated ammonia (ammonium hydroxide 35%).
 - .2 Add water to make the volume 1 litre.
 - .3 To 1 litre of this solution, add 37g of EDTA (ethylene diamine tetra acidic acid).
 - .4 Add attapulgite clay to form a wet paste. Mix by adding clay slowly to the ammonium solution.
- .2 Appropriate protection against this ammonium based chemical must be used. This includes both body and breathing protection. Work area must also be set up to avoid dangerous fumes.
- .3 Do not wet surface of stone, but rather apply directly to dry surface.
- .4 Protect from being re-wetted during dwell time in contact with stone.
- .5 Once poultice is completed dry (cracks and detachment of poultice is evident), remove discard in sealed containers and remove from site.
- .6 Rinse surface of stone. Allow to dry. Repeat application for up to 5 cycles.
- .7 Schedule: 2 m².

3.13 Clean-Up

- .1 Medium pressure rinse off masonry to the satisfaction of the Departmental Representative.
- .2 Rinse from bottom to top, and then from top to bottom.
- .3 Upon completion, check the pH levels of stone, using pH strips, where chemicals have been used during the cleaning process. If pH levels are not neutral, flush with water or appropriate chemical solution. 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 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.
- .8 Schedule: 100% of building, interior and exterior.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

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

1.2 References

- .1 American Society for Testing and Materials (ASTM)
- .1 Canadian Standards Association (CSA)
 - .1 CSA A23.1-04/A23.2-04, Construction Materials and Methods of Concrete Construction.
 - .2 CSA-A371-04, 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 in accordance with Section 01 35 29 - Health and Safety Requirements for materials used for the work of this Section. Indicate VOC content.

1.4 Quality Assurance

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

1.5 Mock-Ups

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

1.6 Delivery, Storage and Handling

- .1 Store cementitious materials and aggregates in accordance with CSA A23.1.
- .2 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.
- .8 Provide and maintain digital data temperature and humidity logs monitors at each elevation of both east and west towers. Placement will be determined once scaffold is set up, but assume locations to have approximate locations of near top and near bottom of scaffold levels. Submit data on a weekly basis during project construction to Departmental Representative. Retain print out hard copies in binders on the project site, filed sequentially in order for quick and easy access and reference during site review visits 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 cements and sands for immediate use within heated enclosure. Allow these materials to reach minimum temperature of 15°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.
 - .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 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 04 05 10 - Common Work Results for Masonry.

PART 2 PRODUCTS

2.1 Materials

- .1 Mortar and grout materials: to Section 04 03 08 - Heritage - Mortaring.

2.2 Grout Injection

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

2.3 Temporary Wood Wedges

- .1 Soaked soft wood wedges with appropriate thickness for stone setting and/or where raking/cleanout operations may loosen stone units.

PART 3 EXECUTION

3.1 Site verification of conditions

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

3.2 General

- .1 Perform work in accordance with CSA-A371. Extent of raking out and repointing is as noted on the Drawings.
- .2 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 100% all joints, interior and exterior.

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- .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: Approved by addendum in accordance with Instructions to Tenderers.
 - .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 proven 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 will be charge.
 - .5 Clean joints to full depth of deteriorated mortar but in no case to less than 55 mm. Note that voids in vertical joints can reach as deep as 350 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 Flush open joints and voids; clean open joints and voids with low pressure water and compressed air to remove all debris and dust.
 - .7 Fine joints (less than 3 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

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- sawcut 50 to 75 mm from end of joint and finish by hand in order to avoid cutting into adjacent stonework.
- .8 Any stone damaged as a result of careless raking, or saw cutting, shall be replaced at no cost to the Departmental Representative.
 - .9 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.
 - .10 Temporary shims to be installed where raking and cleanout activities cause a stone unit to become loose.
 - .11 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 readied for front pointing (55mm). 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 an approx.6 mm diameter clear plastic grout tube. Insert tube and seal with cloth or burlap. Inject grout under low pressure (3-4 psi) 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. Clean spills from surface within 10 minutes of taking place using low pressure wall rinsing equipment.
 - .4 Allow grout to thoroughly cure and humidity in wall to dry before proceeding with frontpointing. Assume 14 days.
 - .2 In the hours leading up to mortar pointing, thoroughly wet joints in order to control absorption such that a thoroughly dampened environment exists within the outer wall area where mortar is being placed.
 - .3 Allow water to soak into masonry and mortar, leaving no standing water, but the joint surface remains 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 max. 75mm layers thickness, allowing each layer to set for 30 minutes before placing next layer. Ram placed mortar layer well just prior to applying subsequent layers in order to compact any shrinkage that may have taken place. Bring face of mortar in backpointed joint to specified minimum depth from stone face, measured from the arris of the masonry unit, as prepared for front pointing.

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- .5 Leave mortar in joint square and of even depth measured from stone arris. Be certain to score the surface of the backpointing in order to assist bonding the frontpointing when it is placed.
 - .6 Prevent mortar from being placed or smeared onto face of stone during pointing work. Provide protection of all masonry below the mortar jointing work such that mortar drops and associated water will not stain stone faces.
 - .7 Stretch dense, tight woven burlap in within 4 inches of wall. Maintain 100% humidity of the burlap. Maintain membrane of 6ml polyethylene plastic against the outside face of the burlap so as to assist with damp condition of the burlap. Lifting the plastic and misting with a misting nozzle on a hose is permitted for back-pointing. Maintain for damp curing for 7 days.
- .3 Frontpointing
- .1 When all required stone repair and replacement work is complete, carry out repointing. Frontpointing mortar will be pigment coloured based on trial recipes.
 - .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. Avoid feather edges. Pack mortar solidly into voids and joints using tools that fit comfortably in the joint width.
 - .3 Over a period of several hours before starting front pointing work soak 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 not perform pointing in freezing or poor 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 profile. Mortar must be recessed by approximately 1 mm or as established during mock-up, such that the arris edge is visible. Flush cut joints.
 - .8 Final finish to expose aggregate texture will be completed using a stiff "churning" brush which is struck on bristle ends, 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 replasticeize the mix.
 - .10 Remove excess mortar from masonry face before it sets and clean thoroughly with water, brushes and thick cotton rags.
 - .11 Provide protection of all masonry below the mortar jointing work such that mortar drops and associated water will not stain stone faces.
- .4 Curing:

.1 Moist cure freshly pointed joints by stretching dense, tight woven burlap within 4 inches of wall. Maintain 100% humidity of the burlap. Maintain membrane of 6ml polyethylene plastic against the outside face of the burlap so as to assist with damp condition of the burlap. Lifting the plastic and misting with a misting nozzle on a hose is permitted for backpointing. However, maintenance to keep the burlap damp during frontpointing must not allow water to be sprayed or misted in any way that directly contacts the fresh mortar joints in the process. Burlap sheeting and plastic must be folded upon adjacent sheets and secured so as to insure openings in the damp curing system does not occur. Maintain damp curing for backpointing for 7 days. Maintain damp curing for frontpointing for 28 days

.5 Protection:

.1 Protect newly laid mortar from frost, rainfall or rapid drying conditions such as wind and direct sun for 28 days.

.6 Curing (heated conditions):

- .1 The masonry is to be maintained at a temperature above 12°C, but no higher than 28°C. Moist conditions near the surface of the masonry should be controlled using damp burlap covered with a plastic membrane protection stretched taught within 4 inches of the face of the masonry, as described above.
- .2 Protect all new jointed masonry from exposure to cold weather environmental conditions such as rain or snowmelt for a minimal period of 28 days after placing of mortar.

3.4 Resetting of stone

- .1 Should stone units become loose or debonded during cutting out mortar joint procedures, the contractor will reset as part of the repointing work. 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 cavity surface.
- .4 Consolidate and parge 100% of exposed core with mortar - fill all the exposed cavities.
- .5 Install stone and point up joints behind the front pointing depth (behind 55 mm) in preparation for grouting deep joint cavity around the stone by setting grout tubes in the joint.
- .6 Allow mortar to set 24 hours and proceed with grout injection. Insert grout tubes along top joint. Grout the stone under low pressure such that all joints of top, bottom, sides and rear are filled.
- .7 Fix masonry units in correct location with water-soaked wood wedges.
- .8 Pull out wood wedges when dried and shrunken.
- .9 Proceed with frontpointing only once grout has cured for 28 days 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 Detached Stone Shards

- .1 Should portions of stone adjacent to mortar joints, such as stone unit corners, become detached during the work of mortar joint work, then the Contractor shall reattach immediately following the specified procedures for shard repair as described in section 04 03 41 Heritage - Repair of Stone.
 - .1 In order to prevent loss of such portions of stone, the Contractor must ensure the already loose portions of stone is retained, kept safe from loss and protected until such time that it is reattached to its original position.
 - .2 Allow for 75 shard repairs per tower to be executed in the project.

3.6 Grouting Section of Masonry Wall

- .1 Where stones are identified to be replaced and/or reset—and where there is masonry dismantling the Departmental Representative will identify the voids to be grout injected. Where it is indicated on the drawings and where it is determined by the Departmental Representative that there are voids in the core of the wall, prepare and install specified grout.
- .2 Clean out voids with clean water until water runs clear. Ensure ambient temperature remains above 15°C for at least 24 hours after voids are cleaned out.
- .3 Fill joints and cracks with mortar set back 55 mm from front edge/arris of stone unit.
- .4 Set grout tubes in joints, in sufficient numbers to insure grout feeds to all areas of the core cavity to be covered (plan for 2 per 1000 cm²). Flexible transparent plastic grout tubes, such as plumbing tube, (6 mm dia.) must reach at least 200 mm to where void to be filled as determined by the Departmental Representative.
- .5 Inject grout under low pressure sufficiently fluid to suit application condition. Gently vibrate to assist flow. Ensure voids are full through grout tubes.
- .6 Grout from the bottom of the wall opening and/or joint to the top
- .7 Allow grout to set prior to proceeding with repairs, frontpointing, backpointing, substrate consolidation and stone setting.
- .8 Take great care not to allow the grout to seep inside the wall and damage the interior finishes. Damage to the interior finishes caused by undue care shall be repaired at the Contractor's expense.
- .9 Allow grout to firm up and thoroughly clean and rinse any grout spills from the surface of the stone to avoid staining.

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- .10 Frontpoint joints and/or consolidate the substrate only after grout has cured and humidity from the operation has subsided.

3.7 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 review and recording 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 72 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.

3.8 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 Clean stone masonry to remove environmental soiling. See Section 04 03 06 - Heritage - Cleaning Historic Masonry
- .5 Remove all debris from stone faces, ledges and sills, as scaffolding is being removed.
- .6 Re-oil all lead flashed surfaces at end of work.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 04 03 07 - Heritage - Masonry Repointing and Repair.
- .2 Section 04 03 42 - Heritage - Replacement of Stone.
- .3 Section 04 05 00 - Common Work Results for Masonry.
- .4 Section 04 21 13 - Brick Masonry.

1.2 References

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C207-06, Specification for Hydrated Lime for Masonry Purposes.
 - .2 ASTM C348-08, Test Method for Flexural Strength of Hydraulic-Cement Mortars.
 - .3 ASTM C940-98a(2003), Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced Aggregate-Concrete in the Laboratory.
 - .4 ASTM C144-04 Standard specification for Aggregate for Masonry Mortar
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .2 CSA A179-04, Mortar and Grout for Unit Masonry.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS):
 - .1 Material Safety Data Sheets (MSDS).
- .4 European standards
 - .1 EN 459-1:2001, Building lime. Definitions, specifications and conformity criteria.
 - .2 EN 459-2:2001, Building lime. Test Methods.

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 types 1 and 2 and in quantity and size in accordance with CSA A179M.
 - .2 Prepare samples to represent same exposure conditions of building. Fully cure minimum 7 days
 - .3 Submit two 100 mm diameter size samples each type of mortar.
 - .1 Colour for mortars will ultimately 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.
 - .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 in accordance with Section 01 45 00 - Quality Control.
- .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. All air content testing will be performed using a 1 litre air meter.
 - .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 weekly basis at discretion of Departmental Representative. All air content testing will be performed using a 1 litre air metre. Keep a log of each batch with record of date, time of mix, where used in wall, Vicat penetration value measured.
 - .3 Vicat cone penetration measurements on each mortar batch for first three days, followed by daily tests at discretion of Departmental Representative. Keep a log of each batch with record of date, time of mix, where used in wall, Vicat penetration value measured.
 - .4 Compressive strength of mortar at 7 and 28 days, and weekly strength tests at discretion of Departmental Representative.
 - .5 Mock-up: provide colour matched samples in prepared joints on building, properly cured under damp conditions as specified, 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 on the towers and identified by the Departmental Representative as to be original mortar and of value to historic knowledge of original construction, to be

tested in laboratory for material composition by the general 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.
- .2 All mixing to be completed within a well lit shed with shelving, large level table, water and electric. The shed must not be further than 200 metres from the wall location where it is to be used in wall. It must be sufficiently weather proof and rain/snow proof so as to maintain stored material and ambient temperatures throughout the year of between 12 and 26 degrees. Heat or cool space accordingly to maintain these temperature tolerances.

1.6 Waste Management and Disposal

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

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. 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 Size for wide joints above 6mm:

Imperial	Metric	Percentage by weight passing each sieve	Percentage by weight retained on each sieve
#4	4.75 mm	100	0
#8	2.36 mm	90	10
#16	1.18 mm	75	15
#30	600 µ	50	25
#50	300 µ	25	25
#100	150 µ	10	15
#200	75 µ	0	10

For fine joints measuring below 4 mm joint height, sieve off/remove all aggregate sizes above 1.18mm (#16).

- .4 Colour: dry powdered in inorganic pigments, maximum quantity permitted in dry form will not exceed 3% 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 pit located at Renfrew, Ontario to approval of Departmental Representative.
 - .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.
 - .2 Lime Type 2: fresh hydraulic lime, finely ground, to EN 459-1, type NHL 12, containing air entraining agent, to Departmental Representative's approval.
- .8 Portland Cement: CSA-A3000, white, non staining, normal, type GU for sandstone.
- .9 Grout for stonework: reinforcement grout, conforming to CSA A179, ASTM C348 and ASTM C940, control water content to conform to CSA A179, Clause 4.2.1.2 or Clause 4.3.1.5,
- .10 Repair mortar and dispersed hydrated limes for crack repair of stone:
 - .1 For mortar repairs including wide cracks mixed on site with aggregate and pigments.
 - .1 Acceptable material: Proprietary premixed repair mortar based on St. Astier Hydraulic lime NHL 12.
 - .2 Alternative Materials: Approved by addendum in accordance with Instructions to Tenderers.
 - .2 For thin cracks and fissures (Colouring using dry pigment to be established during project work):
 - .1 Acceptable material: Dispersed Hydrated Lime (DHL) for Injection and Shelter Coat.
 - 1. Dispersed Hydrated Lime (DHL) for Injection (Kalkinjectionmortel) and
 - 2. Shelter Coat. Supplier: Deffner Hohann, info@deffner-johann.de.
 - .2 Alternative Materials: Approved by addendum in accordance with Instructions to Tenderers.
- .11 Repair mortar for patching stone surfaces:
 - .1 Proprietary premixed stone patching material that is formulated to closely match the colour, texture and physical properties of the stone to be patched.
 - .1 Acceptable material: Proprietary premixed repair mortar based on St. Astier Hydraulic lime NHL 12.

- .2 Alternative Materials: Approved by addendum in accordance with Instructions to Tenderers.
- .2 The mortar shall be formulated to need only to be mixed with potable water at the site.
- .3 The mortar shall be vapour-permeable, frost and salt resistant, shrink resistant, and be physically compatible with the substrate, including, but not limited to porosity, tensile strength and compressive strength.
- .4 Acceptable materials:
 - .1 Neostone, manufactured by Daubois
- .12 Stone dust type 1: Berea 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 For all bedding and backpointing mortar for stonework based on volume proportion specifications:
 - .1 Range for compressive strength; approximate 5.0 MPa at 28 days for pointing work; approximate 7-8 MPa average at 90 days.
 - .2 Mix: 1:2:6 white Portland cement: lime Type SA: aggregate.
- .2 For all frontpointing mortar (front 55mm of all masonry joints):
 - .1 Range for compressive strength; approximate 3.5 MPa at 28 days for pointing work; approximate 5 MPa average at 90 days.
 - .1 Use 1:2.5:8 white Portland cement: lime type SA: aggregate mix for all front pointing applications.
- .3 Vicat Cone Penetration for Stonework;
 - .1 Pointing Mortar (front pointing and backpointing); 18-21mm
 - .2 All Bedding Mortar; 25-35mm
- .4 Allowable air content for all lime/cement mortars; 8-12%.
- .5 For ease of consistent measuring units, assume 1 litre as the standard 1 part unit.
- .6 Use separate measuring boxes, of rigid construction, when mixing proportionately, such that each part measure of a specific mix is contained within a designated box.
- .7 Do not add air entraining admixture to mortar mix.
- .8 All mixing to be completed within a well lit shed with shelving, large level table, water and electric. The shed must not be further than 200 metres from the wall location where it is to be used in wall. It must be sufficiently weather proof and rain/snow proof so as to maintain stored material and ambient temperatures throughout the year of between 12 and 26 degrees. Heat or cool space accordingly to maintain these temperature tolerances.
- .9 Grouting:
 - .1 Mix as per instructions provided by manufacturer.

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. Use 1 litre measurements for each part.
 - .2 Begin by mixing dry ingredients in a bucket for approximately 1.5 minutes, then add mix to predetermined quantity of water in a mixing bin/bucket. Whip-mix for approximately 2 minutes. Let rest for 3 minutes. Final whip-mix ingredients for a final approximate 2 minutes. The mortar should easily form when spun by hand into a ball.
 - .3 Establish a best means of holding the mixing bucket in firm position during the mixing procedure. Foot holding while mixing will not be permitted.
 - .4 All mortar used for rebuild areas or wall building can be mixed using a regular drum/paddle mixer, whereby paddles rotate independent to the drum. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes.
 - .5 Water content for mortar to be determined by Vicat penetration testing.
 - .6 Record water quantities and use for subsequent mixes to help ensure uniformity of all subsequent mixes.
 - .7 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 insuring thorough incorporation of ingredients and air-entrainment.
 - .2 Submit mixing tools and container for approval prior to starting pointing work.
 - .8 Thoroughly clean all mixing boards and mechanical mixing parts between batches.
 - .9 Mortar must be weaker than the units it is binding.
 - .10 Mortar must not contain elements detrimental to the original masonry or surrounding materials.
 - .11 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.

.12 Use mixes within 40 minutes. Do not re-temper with water.

3.4 Mixing - Repair Mortars

- .1 Mix DHL and patching repair mortars in accordance with the manufacturer's instructions and using the same mixes and methods as the approved mock-ups. Refer to Section 04 03 41 - Repair of Stone and Section 04 05 00 - Common Work Results for Masonry.
- .2 Mixed in small quantities as needed. Mix by hand and small paddle on electric drill (2500 rpm).

3.5 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 mortar 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.

3.6 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.

3.7 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 maintain Vicat penetrometer throughout the duration of the project work.
- .5 Use mortar matching in colour determined by test samples prepared in the wall and cured during mock-up work for coloured mortar approvals for front-pointing to minimum depth of 55mm.
 - .1 Colour mock ups and approvals for repair mortar mixes will be based on cured examples placed in prepared cavities in original stone both on the wall and within a specially prepared sample stone into which numerous slots have been cut to receive various colours proposals of the repair mortar.

3.8 Mortar use schedule

- .1 Use bedding mortar for all rebuild locations and back pointing.
- .2 Use back pointing mortar where required. Assume 60% of all vertical joints and 20% of all bedding joints will require back pointing.
- .3 Use front pointing mortar in all locations.

3.9 Sequence

- .1 Do front pointing no sooner than 28 days after rebuilding.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

- .1 Section 01 43 17 - Masonry Conservator.
- .2 Section 04 03 06 - Heritage - Cleaning Historic Masonry.
- .3 Section 04 03 07 - Heritage - Masonry Repointing and Repairs.
- .4 Section 04 03 08 - Heritage - Mortaring.
- .5 Section 04 03 42 - Heritage - Replacement of Stone.
- .6 Section 04 05 00 - Common Work Results for Masonry.
- .7 Section 04 11 00 - Proprietary Grout Anchors.

1.2 Reference Standards

- .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-A179-04, 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 the 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 10oC 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 10oC 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 21 - 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 - Mortaring.
- .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
- .7 Epoxy Resin, low viscosity, UV stable, capable of setting and curing in wet conditions.
- .8 Acrylic Resin:
- .9 Acetone solvent. Industrial grade.
- .10 Methyl Ethyle Ketone (MEK) solvent.
- .11 Hot glue cartridges with electric gun dispenser.
- .12 Modelling clay.
- .13 Plumber's adhesive tape.
- .14 Burlap, untreated and non-staining.
- .15 100% cotton rags.
- .16 Hardwood wedges: free of tannins, various lengths and thickness.
- .17 Backer-rod: Polyethylene rope to accommodate all joint width snugly.
- .18 Syringes: 30 ml and 60 ml volumes, with twisted attachment for standard needles.
- .19 Catheters: 60 ml volume capacity.

- .20 Needles for syringes: size numbers 14, 16, 21.
- .21 Plumber's 6 mm and 12 mm clear tubing.
- .22 De-ionised water.
- .23 Repair mortar for wide cracks: Refer to Section 04 03 08 - Heritage - Mortaring.
- .24 Dispersed hydraulic lime (DHL) injection grout and shelter coat: Refer to Section 04 03 08 - Heritage - Mortaring.

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 scriber 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 Dremel
 - .16 Diamond cutting blades, turbo style, 86 mm.

2.4 Mortar Mixes

- .1 Mixes, see Section 04 03 08 - Heritage - Mortaring.
- .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, after scaffolding has been erected but 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 metal tags as described in Section 04 43 43.
- .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 - Heritage - 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 or marked 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 Tool 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 0.5 mm will be allowed between Dutchman insert and host stone joints. This includes backside joint.
- .9 Smooth, tool, carve, or texture surface to match adjacent exterior surface of the cavity. If required, use pressurized abrasive equipment to achieve texture.
- .10 Provide attachment of inserted dutchman to cavity by inserting one stainless steel rod (12 mm dia.) into back side for Dutchmen smaller than 200 mm x 200 mm, and two rods (12 mm dia.) for Dutchmen larger than 200 mm x 200 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 0.5 mm maximum surrounding it. Use slurry of hydraulic lime (NHL 13) to fill cavity joint around Dutchman. Thoroughly soak stone surfaces prior to applying the slurry by placing stone in a bucket of water.
- .12 Allow slurry and resin for anchors to set thoroughly. Wipe all slurry spills from surface to insure against lime staining.
- .13 Make certain that sufficient slurry is used, so that joint is 100% filled and flush with the surface.
- .14 Schedule: For pricing, allow for a total of 0.4 m³ of dressed Berea stone and 0.02 m³ of Nepean field stone. Assume total number of repairs, as follows:
 - .1 90 small repairs.
 - .2 36 large repairs.

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
- .5 Allow for 160 plugs in total.

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, pneumatic 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.
- .5 Schedule: Allow for 7.5 m².

3.8 Pinning

- .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, if necessary. 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 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 3.12 below) shall be carried out.
 - .1 For wide fissures (i.e. up to 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. 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.
- .9 Schedule: Allow for 100 pinning repairs.

3.9 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.
- .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 crack fill described in 3.8 above (Mechanical consolidation of cracks in stone).
- .7 Schedule: Allow for 75 shard repairs to be executed in the project.

3.10 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.
 - .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 3.8 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 3.12 below) shall be carried out.
 - .9 Schedule: Allow for 70 repairs.

3.11 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 3.12 below) shall be carried out. Tool the joint if required to match the existing surface.
- .11 Schedule: Allow for 30 repairs.

3.12 Restoration Mortar Repair

- .1 Where deterioration is localized, 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 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 mortar repair will be judged as failed if it is cracked and/or sounds hollow to tapping.
- .2 The locations for mortar repairs will be marked out by the Departmental Representative.
- .3 Cut out deteriorated portion including any old repairs 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 15 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 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 a 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 a 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.
- .10 For pricing, assume mortar repairs located above the heads of seventh floor windows are to receive a shelter coat in order to provide additional protection. Assume average repair size is 100 mm x 100 mm x 50 mm deep. Allow for a total of 0.5 m² of mortar repairs.

3.13 Cleaning

- .1 Demonstrate cleaning operations to Departmental Representative before starting cleaning work.
- .2 Clean stone work surfaces after repairs and rebuilding 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.

3.14 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 - Mortaring.
- .3 Section 04 05 00 - Common Work Results for Masonry.
- .4 Section 04 05 19 - Masonry Reinforcement and Connectors.
- .5 Section 04 11 00 - Proprietary Grout Anchors.

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 C568 Standard Specifications for Limestone Dimension Stone - type III (for limestone)
 - .2 ASTM C616 - 08 Standard Specifications for Quartz-Based Dimension Stone.(for sandstone)
 - .3 ASTM C97 Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
 - .4 ASTM C99 Test Method for Modulus of Rupture of Dimension Stone
 - .5 ASTM C170 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. All the tests identified above at 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. If the results do not match the requirements, the stone will be refused.

1.3 Stone Quality Control from the Departmental Representative

- .1 The Departmental Representative (Masonry Conservator) shall inspect the stone blocks and stone units at the following stages:
 - .1 At the quarry: The stone blocks shall be selected by the Departmental Representative.
 - .2 At the Contractor's facility before cutting: The delivered stone blocks shall be approved by the Departmental Representative at the shop before the Contractor proceeds with the cutting.
 - .3 Prior to Installation: The cut stone units shall be approved by the Departmental Representative before installation in the building.

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 21 - 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: Nepean (Acceptable material: light buff and white coloured St. Canut) sandstone.
 - .2 Type 2: Cleveland Amherst Berea sandstone, colour buff, for dressed ashlar, moulded stone and sculpted detail.
- .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 To maintain continuity of colour and texture of existing units to be replaced or to match adjacent units, as applicable.
 - .4 Anchors, cramps, dowels: to Section 04 05 19 - Masonry Reinforcement and Connectors and Section 04 11 00 - proprietary Grout Anchors.
 - .5 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 SANDSTONE PROPERTY STANDARDS
 - .1 Density, min kg/m3 2400
 - .2 Absorption by weight, max. % 3.0
 - .3 Compressive strength, min. MPa 28
 - .4 Modulus of rupture, min. MPa 6.89
 - .5 Abrasion resistance, min. hardness 8

2.3 Anchors, Ties, and Mortar

- .1 Anchors, cramps, dowels: refer to Section 04 11 00 - Proprietary Grout Anchors.
- .2 Mortar: refer to Section 04 03 08 - Heritage - Mortaring.

2.4 Quarry visits.

- .1 Arrange for Departmental Representative to visit the two quarries proposed for the supply of the stone. Acceptable stone will be selected by the Departmental Representative at the quarry sites.

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 within 50 mm of back of stone 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 pressure 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.
- .16 For pricing, allow for a total of 13.75 m³ of dressed Berea stone and 1.1 m³ of Nepean field stone. Assume total number of replacements as follows:
 - .1 322 dressed Berea stones.
 - .2 49 Nepean field stones.

3.6 Front Pointing

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

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 02 41 21 - Selective Structure Demolition.
- .2 Section 04 03 42 - Heritage - Replacement of Stone.
- .3 Section 04 05 00 - Common Work Results for Masonry.

1.2 Storage and Protection

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 "Common Product Requirements".
- .2 Protect stone units and facilitate their reinstallation.
- .3 Store dismantled stone masonry units in the designated area on site. Protect from exposure to water, elements, and potential mechanical damage under shelter or fully covered with polyethylene. Units to be placed on wooden pallets and are not to sit directly on the ground. Should there be insufficient storage space on site, the contractor shall make arrangements to safely transport and store excess stone units off-site until required to returned to the site. No additional costs can be claimed for off-site transport and storage.
- .4 Stone units designated for replacement with new units are to be retained for repair of other units. Unused removed stone units are to be handed over to the Departmental Representative. No stone units are to be disposed of without the Departmental Representative's approval.

1.3 Shoring, cradling and temporary framing work

- .1 Refer to Section 04 05 00 - Common Work Results for Masonry.
- .2 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 hired by the General Contractor. Shoring, cradling, and other temporary framing work design to be review and approved by the Departmental Representative prior the work.

1.4 Sequencing

- .1 See section 01 14 23 - Sequence of the work.
- .2 The extent of stone masonry units that are to be removed and reinstalled is indicated on the drawings.
- .3 Mark stones and other elements or components to show their identity, number and position in the building. Markings to be done on back of stone using waterproof marker or paint.
- .4 General Contractor to take high definition general pictures (professional quality) of all the areas to be dismantled and rebuild by façade. All the stones to be dismantled on the pictures to be digitally numbered. General Contractor to submit the key-pictures to the Departmental Representative for review and approval. Stone numbers on the pictures and on the stainless steel tags to be the same.

- .5 Keep the key-pictures up-to-date and, produce a copy following every modifications.
- .6 Ensure that the key-pictures contains relevant information which will facilitate the reinstallation of each stone in its original location, as indicated on the drawings.
- .7 Submit up-to-date copies of the key-picture as well as chronological information concerning each numbered unit (individual cards of units), when requested.

PART 2 PRODUCTS

- 2.1 Not Used
 - .1 Not Used.

PART 3 EXECUTION

3.1 Inspection

- .1 Examine areas and conditions under which work is to be performed and notify the Departmental Representative in writing of conditions detrimental to the proper and timely completion of the work.

3.2 Examination, Marking & Recording

- .1 Before starting the work of this Section, follow the examination procedures specified in Section 04 03 41 "Repair of Stone". Mark stones and other elements or components to show their identity and position in the building. Markings to be done with a stainless steel tag with the stone number and anchored at the back of the stone with a stainless steel fastener.
- .2 For any stones requiring replacement, thoroughly document the dimensions to guide the fabrication of the replacement.

3.3 Support

- .1 Construct shoring and cradling, and other temporary framing work needed to support the structure, or parts of it, during removal operations and in anticipation of reinstallation, where the structure is not to be completely dismantled, according to approved drawings, prepared by and bearing the seal and signature of the structural engineer referred to paragraph 1.3 above.

3.4 Loosening Stones

- .1 Rake-out all the mortar joints (as per section 04 03 07) and use approved methods to carefully loosen stones which will cause no damage either to stones or to other architectural elements.
- .2 Do not use circular millstone or saw, pneumatic chisel, steel tools exerting concentrated pressure on edges of stone. Obtain the Departmental Representative's approval for the use of power tools before commencing work.
- .3 Loosen wet masonry only when the temperature is above 5°C.

- .4 The General Contractor to be responsible for damage to stones being removed, adjacent stonework designated to remain and other adjacent construction. Repair such damage to the satisfaction of the Departmental Representative, at no additional cost to the Contract.

3.5 Handling

- .1 The use of Lewis bolts for handling stone is not permitted.
- .2 Place detached stones on wood surfaces during handling. Prevent contact with metal.
- .3 When stones are lowered to the deck, place directly on padded wooden platforms that will be used for storage. Distribute stored stones so as to ensure that the structural loading capacity of the deck is not exceeded. Refer to Section 01 50 00 "Temporary Facilities" for structural analysis requirements.
- .4 Ensure that sharp edges of stones do not come into contact with any hard object.
- .5 Do not place stones directly on ground or vegetation.
- .6 In freezing weather, keep stones dry.
- .7 Protect wet stones from freezing.

3.6 Temporary Storage

- .1 Place stones in a designated area for cleaning, detailed inspection and for final marking, before storage.
- .2 Ensure that stones are accessible and easily removed, and placed so as to be retrieved and inspected quickly, when required.

3.7 Cleaning for purposes of rebuilding and good bond

- .1 Do cleaning operations at above freezing temperature. After cleaning, protect wet stones against freezing until dry.
- .2 Clean stones by wet scrubbing with vegetable fibre brush unless otherwise instructed by the Departmental Representative. Use 500 psi water jet.
- .3 Remove excess mortar by hand. Use power tools only with the prior written approval of the Departmental Representative.

3.8 Storage

- .1 When stones are placed under shelter, the shelter must be adequately ventilated and designed to keep condensation from forming on the internal surfaces of shelter.
- .2 Lay out the storage so that each stone will have its numbered face visible, and be accessible or removable without having to move adjacent stones.
- .3 Show the layout of stones to be stored on a record drawing and submit a copy to the Departmental Representative.

3.9 Marking and reinstallation.

- .1 Stainless steel tag to be removed right prior the stone reinstallation.

3.10 Stone Masonry Repair

- .1 Repair individual stones as necessary in accordance with Section 04 03 41 "Repair of Stone".

END OF SECTION

PART 1 General

1.1 Related Sections

- .1 Section 10 28 10 - Washroom Accessories

1.2 Summary

- .1 Section includes:
 - .1 Identification of existing Tennessee marble wall panels, as indicated;
 - .2 Removal of existing Tennessee marble wall panels, as indicated;
 - .3 Packing, crating, delivery and storage of existing Tennessee marble wall panels; some marble panels are to be re-used as indicated;
 - .4 Supply and installation of new (or re-used) Tennessee marble panels, thresholds, bases, cornices, ledges, carved cove bases;
 - .5 Cleaning, repair and refinishing of all existing Tennessee marble panels, mouldings, baseboards;
 - .6 Removal of paint from all marble;
 - .7 Marble joint repair and repointing;
 - .8 Supply, installation, resetting, repair, cleaning, honing and repointing for Tennessee marble floor;
 - .9 Supply and installation of new marble floor borders incorporated.
 - .10 Coring holes to facilitate installation of grab bars.

1.3 References

- .1 Terrazzo Tile Terrazzo Tile and Marble Association of Canada (TTMAC)
 - .1 Maintenance Guide, latest revision.
 - .2 Marble and Granite, latest revision.
- .2 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI), latest revision.
 - .1 ANSI A108.1, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1).

1.4 Quality Assurance

- .1 Single Source Responsibility for Products: Obtain each type Product from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.
 - .2 Contractor: a company with minimum five (5) years successful performance in heritage conservation work similar to that specified for this project.
 - .3 Workers abilities:
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- .1 Work shall be performed by personnel having a minimum of five (5) years recent experience with heritage restoration work of the type specified and displaying appropriate abilities as demonstrated through mock-ups.
- .2 Workers shall be specialized in techniques related to the type of heritage material involved.
- .3 Only accepted procedures and the personnel that performed them during the mock-ups may be utilized to do that procedure throughout the duration of the work.
- .4 No approved specialized workers shall be replaced during the progress of the work without written acceptance by the Heritage Consultant.
- .4 Acceptance of workers:
 - .1 The Departmental Representative reserves the right to reject workers who do not demonstrate appropriate abilities or experience.

1.5 Work Results

- .1 Perform work in accordance with The Standards and Guidelines for the Conservation of Historic Places in Canada, 2nd ed. , published by Parks Canada.
- .2 Materials and procedures specified in this Section shall serve as basis for submittals.
- .3 Contractor is responsible for any damage to or loss of heritage materials occurring as a result of site, handling, transport and/or storage activities.
- .4 Ensure materials, equipment and procedures do not affect the existing structure.
- .5 Apply methods that minimize the risk of damage to heritage materials.
- .6 Recording and documentation of heritage items shall meet requirements set out in article 1.12.

1.6 Submittals

- .1 Submit proof of contractor's experience in heritage conservation work of similar complexity.
 - .2 Submit proof of workers experience in heritage conservation work of similar complexity.
 - .3 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet.
 - .2 Submit copies of WHMIS MSDS - Material Safety Data Sheets.
 - .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions, including storage, handling and Project conditions.
 - .5 Samples:
 - .1 Submit duplicate samples of each type new marble required, showing full range of colours, textures, finishes, and other
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variations related to visual characteristics expected in finished work.

- .6 Shop Drawings:
 - .1 Submit detailed shop drawings of each type and shape of new marble item required. Indicate mounting details for wall panels and door casing.

1.7 Product Delivery, Handling and Storage

- .1 Deliver, store and handle products in accordance with manufacturer's recommendations, using means and methods to prevent damage, deterioration and loss, including theft.
- .2 Deliver, store and handle products in accordance with protective measures outlined in Section 01 35 91.
 - .1 Schedule delivery to minimize long term storage at site and to prevent overcrowding of construction spaces.
 - .2 Coordinate delivery with installation time ensuring minimum holding time for flammable, hazardous, easily damaged items, or items sensitive to deterioration, theft and other losses.
 - .3 Deliver products to site in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
 - .4 Inspect products upon delivery ensuring compliance with Contract Documents, and ensuring products are undamaged and properly protected.
 - .5 Store products at site to facilitate inspection and measurement of quantity or counting of units.
 - .6 Store heavy materials to prevent endangering supporting construction.
 - .7 Store products subject to damage by elements above ground, under cover in a weather-tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
- .3 Promptly inspect shipments to assure products comply with requirements, quantities are correct, and products are undamaged.

1.8 Maintenance Data

- .1 Provide maintenance data as required in Section

1.9 Pre-Construction Conference

- .1 One (1) week prior to scheduled start of work of this Section, the representatives of the following entities shall meet at the project site: Contractor, Departmental Representative, Masonry Conservator, sub-contractor, materials manufacturer/supplier and representatives of other entities directly concerned with Work of this Section. This meeting will be coordinated through the Project Construction Manager.
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- .2 Attendees shall review all pertinent details and specifications, noting any potential problems and making any changes, deletions or additions as deemed necessary. The Conference will include but not be limited to the following:
 - .1 Verify Project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other trades.
 - .4 Availability of materials.
 - .5 Submittal requirements.
 - .6 Scheduling.
 - .7 Additional items relating to the Work.
- .3 Attendees shall also inspect the worksite and review condition of site and substrates, protection requirements, determine where mock-ups will be prepared and where or how other requirements such as lighting and ventilation will be implemented.
- .4 Minutes will be taken of the meeting, including agreement or disagreement on matters of significance. If meeting ends with substantial disagreement, it will be determined how disagreements will be resolved and a date will be set for a reconvened meeting. A copy of the minutes will be furnished to all attendees.

1.10 Project Conditions

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with Section 01 50 00.
 - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 15 degrees C for 24 hours before, during and after work completion.
 - .3 Provide continuous ventilation for 7 days after completion.
 - .4 Coordinate use of existing ventilation system with Project Construction Manager and ensure its operation as required.
 - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
 - .6 Provide minimum lighting level of 700 Lux on work surfaces.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Ambient air and substrate temperatures shall be above 15 degrees C.
 - .2 The relative humidity shall be maximum 30% in winter and 60% in summer.
 - .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using a "cover patch test".
 - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.

1.11 Documentation

- .1 Photographic Record: Prior to removing existing marble items and panels, photograph the following:
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- .1 General view of the work.
 - .2 Detail shots of each heritage item showing condition and appearance at commencement of work. Item shall be photographed to show all sides.
 - .3 The location of each item shall be identified in writing on the photograph.
 - .4 Photograph quality: Well-illuminated, proper exposure, free of glare and motion blur. And produced using high-resolution digital equipment
 - .5 Provide 227 x 184 mm photographs in archival mountings assembled in a binder and submitted in 3 copies to the Departmental Representative.
 - .6 Include copy of photographs on portable digital storage media. Minimum 9 megapixel quality, RAW format.
 - .7 Submit typical photographic sample in printed and digital format to Heritage Consultant for review, prior to commencement of Work.
- .2 When heritage materials must be transported to contractor's shop, label and photograph all Heritage Materials prior to their removal. The labelling method shall be sufficiently clear to allow future reinstallation. In addition to numbering, labelling shall identify the following information:
- .1 Room of origin
 - .2 N/S/E/W wall
 - .3 Vertical orientation
 - .4 Specifics (as applicable)
 - .5 Open a condition assessment log recording the general condition of each individual Heritage Marble item and panel. Note any irregularities using the Condition Assessment Form template appended to this section. Sheets shall be assembled in a binder and submitted in 3 copies to the Heritage Consultant.
 - .6 Keep an inventory of removed items using the Inventory Form template appended to this section. Attach a corresponding inventory form to each crate in a transparent plastic sleeve. 3 copies of all sheets shall be assembled in binders and submitted in to the Heritage Consultant.

1.12 Protection

- .1 Prior to work, isolate work area from adjacent areas in accordance with Heritage Protection drawings.
 - .2 Protective barriers shall be constructed as indicated and to requirements of Section 01 35 91.
 - .3 Have Departmental Representative review protective barriers prior to commencement of work.
 - .4 Where heritage materials must be uncovered to perform the work, carefully remove heritage protections and store on site if work needs to be protected once completed; if not, dispose of removed heritage protection off site and in accordance with local regulations.
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- .5 Removal methods must not damage underlying heritage materials; where extensive or complex protections are involved, Departmental Representative may require mock-ups of protection removal.
- .6 Maintain in good condition protections to heritage materials not part of work; if unprotected heritage materials not part of work are found in work area, install protective barriers to requirements of Section 01 35 91 and Heritage Consultant's directions.
- .7 If performance of the work requires substantial quantities of water, install water controls as indicated. Have Departmental Representative review water controls prior to start of work.
- .8 At completion, re-install protective barriers where indicated. Follow procedures described in Section 01 35 91.

1.13 Mock-Ups and Tests

- .1 Construct mock-ups demonstrating the abilities and skill of the workers performing the work and the tools and materials required to perform the work. Departmental Representative shall determine location and extent of mock-ups.
- .2 Departmental Representative and Masonry Conservator shall be present to perform review process. Advise Departmental Representative minimum 7 days prior to beginning of mock-up preparation.
- .3 Each type of work or procedure specified in Part 3 of this Section requires a mock-up. Heritage Consultant or Heritage Conservator reserves the right to have additional mock-ups prepared to suit Project conditions.
- .4 Testing is required to determine original colour of joints and composition in marble work. Document findings and remit to Heritage Consultant.
- .5 As indicated, only the workers that perform the mock-ups may be utilized to do that work or procedure throughout the duration of the work.
- .6 Heritage Conservator may demonstrate proper procedures and work practices to workers in order to obtain required results.
- .7 When multiple teams of workers are to perform a certain type of work, every team shall prepare required mock-ups to ensure consistent results for the entire work specified in this Section.
- .8 Mock-ups shall be kept protected and intact during the entire duration of the work of this Section.
- .9 Heritage Consultant will determine if mock-ups may form part of finished work or if they must be removed from the site in which case they shall be dismantled and disposed of in accordance with local regulations.

1.14 Cleaning

- .1 At completion, remove extra materials, tools and rubbish and leave area clean and ready for inspection.
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- .2 Where required, install heritage protections as indicated when directed by Heritage Consultant.

PART 2 PRODUCTS

2.1 Materials

- .1 Replacement marble: Tennessee marble. Source:
 - .2 Marble cleaning products:
 - .1 2010 All Surface Cleaner.
 - .2 Coating removal: HydroClean.
 - .3 Masking products:
 - .1 Masking tape: painter's masking tape.
 - .2 Sheet masking: polyethylene sheet, minimum 0.15 mm thick (6 mils) and cotton sheeting or other material approved by Departmental Representative.
 - .3 Rubber mask: removable latex coating designed to protect surfaces.
 - .4 Chemical paint remover for non-polished surfaces: to be based on methyl chloride or equivalent.
 - .1 Peel Away barrier paper manufactured by Dumont Chemicals Inc. or pre-approved equivalent.
 - .5 Chemical paint remover for polished marble surfaces: based on methylene chloride so as not to damage polished surface of the marble.
 - .1 Acceptable product: Polystripper
 - .6 Copper or stainless steel wire and plaster of Paris, as required for marble panel installation.
 - .7 Adhesive for marble coves and bases: polymer modified mortar to ANSI A118.4, white colour.
 - .1 Acceptable product: Mapei White Kerabond / Keralastic or approved equivalent.
 - .8 Two component epoxy adhesive: to contractor's standards and TTMAC approved.
 - .9 Stainless steel filleted rods, size to suit, 300 series stainless steel.
 - .10 Coloured marble filler: marble dust and epoxy mix to suit patching and filling, as recommended by TTMAC and tested as per article 1.13 and approved by Departmental Representative. Other products may be required, as determined by mock-ups, such as Akemi® touch-up products.
 - .11 Slow set gypsum plaster and dry pigments for colouring, to be used for joint repairs.
 - .12 Grouts:
 - .1 Non-sanded or sanded coloured grout with latex, prepared, to ANSI 118.6, colours to match original colours as per testing. Use sanded grout for large joints. A non-staining, fine sand, lime and cement mortar mix may be required by Heritage Conservator.
 - .2 Floor Grout for injection: Rosendale Injection Grout 11G N.
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- .3 Floor Grout: epoxy resin based
- .4 Sand coat / base coat:
- .13 Bedding mortar for floors:
 - .1 Portland Cement, white, non-staining, normal.
 - .2 Sand: Sharp, screened sand: to ASTM C144 passing 16 mesh.
 - .3 Slurry bond coat: mix Portland cement and water to a creamy paste consistency. Mix ratio to be confirmed during mock-ups.
 - .4 Bedding mortar mix proportion: 1 part Portland cement, 3 parts sand, or as determined during mock-ups.
- .14 Colourless, slip and stain resistant penetrating sealer with Ph factor between seven and ten, that does not affect colour or physical properties of marble surface and compatible with adjacent terrazzo flooring.
- .15 Pigmented microcrystalline wax for crack repairs.
- .16 For marble wall panel finishing. Renaissance micro-crystalline wax.

2.2 Equipment and Accessories

- .1 A heavy duty industrial Dremel-type tool.
- .2 86mm diamond cutting blade.
 - .1 Marble joint repair: a thin blade of 1 mm thickness, custom dimensioned to suit the thickness of the marble joint without cutting into sides while scoring out existing joint compound to a 2 mm depth.
 - .2 Tennessee Marble Flooring: small diamond cutting blade of 50mm diameter.
- .3 Fasteners : stainless steel, 300 series, to suit.
- .4 Wide spatula, such as a plastering spatula, with the edges rounded so as to prevent gouging of the marble floor surface.
- .5 Flush-cutting grinders capable of fitting 5 and 12 inch diamond cutting blades for masonry. Grinders must have variable speed.
- .6 Diamond cutting blades to be continuous edged. All blades must be new.
- .7 Suction cups for lifting and handling stones.

2.3 Packing and Crating Materials

- .1 Conform to the following material grades for packing and crating.
 - .1 Lumber: spruce, pine or fir to CAN/CSA-O141, NLGA #2 grade, S4S, moisture content 19% (S-dry) or less.
 - .2 Plywood: exterior grade softwood plywood to CSA O151, thickness as indicated.
 - .3 Vapour permeable sheeting: flashspun polyolefin such as Tyvek or equivalent.
 - .4 Soft padding: resilient medium-density closed-cell polyethylene foam sheeting.
 - .5 Low-density extruded polystyrene, minimum 25 mm.
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- .6 Use only low impact and low vibration fasteners, including bolts with nuts and washers, wood screws and removable non-residue adhesive strips and tapes.

PART 3 EXECUTION

3.1 Protection

- .1 Protect surrounding heritage materials as described in article 1.12.
- .2 Refer to manufacturer's Material Safety Data Sheets for hazard data, special protection, for use and precautions to be taken with specified products. Comply with manufacturer's recommendations for proper use of chemicals.

3.2 Identification

- .1 Prior to removal, all marble panels, bases, etc. must be clearly identified and numbered as indicated in article 1.11.
- .2 Marble panels that must be removed and re-installed must also be photographed and dimensioned for exact re-installation.
- .3 Have Departmental Representative approve identification and noted photographs prior to removal.

3.3 Marble Wall Panel Removal

- .1 Remove marble panels in accordance to the following procedures:
 - .1 Inspect each marble piece prior to removal. Evaluate condition, potential weaknesses (microfractures), and ascertain whether additional precautions for the removal are required.
 - .2 Carefully remove mortar, grout and any epoxies found in the joints using hand tools only. The use of percussion tools and rotary saws is not acceptable unless authorized by Heritage Consultant in a specific location.
 - .3 Carefully remove and document each individual marble panel starting from the top of the wall and working downwards. Remove and set aside cramps and anchors as work progresses. Remove plaster spots from back prior to packing.
 - .4 Label, wrap and pack stones immediately in accordance with article 3.5. Do not leave unlabelled stones unattended on site.
 - .5 Remove hardware from marble partitions, identify and store as directed by Heritage Consultant.

3.4 Marble Base Removal and Reinstallation

- .1 Remove existing marble bases as per approved mock-ups and tests.
 - .2 Take care not to damage existing marble bases. Heritage Consultant will indicate where to store removed bases until time of re-installation.
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- .3 Pack and crate bases and transport to Contractor's shop for repair and refinishing.
- .4 Repair existing bases as follows:
Repair cracked or split marble bases using two component epoxy adhesive.
Fill holes and small cracks and colour match as per approved mock-ups and tests, prior to surface grinding and polishing.
Re-grout as needed. The grout is to match the original existing grout in dimension, colour and texture. Do not match to dirty grout.
Grind and polish to match original finish.
- .5 Have Departmental Representative inspect and approve bases at Contractor's shop prior to transport to site. Pack and crate and transport to site at appropriate time.
- .6 Reinstall bases as indicated.

3.5 Packing, Crating and Transportation

- .1 Label, wrap and pack marble panels immediately. Do not leave unlabelled marble panels unattended on site.
 - .2 Ensure that salvaged marble panels are clean and dry before wrapping.
 - .3 Design each individual crate to prevent infiltration of water, dust and construction debris and as follows.
 - .4 Design crates to accommodate marble panels to be salvaged, transported and stored without damage or deterioration.
 - .5 Crates shall be designed to take into account handling and transporting restrictions.
 - .6 Contractor shall provide exact dimensions, design, and weight capacity of crates to suit site and transporting restrictions. Design crates to allow transport by forklift or hydraulic hand pallet truck.
 - .7 Avoid damage to marble edges when handling and transporting. Provide polystyrene foam padding on the storage setting edge. Wrap each individual marble panel in vapour-permeable, waterproof sheeting. When applicable, place polished faces together and separate with thin polyethylene foam sheeting minimum 6 mm thick. Separate and wedge panels firmly using polystyrene foam insulation to prevent displacement and reduce vibration during transport.
 - .8 Construct crates with rigid framing materials. Enclose all sides of crates using minimum 13 mm plywood to protect contents from direct impact.
 - .9 Leave openings and gaps in rigid casing to ensure that crates are not airtight. Indicate handling and storage instructions on crates as per approved mock-ups.
 - .10 Attach inventory forms to crates in waterproof transparent envelopes.
 - .11 Fasten crates to floor inside truck cab in such a way to prevent any movement during vehicular transport. Transport to Contractor's storage facilities.
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- .12 Contractor's storage facilities shall be indoors, secure and heated to minimum 15°C.
- .13 Handle crates carefully; store crates in their intended positions and do not stack.

3.6 Supply and Installation of New Marble

- .1 Inspect brick and new pre-engineered heavy gauge structural studs and support wall and ensure level and plumb. Ensure walls meet required tolerances; advise Departmental Representative of any defect affecting installation.
 - .1 Install anchor bolts for brick and terracotta walls at proper locations as per reviewed Engineered shop drawings. Use only stainless steel chemical anchors. Install metal furring channels at anchor positions for pre-engineered heavy gage structural stud walls.
 - .2 Install each new stone on stainless steel anchors of type indicated on reviewed Engineered shop drawings.
 - .3 Stones must be anchored with two anchors supporting the stone on the bottom and two anchors on top holding back the top of the stone; use split tail anchors to restrain top of stones and support bottom of stone above. Install lateral anchors as required.
 - .4 Point all joints using pointing mortar of colour selected by Heritage Conservator. Follow procedures set out in article 3.11 - Marble Joint Repair.
- .2 Supply new marble items as indicated or required.
- .3 Cut, carve, drill, polish and fit as per reviewed shop drawings and to match existing work. On site, core drill holes for mounting hardware as indicated, and provide polished edges.
- .4 Have Departmental Representative review and inspect finished marble items at Contractor's shop prior to shipping to site. Pack and deliver finished marble items as per article 3.5.
- .5 Install marble panels, partitions, bases, cornices and coves where indicated and in accordance with approved mock-ups.
- .6 Carved marble coves are embedded in new ceramic tile flooring. Install with white polymer modified adhesive.
- .7 Grout joints as per approved mock-ups.
- .8 Where required, install marble bases to prepared Douglas fir plywood bases and adhere using two component epoxy adhesive such as Mapei Kerapoxy or approved equivalent.

3.7 Marble Cleaning

- .1 The objective is to remove surface soiling, stains, and glue residue from the marble surfaces. The cleaned surfaces should have uniform appearance without streaks, blotches, or pronounced irregularities. The intent is to use the gentlest cleaning methods available with the least amount of water that do not damage the stone or adjacent surfaces. Care must be taken not to overclean or "burn in" the substrate while using wet chemical cleaning methods.
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- .2 It is possible there may be protective coatings on the existing marble. If a coating is present, remove it using the coating removal product as directed by Masonry Conservator and as recommended by manufacturer. Ensure all traces of existing coatings are removed before the marble is cleaned.
- .3 Wipe dust from surface with damp cloth and allow to fully dry.
- .4 Remove all adhesives such as scotch tape from surface of marble prior to cleaning.
- .5 Mask off only portion of wall that can be completed in one cleaning application. All workers must be approved for work in accordance with mock-up review.
- .6 Provide full protection from spills, absorption, or leaking onto all adjacent surfaces outside the area to be cleaned during any given cycle. Provide gutters and traps to secure that all cleaning solutions and rinse water is retained, moved to sealed containers and removed safely from site.
- .7 Final dilution of the cleaning product used for marble cleaning will be based on results of mock-ups, and will be the decision of the Departmental Representative. Approximate dilution of 1 part cleaner to 3 parts water is anticipated.
- .8 Apply cleaner using rollers, or airless sprayer.
- .9 Allow to remain on wall surface, kept wet with solution, for up to 10 minutes. Keep surface wet; do not allow to dry. Scrub surface with soft bristle brushes and rinse thoroughly using water delivered under low pressure through an airless sprayer.
- .10 Allow wall surface to dry. Repeat procedure up to 3 times to heavily soiled areas and only after direction is given by the Heritage Conservator or Consultant.
- .11 Remove all masking tapes and protections from area once cleaning is completed.
- .12 Once all cleaning within a given room area is completed and the walls are thoroughly dry, apply the Renaissance wax to surface using a thick, soft, lint-free cotton rag and rub over surface in a thin film. Allow to dry, and proceed to gently buff the surface with a similar thick cotton rag that is 100% lint free. Repeat to provide a second wax application. Do not apply second application until approval is given by the Heritage Conservator or Consultant.
- .13 Protect walls from all future construction dust and dirt by securing a sheet of polyethylene from top to bottom of the finished clean wall.

3.8 Removal of Paint from Marble

- .1 Provide full protection from spills, absorption, or leaking onto all adjacent surfaces outside the area to be cleaned during any given cycle. Provide gutters and traps to secure that all cleaning solutions and rinse water is retained, moved to sealed containers and removed safely from site. Protect adjacent heritage surfaces in accordance with Section 01 35 91 and as follows. Coordinate with Section 02 83 19 for lead abatement.
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- .2 Use conventional painters' masking tape and masking procedures to protect any metal, wood or plaster items from accidental exposure to paint removal chemicals. Polyethylene sheet is an effective masking sheet.
- .3 If required or directed by Heritage Conservator, use ABR rubber mask to protect adjacent stone items from accidental exposure to paint removal chemicals. Apply rubber mask to manufacturer's written instructions and as indicated in article 3.1.
- .4 Apply methylene chloride based paint remover product (such as Polystripper) to the masked off area. Ideally, apply from floor to ceiling of any given area of the wall. Apply with trowel or paint brush, making certain to not scratch surface of marble.
- .5 Apply to thickness of not less than 3 mm. Best application procedure is to apply a thin coat first, followed by a second coat to bring the stripper to required thickness.
- .6 Cover with Peel Away paper and allow to dwell on surface for 4hours.
- .7 Scrape paint material and loosened paint from surface with plastic trowels. Steel trowels with rounded corners to prevent gouging will be allowed following mock-up approval by Heritage Conservator.
- .8 Rinse surface with low pressure rinse not greater than 700 psi. Use fan-tipped spray nozzle. Pass pressure rinsing nozzle slowly over surface, making a total of 4 passes to insure that all surfaces have been rinsed thoroughly.
- .9 Repeat procedure 2 additional times to complete the paint removal from the stone.
- .10 Allow wall to dry slowly at room temperature for one month before carrying out any repairs to the surface.

3.9 Repair of Fractured Marble Panels

- .1 Label, photograph and set aside stones fractured during removal. Advise Heritage Consultant.
- .2 Carefully align, assemble and clamp the stone fragments face down on a polished granite panel and submit to Heritage Consultant for review.
- .3 Using a router, stainless steel filleted rods and epoxy paste, pin together the fragments under the direct supervision of the Heritage Conservator.
- .4 Repair crack or any voids along the crack line following specified products and procedures.

3.10 Repair and Refinishing of Existing Marble

- .1 Repair and refinish existing marble panels, bases, casing, and baseboards in accordance with the following guidelines.
 - .2 Typical marble replacement:
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- .1 Where marble unit is missing or where unit is otherwise cracked and divided portions are out of alignment, replacement will be carried out.
 - .2 Carefully remove existing material from the unit location in the wall.
 - .3 Prepare new marble unit to match existing with regards dimension and finish. Be certain that hind side of panel is thoroughly clean and roughened. Lessen the length and width dimension by 0.5 mm in order to assist ease of setting replacement unit in bond position of the wall.
 - .4 Build up Plaster of Paris daubs on back up wall such that the new unit will make full contact with the Plaster of Paris when pushed into position, before gently easing the unit into position using vacuum lifting equipment. Use small wedges to position unit in its final position. Include copper fastener ties into marble to secure to plaster daubs of wall.
 - .5 Joint unit with appropriate grout or mortar. Mix, colour and consistency to be determined by Masonry Conservator. Cure mortar under damp conditions for 7 days. Front point as part of general wall repointing activity.
- .3 Typical dutchman repair:
- .1 Where marble wall unit is voided of a dimension between 25 cm square and 100 cm square, a new portion of marble, referred to as a dutchman, will be inserted.
 - .2 Carefully cut out square cavity at the voided surface area using a square template, where vertical and horizontal position is true.
 - .3 Prepare new marble dutchman to match existing with regards dimension, geologic features/markings and finish. Be certain that hind side of dutchman is thoroughly clean and roughened. Insure that the dutchman fits tight with the square cavity that is to receive it. Dry fit prior to installing to make certain the fit is tight.
 - .4 Build up Plaster of Paris daubs on back up tile wall such that the dutchman will make full contact with the Plaster of Paris when pushed into position, before gently easing it into position. Use polyester resin (knife grade) pigmented to match the marble colour to bond the dutchman joints. Where the dutchman is set along a joint or joints, use small wedges to position in its final position. Clean all resin smears with acetone before it sets.
 - .5 Fasteners designed to assist the installation procedure and fixing of dutchman in position can be proposed by the contractor for acceptance by the conservator.
 - .6 Augment cosmetic quality of the dutchman joints with pigmented microcrystalline wax if felt necessary by the conservator. Place and buff surface.
 - .7 Where relevant, joint unit with appropriate grout or mortar. Mix and consistency of mortar to be determined by Heritage Conservator. Cure mortar under damp conditions for 7 days. Cure grout to grout manufacturer's instructions. Front point as part of general wall repointing activity.
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- .4 Typical crack repair:
 - .1 Make certain that crack is thoroughly cleaned of dirt or previous fillers.
 - .2 Apply knife grade polyester or epoxy resin to the top surface of the crack using a spatula, making certain the resin is forced into the crack depression. Resin is to be coloured to closely match the surface colour and geologic features of the marble.
 - .3 Cut resin flush with surface and wipe solvent to remove smears before the repair sets.
 - .4 As required, fill top surface of crack with a pigmented microcrystalline wax. Buff surface of crack with buffing cloth.

 - .5 Typical hole repair:
 - .1 Remove all plugs and fasteners by gently drawing out from position in unit. Do not allow spalling of surface to occur. Use a core drill bit as last possible effort for difficult to remove plugs fasteners. In order to minimize the impact on the wall surface, use core bits with outside diameter which is one maximum of 2 mm wider than the plug being removed.
 - .2 Thoroughly remove all dust or other dirt from affected surface of marble to be repaired.
 - .3 Fill hole and any lateral damage surface associated with the previous fastener with polyester or epoxy resin (knife grade) which has been pigmented to match the immediate location of the marble surface. Cut flush and smooth with surface.
 - .4 In-paint for any cosmetic touch-ups to improve cosmetic appearance of the repair. All such touch ups and cosmetics will be completed after any general honing of the marble surface or cleaning.

 - .6 Grouting of marble:
 - .1 As indicated, original grout shall be tested during mock-up preparation to determine exact colours. Match original colour, profile, and appearance of joints to Heritage Conservator's satisfaction.
 - .2 Carefully remove mortar, grout and any epoxies found in the joints using hand tools only. The use of percussion tools and rotary saws is not acceptable unless authorized by Heritage Consultant in a specific location. Do not scratch or damage marble surface in any way.
 - .3 Apply grout per manufacturer's instructions; tool if required to match original jointing.
 - .4 Wipe excess grout from stone.

 - .7 Marble honing:
 - .1 All marble surfaces to be honed unless otherwise noted. Demonstrate honing and, if required, polishing work for each type of marble and each type of vertical and horizontal application as designated by the Heritage Consultant during mock-up preparation.
 - .2 Honing shall be performed after repairs.
 - .3 All floors surfaces will be rehoned.
-

- .4 Assume all honing of wall panels, baseboards, stairs, or floor pavers will require three grit passes - a course grit, a medium grit, and a fine grit - followed by a final hone using honing powders. In other words, four passes in total are to be assumed for pricing. The grit sizes used for each pass will be determined during mock-ups.
- .5 All polishing marks such as scours or polish-pad patterns must be removed. Use honing powders as required.
- .6 Unless directed otherwise by the Departmental Representative, existing honing levels for walls and floors are to be reproduced.

3.11 Marble Joint Repair - Wall Panels, Tennessee

- .1 Cutting out:
 - .1 Tape sides of joints with painter tape prior to cutting, making certain the surface is dry when applying.
 - .2 Horizontal joints will require scoring using a hand held sharp tool guided by a straight edge to prevent cutting into surface of marble.
 - .3 Score the surface of the joints only. The aim is to not remove the solid existing jointing material, but rather to provide sufficient depth to tuck new mortar such that the face of the joint is renewed with new mortar.
 - .4 It is anticipated that the vertical joints will display some frequency of voiding or of being debonded. When this is encountered, it is important to not cut aggressively, but rather to retain as much of the original recessed mortar compound as is possible.
 - .5 Once joints are cut to depth of 2mm, thoroughly vacuum all dust from joints. A final clean must be provided by blowing all remaining traces of dust from the joints using compressed air.
 - .6 Remove tape and wipe surface of marble clean with damp cotton cloths to remove all dust from surface. Change rinsing water frequently to insure surface is clean. Wipe with clean thick cotton rags to dry surface.
 - .2 Repointing:
 - .1 To be completed after cleaning of marble surface.
 - .2 Retape the sides of all joints with 35mm wide painters tape, making certain the surface is clean dry when applying and that joints are thoroughly clean and free of dust.
 - .3 Mortar compound to be slow setting gypsum plaster. Prepare mock-ups to determine suitable colour. Prepare up to 12 coloured samples.
 - .4 While wet and easily pliable, work the plaster into joints using a 30mm wide trowel. The trowel can be metal as long as the edges are slightly rounded to prevent gouging marble surface. Use a clean moist sponge to wipe the joint compound flush with the marble surface. Make certain to not smear the compound outside the taped edges and onto the surface of the marble.
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- .5 Once set, remove tape and clean all smears or drips or dust caused by the joint compound placement procedures.

3.12 Tennessee Marble Flooring

- .1 Remove marble tile flooring to facilitate structural work, and reinstall.
 - .2 Lifting tiles
 - .1 Cut out with a thin blade of 1mm thickness all loose or voided joints in the border pavers. Contractor should be aware that the joints are presently a hard and brittle polymer adhesive.
 - .3 Resetting stones:
 - .1 It is the installer's responsibility to clean all subfloor surfaces to remove dirt, dust, debris, and loose particles immediately prior to setting marble floor and to ensure that the area to receive the stone flooring meets the deflection standards of the industry.
 - .2 Curing compounds of any kind shall not be used on the slab on which floor marble is to be directly set.
 - .3 Before being set, all marble shall be clean and free of foreign matter of any kind.
 - .4 Apply a slurry bond coat to the concrete slab.
 - .5 Install appropriate mortar bed. The consistency is to be fairly stiff, or as determined during mock-ups.
 - .6 Back-butter underside of paver (bond coat), or sprinkle the mortar bed with water and cement. In the latter procedure, the back of the marble shall be wet. Use sufficient bond coat, as determined during mock-ups, to ensure 90% contact.
 - .7 The marble shall be tamped with a suitable mallet until firmly bedded to the proper level of the floor. Install paver while bedding mortar is still in a plastic state.
 - .8 Joints between the marble pieces shall show an even width when laid and finished. The original joint widths are to be reproduced. All joint exceeding original width will be refused and the stones will have to be reset. Use appropriately sized spacers to achieve a consistency in the width.
 - .9 Clean excess material from surface prior to final set.
 - .10 Keep two-thirds of the depth of joints free of setting material.
 - .11 The floor shall be roped off for 24 hours after installation.
 - .12 Sound pavers after setting materials have cured and replace hollow sounding stone before grouting.
 - .13 After paver setting bed has cured, a honing grit pass may be required to ensure that new and old pavers are level. This is to be done according to mock-up results and following the recommendations of the Masonry Conservator. This honing grit pass will be in addition to the three grit passes and a hone required for marble finishing. In other words, in some selected floor areas, up to five passes (4 grits and a hone) may be required.
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- .14 The paver stone joint will be injected with Natural Cement grout under low pot pressure. Allow proper setting time before grouting.
- .15 Once joint is grout injected, all excess spills and the top surface of joint wiped to depth of 2-3 mm below stone surface, and the grout fully cured, joint will be topped up and cut flush using a polymer resin based grout.
- .16 The surface will be cleaned of all residual smears, etc. from the resin grout. Rehoning surface of floor as part of general floor surface treatment.
- .17 Cleaning or additional surfacing, if required, shall not be undertaken until the new floor is at least seven days old.
- .18 Individual stones and last stone in field: Lower stone into place while supporting it with suction cups and high tension stainless steel wire. When the stone is in place, cut the wires and tuck them into the joint. Use spacers to ensure position of stone. Use heavy card paper to protect the edges.
- .4 Final inspection of floor repairs, replacements and resetting: completed work is to be inspected by the Masonry Conservator, Contractor and Departmental Representative. Broken, cracked, hollow sounding or damaged pavers are to be replaced or repaired.
- .5 Sealer application to floors: the application of a sealer is to be assumed, but final confirmation will depend on mock-up results. Sealers will require an on-going maintenance program, requiring re-application every 3-5 years or as recommended by sealer manufacturer.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 01 43 17 - Masonry Conservator.
- .2 Section 04 03 06 - Heritage - Cleaning Historic Masonry
- .3 Section 04 03 07 - Heritage - Masonry Repointing and Repair
- .4 Section 04 03 08 - Heritage - Mortaring.
- .5 Section 04 03 42 - Heritage - Replacement of Stone.
- .6 Section 04 03 44 - Heritage - Repair of Marble
- .7 Section 04 05 19 - Masonry Reinforcement and Connectors.
- .8 Section 04 11 00 - Proprietary Grout Anchors.
- .9 Section 04 21 13 - Brick Masonry.
- .10 Section 07 92 10 - Joint Sealing.

1.2 Unit prices

- .1 Items of work specified below will be paid based on actual quantities measured on site by the Contractor and validated by the Departmental Representative, and unit prices stated in the Tender Form. The methodology of measurement of the quantity on site has to be approved by the Departmental Representative. Refer to various masonry sections for applicable requirements for each unit of work.
- .2 No additional charges will be permitted for extra costs to unit rates such as overhead and profit, scaffold rentals, management charges, winter handling.
- .3 The unit prices are all inclusive, except taxes, and will be identical as both an extra and as a credit.

1.3 References

- .1 Canadian Standards Association (CSA):
 - .1 CSA-A179-04, Mortar and Grout for Unit Masonry.
 - .2 CSA-A371-04, 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 in accordance with Section 01 33 00 - Submittal Procedures and 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 Two of each type of brick.
 - .5 One of each type of cleaning material in 250 ml container with safety screw caps.
 - .6 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 supervision of the Masonry Conservator specified in Section 01 43 17.
- .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, published by Parks 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 Ontario. 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 - 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.
- .3 Construct mock-ups to illustrate:

- .1 Stone repair: Construct a mock-up of a representative sample of each type of repair. Include the following mock-ups:
 - .1 Four fissure repairs
 - .2 Four deep crack repairs
 - .3 Five restoration mortar repairs
 - .4 Four stone resetting repairs
 - .5 Four in-situ fracture repairs
 - .6 Four fracture repair, with stone removed
 - .7 Two stone restoration repairs, on sandstone elements
 - .8 Six Dutchman repairs. (two of each type, flat, templated and sculpted)
 - .9 Five pin and fill stone consolidation treatment
 - .10 Cavity preparation at three locations.
 - .11 Repair mortar placement at Four locations.
 - .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 (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 (1 test for each type of stonework and mortar type, including junctions at differing stonework and methodology to meet environmental requirements for mortar curing).
 - .3 Front pointing of joint. One test for each type of mortar and each type of stonework, including junctions at differing stonework and methodology to meet environmental requirements for mortar curing.
 - .3 Grouting: Filling of voids and cracks in the core of the wall as specified in Section 04 03 07 - Historic - masonry Repointing and repair. Provide a mock-up of 0.75 m³ of grout injection.
 - .4 Cleaning: Each type of stone and each type of masonry cleaning specified in Section 04 03 06 - Historic Masonry Cleaning. Illustrate cleaning techniques required representative of full range of soiling or stains. Extents of mock-ups as indicated in section 04 03 06. Locations to be identified by the Departmental Representative once the scaffold is set up.
 - .5 Stone, coursing or bond pattern, joints between units, and movement control joints.
 - .6 Backup wall, connectors and accessories.
 - .7 Grouted anchors: Install full scale mock-up of grouted anchors as specified in Section 04 11 00 - Proprietary Grouted Anchors.
- .4 Allow samples to cure at least 7 days before obtaining the Departmental Representative's approval for colour match. Samples shall be viewed from a distance of approximately 2.5 m.
 - .5 When accepted, mock-ups shall demonstrate the minimum standard for this work. Accepted mock-ups may remain as part of the finished work.
 - .6 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.
 - .7 Construct mock-up where indicated by Departmental Representative.
 - .1 Coordinate and sequence activities accordingly.
 - .8 Allow 72 hours for inspection of mock-up by Departmental Representative before proceeding with work.
 - .9 Repeat mock-up until satisfactory results are obtained to satisfaction of Departmental Representative (above and beyond the mock-up quantities mentioned in the specifications).
 - .10 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. Only unopened materials purchased and dedicated to this project only will be accepted. Opened or otherwise used or doubted fresh production of product will be removed from site at request of the Departmental Representative.
 - .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.
 - .6 Provide and maintain digital data temperature and humidity logs monitors at each elevation of both east and west towers. Placement will be determined once scaffold is set up, but assume locations to have approximate locations of near top and near bottom of scaffold levels. Submit data on a weekly basis during project construction to Departmental Representative. Retain print out hard copies in binders on the project site, filed sequentially in order for quick and easy access and reference during site review visits by the Departmental Representative.
- 1.9 Waste Management and Disposal
- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - 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 ambient temperature is between 12°C and 28°C and Relative Humidity (RH) is greater than 50% during installation.
 - .1 Curing conditions for repointing mortars: maintain for a period of 7 days for backpointing and 28 days for front pointing, 100% humidity.
 - .2 Curing conditions for repair mortars: maintain for a period of 12 days, 100% humidity provided by moist fabric and tape sealed plastic sheet covers.
- .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 by Departmental Representative in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Remove work exposed to lower than allowed or higher than allowed 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 21oC.

- .2 Use protection methods acceptable to the Departmental Representative.
- .3 Keep repaired area humid for specified number of days to insure a proper cure.
- .4 Do not use or prepare mortar when the ambient air temperature is above 28°C at the location of the work.
- .5 Indoor environment:
 - .1 The interior of the ventilation towers is generally at the same temperature as the building, as they are exhausting indoor air at all times. However, the walls are uninsulated, so core drilling from the interior will result in the core entering the freezing zone of the wall in winter months. Provide temporary heat if work of this nature is planned in cold weather.
 - .2 The exhausting of indoor air results in a continuous, and strong current of air inside the towers.

PART 2 PRODUCTS

2.1 Materials

- .1 Refer to related sections for stone, brick, related materials, accessories and material preparation procedures.
- .2 Burlap: clean, tightly woven (landscape open weave or fabric not accepted), non-staining, free of printed matter, to Departmental Representative's approval.
- .3 Plumber's hemp: asbestos-free, oil- free jute rope.

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, location and repair identification marking, approval and instructions for each

specified repair and replacement of masonry units before proceeding with repair work. Contractor is not to mark the wall for repairs or other instruction notations.

- .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 sculptural carvings are not damaged during work. Provide padded, rigid protection of these elements. Submit protection measures to Departmental Representative for approval.
- .2 Provide safe containment, collection and removal of sandstone, sandstone dust and mortar joint dust and related debris.
- .3 Ensure workers are informed of hazards and trained in procedures prior to commencing work. Ensure workers wear protective clothing and gear during work on sandstone.
- .4 Where cutting out of sandstone produces sandstone dust particles, and cutting out of mortar produces silica dust take the following measures.
 - .1 Use wet techniques to eliminate dust, when possible.
 - .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 Ontario.
 - .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.
- .8 Determine precise exterior wall thicknesses at each level of building by drilling minimal size pilot holes. Repair and make good holes to match existing condition.

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 Rebuilding

- .1 Remove, repair and replace masonry as indicated.
- .2 Jointing:
 - .1 Allow joints to early initial hydraulic set, then finish joint as specified.
 - .2 Finish brick masonry joints to match original.
 - .3 Finish stone joints as specified in Section 04 03 07 - Historic Masonry Repointing and Repair.
- .3 Cutting:
 - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
 - .2 Make brick cuts straight, clean, and free from uneven edges.
- .4 Building-In:
 - .1 Build in items required to be built into masonry.
 - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
- .5 Wetting of masonry:
 - .1 Except in cold weather, wet brick and stone having an initial rate of absorption exceeding 1 g/minute/1000 mm²: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.
 - .2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.
- .6 Support of loads:
 - .1 Use grout to CSA A179 where grout is used in lieu of solid units.
- .7 Interface with other work:

- .1 Cut openings in existing work as indicated on drawings (ex: concrete floor cutting to get access to the floor structure).
- .2 Openings in walls: approved by Departmental Representative prior to commencing the work.
- .3 Make good existing work. Use materials to match existing.
- .4 Finish all existing metal elements found within masonry assemblies, or that are in contact with masonry, in accordance with Section 09 91 10 - Painting.
- .8 Limitations on Work Sequence and Timing:
 - .1 Install the structural steel and anchors only in restored masonry. Restore the interior brick before mounting the steel frame. Restore the exterior Nepean stone masonry before the installation of the in-plane anchors.
 - .2 Allow for 28-day curing period before coring in the newly restored masonry.
 - .3 Allow for 14-day curing period before coring in masonry within a 3 m radius of newly restored masonry.
 - .4 Restore the stone quoins in vertical order starting from the lower sections. In the strapped sections with wood blocks and cables, remove the wood blocks and cables in small sections not exceeding 1.0 m in height to allow for the restoration of masonry and the installation of the in-plane anchors.
 - .5 Maintain stability of existing wall by implementing the following measures:
 - .1 limit contiguous dismantled stone quoin areas to three courses in height, unless otherwise approved by the Departmental Representative.
 - .2 Limit stone rebuilding areas to three quoin courses in height per day.
 - .3 Coordinate brick dismantling with rebuilding activities to ensure large areas of brick are not left dismantled for prolonged periods of time.
 - .6 Ensure cavity is properly prepared. Remove mortar to expose brick core.
 - .7 Thoroughly humidify the core by dampening with water prior to placing mortar.
 - .8 Mortar to be placed into bedding location for each stone
 - .9 Maintain original joint dimensions/widths.
 - .10 Ensure stone is level and plumb.
 - .11 Ensure that all new stones are premeasured to fit the exact dimensions in which they will be set.
 - .12 Gauge mortars to make certain stone is 100% bedded on all joint sides.
 - .13 Ram mortar with thin metal tool in preparation for front pointing.
 - .14 Top stone or course of stones of rebuilt area must be thoroughly packed, rammed with mortar to ensure no voids and temporarily shimmed to maintain correct position and alignment.
 - .15 Bring all mortaring work to within 50mm of finish
 - .16 Set stones in their natural bedding orientation and in their original orientation (i.e. top up).

- .17 Perform front pointing and mortar repairs after cleaning. Perform Cleaning under Section 04 03 06 after rebuilding and repairs.

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 and grouts in the project (grouting, bedding mortar, front pointing mortar and backpointing mortar) shall be carried out by a Testing Laboratory designated by the Departmental Representative and engaged by PWGSC. The laboratory tests shall occur once a week (2 tests 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 mixed samples and shall include the compressive strength at 7 days, 28, and 90 days, air entrainment percentage, Vicat cone testing (mortar only) and flexural strength.

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 42 - Heritage - Replacement of Stone.
- .2 Section 04 05 00 - Common Work Results for Masonry.
- .3 Section 04 11 00 - Proprietary Grout Anchors.
- .4 Section 04 21 13 - Brick Masonry.

1.2 References

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM A580/A580M-06, Standard Specification for Stainless Steel Wire.
 - .2 ASTM A666-03, 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, Mortar and Grout for Unit Masonry.
 - .2 CSA-A370-04, Connectors for Masonry.
 - .3 CSA-A371-04, Masonry Construction for Buildings.
 - .4 CSA-S304.1-04, Design of Masonry Structures.
 - .5 CAN/CSA-A23.1-04, Concrete Materials and Methods of Concrete Construction.

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 21 - 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-S304.1.
- .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-S304.1, 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-S304.1, CSA-A371 and CSA-A179 and as indicated.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 04 05 00 - Common Work Results for Masonry.
- .2 Section 04 05 19 - Masonry Reinforcement and Connectors.
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 05 12 23 - Structural Steel for Buildings.

1.2 Anchors Schedule

- .1 Items of work shown in summary table as specified in article entitled Schedule in this section will be paid based on actual quantities measured on site. Refer to schedule included in the present section for description of anchor types.
- .2 For anchors not shown in summary table, base price on quantities indicated and as specified in article entitled Schedule in this section.

1.3 References

- .1 Canadian Standards Association (CSA):
 - .1 CSA-A371-04, Masonry Construction for Buildings.
 - .2 CSA A82.2-M78 Methods of Sampling and Testing Brick.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM A276-08a, Standard Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM E96/E96M-05, Standard Test Methods for Water Vapor Transmission of Materials.
 - .3 ASTM C109/C109M-08, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens).
 - .4 ASTM C39/C39M-05e2, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - .5 ASTM C666/C666M-03, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 British Standards Institute (BSI).
 - .1 EN772 part 22, 1999, Methods of Test for Masonry Units - Part 22: Determination of freeze-thaw resistance of Clay Masonry Units.

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 - Submittal

Procedures, and Section 04 05 10.

- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet, including material properties and related testing standards.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.
 - .3 Submit test data from recognised testing facility showing anchoring system has demonstrated ability to provide 40 year freeze-thaw durability as per ASTM C666.
- .3 Shop Drawings:
 - .1 Submit drawings showing design of anchor system, including design calculations.
 - .2 Drawings to be stamped and signed by qualified professional engineer registered in Province of Ontario, and retained by anchor supplier.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.5 Quality Assurance

- .1 Submit test reports and certificates in accordance with Section 01 45 00 - Quality Control.
- .2 Test Reports: provide certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: provide product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 Quality Assurance - Mock-Ups

- .1 Construct mock-ups in accordance with section 01 45 00 - Quality Control and Section 04 05 00 - Common Work Results for Masonry.
- .2 Install full scale mock-up of each anchor type in location designated by the Departmental Representative. Testing shall take place before any masonry work proceeds.
 - .1 Test anchors to failure for design loads less or equal to 5.0 kN; to 1.3 times design load for other anchors.
 - .2 Dismantle masonry adjacent to anchor to show extent of grout penetration. Acceptable criteria for bonding to parent material: greater than or equal to 90% of potential contact area. Re-install mock-up until specified value is achieved.

1.7 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - 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 in appropriate containers on-site for recycling in accordance with Waste Management Plan.

PART 2 PRODUCTS

2.1 Materials

- .1 Grout anchors: proprietary assembly comprising steel anchor body and grout retaining device designed for filling with non-shrink grout.
- .2 Anchor body: stainless steel to ANSI type S304. Test criteria ASTM A276.
- .3 Grout: to meet the following performance characteristics:
 - .1 99% cementitious content: portland cement and/or lime materials.
 - .2 Compressive strength: greater than 17.5 MPa. Test standard ASTM C109 or ASTM C39.
 - .3 Freeze Thaw Durability: 40 years to ASTM C666 or EN772 part 22.
- .4 Acceptable Materials:
 - .1 Masonry restoration anchors as supplied by CINTEC CANADA LTD.
 - .2 Alternative Materials: Approved by addendum in accordance with Instructions to Tenderers.

2.2 Fabrication

- .1 Fabricate anchor sizes to details indicated.
- .2 Anchor types: as specified in article entitled Schedule.
- .3 Anchor lengths: determine sizes on site prior to fabrication.

PART 3 EXECUTION

3.1 Installation

- .1 Install anchors using individuals trained and certified by approved anchor supplier.
- .2 Core-drill anchor holes using air cooled diamond drilling process. Rotary percussive drilling or water cooled drilling not permitted. Coring must be directional, straight, plumb and true, unless noted otherwise, by applying constant pressure. Vibration caused by coring is not acceptable.
- .3 In areas with suspected asbestos contamination, drilling operation shall be dust-free. Use rubber boot around drill bit at wall face and remove dust generated with vacuum equipment having HEPA filter.

3.2 Weak Substrates

- .1 Where weak substrates prevent adequate bonding of grout, relocate and groove or undercut anchors as directed by Departmental Representative.
- .2 Cost of work requiring specified adjustments resulting from weak substrates will be paid by Departmental Representative.

3.3 Field Testing

- .1 Proof test 30% of all installed anchors designed for unfactored design loads of 5.0 kN or less to 100% of the specified unfactored design loads.

3.4 Cleaning

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

3.5 Schedule

- .1 Anchor types and quantities: See following table:

Stainless steel threaded rod fully grouted anchors

Type	Anchor Dia. (mm)	Hole Dia. (mm)	Anchor length (mm)	Grouted Length (mm)	Hardware	Unfactored Design Load (kN)	Location	Quantity
A1	15	50	700	600	washers and nuts	3.0	Channels mounting anchors*	***
A2	20	75	4500	4300	SS angles, washers and nuts	20.0	In-plane anchors**	***

- * Installation from interior surface
- ** Installation from exterior surface
- *** As indicated on drawings

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

- .1 Section 04 03 06 - Heritage - Cleaning Historic Masonry.
- .2 Section 04 03 07 - Heritage - Masonry Repointing and Repair.
- .3 Section 04 03 08 - Heritage - Mortaring.
- .4 Section 04 05 00 - Common Work Results for Masonry.
- .5 Section 04 05 19 - Masonry Reinforcement and Connectors.

1.2 References

- .1 Canadian Standards Association (CSA):
 - .1 CSA-A82-06, Fired Masonry Brick Made from Clay or Shale.

1.3 Submittals

- .1 Submit documents and samples in accordance with Section 04 05 10 - Common Work Results for Masonry.

1.4 Waste Management and Disposal

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

PART 2 PRODUCTS

2.1 Manufactured Units

- .1 Burned clay face brick: to CSA-A82.
 - .1 Type: FBS.
 - .2 Grade: SW.
 - .3 Maximum absorption: 5%.
 - .4 Maximum saturation coefficient: 0.78.
 - .5 Minimum compressive strength: 35 MPa.
 - .6 "Ontario" size to match existing bricks.
 - .7 Colour: red
- .2 Clay flue liners
 - .1 330 mm square
 - .2 203 mm square
 - .3 Custom-made transition unit to join the two sizes
 - .4 Elbow units as required to form the flue routing indicated

PART 3 EXECUTION

3.1 Manufacturer's Instructions

- .1 Compliance: comply with manufacturer's installation instructions and data sheets.

3.2 Removal of Existing Brick

- .1 Verify with Departmental Representative, locations and dimensions of areas of work, and methods required at junctions with brick to remain.
- .2 Working with the Departmental Representative, individually 'sound' bricks by tapping with a mallet to confirm the scope of brick dismantling required.
- .3 Use mechanical hand methods of removal. Obtain Departmental Representative's approval for use of power tools before commencing work.
- .4 Carefully dismantle walls. Leave adjacent brick designated to remain clean and free of mortar, chips and cracks, and ready to receive new materials.

3.3 Installation

- .1 Do masonry work in accordance with Section 04 05 00 - Common Work Results for Masonry.
- .2 Bond, coursing and jointing: to match existing.
- .3 Do tying and grouting in accordance with Section 04 05 19 - Masonry Reinforcement and Connectors.
- .4 Clean masonry as work progresses.
- .5 Dismantle brick wall as required to locate existing flues, and form new connections as indicated. Provide new, re-routed connections to existing flues within existing brick wall assembly. Enclose with new brick.

3.4 Schedule

- .1 Interior of vent towers: remove and replace 75% of clay brick, as directed by Departmental Representative on site, using methodology described in 3.2.2 above.
- .2 Allow for an aggregated 20 square metres of brick infill in locations not indicated on drawings, to a thickness of three wythes.
- .3 Allow for two new flue connections.

END OF SECTION