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DEMOLITION AND DECONSTRUCTION

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DEMOLITION AND DECONSTRUCTION
05/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.6 (2006) Safety & Health Program Requirements for Demolition Operations - American National Standard for Construction and Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61 National Emission Standards for Hazardous Air Pollutants

1.2 PROJECT DESCRIPTION

1.2.1 Definitions

1.2.1.1 Demolition

Demolition is the process of wrecking or taking out any load-supporting structural member of a facility together with any related handling and disposal operations.

1.2.1.2 Deconstruction

Deconstruction is the process of taking apart a facility with the primary goal of preserving the value of all useful building materials.

1.2.1.3 Demolition Plan

Demolition Plan is the planned steps and processes for managing demolition activities and identifying the required sequencing activities and disposal mechanisms.

1.2.1.4 Deconstruction Plan

Deconstruction Plan is the planned steps and processes for dismantling all or portions of a structure or assembly, to include managing sequencing activities, storage, re-installation activities, salvage and disposal

mechanisms.

1.2.2 Demolition/Deconstruction Plan

Prepare a [Deconstruction Plan](#) and submit proposed salvage, demolition, deconstruction, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress [and](#) a detailed description of methods and equipment to be used for each operation and of the sequence of operations. [Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use.](#) Coordinate with Waste Management Plan in accordance with Section [01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL](#).

Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with [EM 385-1-1](#). Plan shall be approved by Contracting Officer prior to work beginning.

1.2.3 General Requirements

Do not begin demolition or deconstruction until authorization is received from the Contracting Officer. [The work of this section is to be performed in a manner that maximizes the value derived from the salvage and recycling of materials.](#) The work includes demolition, deconstruction, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with [EM 385-1-1](#), Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.3.3 Trees

Protect trees within the project site which might be damaged during demolition or deconstruction, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.4 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Prior to start of work, the Government will disconnect and seal utilities serving each area of alteration or removal upon written request from the Contractor.

1.3.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted. Where burning is permitted, adhere to federal, state, and local regulations.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval.:

SD-01 Preconstruction Submittals

Demolition & Deconstruction Plan; G
Existing Conditions

SD-07 Certificates

Notification; G

SD-11 Closeout Submittals

Receipts

1.6 QUALITY ASSURANCE

Submit timely notification of demolition and deconstruction projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the State's environmental protection agency local air pollution control district/agency and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSP A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.6.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area as required. .

1.7 PROTECTION

1.7.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.7.2 Protection of Personnel

Before, during and after the demolition and deconstruction work continuously evaluate the condition of the structure being demolished and deconstructed and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.8 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield pavements. Remove all such materials that may appear on operational aircraft pavements due to the Contractor's operations. If necessary, the Contracting Officer may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. The barricade shall include a fence covered with a fabric designed to stop the spread of debris. Anchor the fence and fabric to prevent displacement by winds or jet/prop blasts.

Remove barricade when no longer required.

1.9 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

1.10 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 DISPOSITION OF MATERIAL

3.1.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.1.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated in the Scope of Work and Drawings to be reused or relocated to prevent damage, and reinstall as the work progresses. Coordinate the re-use of materials and equipment with the re-use requirements in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Capture re-use of materials in the diversion calculations for the project.

3.2 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or

adjacent areas. Apply local regulations regarding hauling and disposal.

3.3 DISPOSAL OF REMOVED MATERIALS

3.3.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan.

3.3.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.3.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on Government property.

3.3.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.4 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

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REMOVAL AND SALVAGE OF HISTORIC CONSTRUCTION MATERIALS

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SECTION 02 42 91

REMOVAL AND SALVAGE OF HISTORIC CONSTRUCTION MATERIALS
11/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
40 CFR 261	Identification and Listing of Hazardous Waste

1.2 PROJECT DESCRIPTION

The work includes removal and salvage of identified historic items and materials, and removal of resulting rubbish and debris. General demolition of non-historic materials and removal of resulting rubbish and debris must comply with the requirements of Section 02 41 00 DEMOLITION AND DECONSTRUCTION. Store salvaged or recycled materials daily in areas and in a manner specified by the Contracting Officer. In the interest of conservation, pursue salvage and recycling to the maximum extent possible. Submit a [Work Plan](#) that includes procedures proposed for the accomplishment of the work. The Work Plan procedures must provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged or recycled, dust control, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. Include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in the Work Plan.

1.2.1 Dust Control

Control the amount of dust resulting from removal, salvage and demolition operations to prevent the spread of dust to occupied portions of the construction site, to avoid creation of a nuisance in the surrounding area and to minimize occupational exposures. Occupational exposures cannot exceed the requirements in 29 CFR 1910.1000 and 29 CFR 1926.55. Use of water to control dust will not be permitted when it will result in, or create, damage to existing building materials and hazardous or objectionable conditions such as ice, flooding and pollution.

1.2.2 Protection

1.2.2.1 Protection of Existing Historic Property

Survey the site and examine the drawings and specifications to determine

the extent of work before beginning any removal, salvage or demolition work. Take necessary precautions to avoid damage to existing historic items that are to remain in place, to be reused, or to remain the property of the Government. Repair or restore items damaged by the Contractor to original condition, or replace, as approved by the Contracting Officer. Coordinate the work of this section with all other work and construct and maintain shoring, bracing and supports, as required. Ensure that structural elements are not overloaded and provide additional supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.2.2.2 Protection From the Weather

Protect the interior of buildings to remain and salvageable materials from the weather at all times. Store salvaged historic materials off the ground and under weathertight covering.

1.2.2.3 Environmental Protection

Ensure a thorough inspection has been performed for hazardous materials prior to beginning work.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval.

SD-01 Preconstruction Submittals

Work Plan; G

1.4 QUALIFICATIONS

Provide qualified workers trained and experienced in whole-building recycling, including removal and salvage of historic materials. Submit documentation of five consecutive years of work of this type with a list of similar projects identifying when, where, and for whom the work was done. Provide a current point-of-contact for identified references.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 HAZARDOUS MATERIALS

Unforeseen hazardous materials may exist in wall cavities, beneath floors, in chases, inside various components, as well as other building materials. Exercise extreme care when performing demolition and salvage operations to ensure unexpected hazardous materials area not inadvertently disturbed creating a potential exposure concern. If suspect hazardous materials are observed or encountered, stop work and notify the Contracting Officer immediately.

3.2 DISPOSITION OF MATERIALS

The Contractor, upon receipt of notice to proceed, is vested with the title

to materials and equipment to be demolished, except Government and using service salvage and historical items. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.2.1 Material Salvaged for the Contractor

Temporarily store salvaged material as approved by the Contracting Officer and remove from Government property before completion of the contract. Sale of salvaged material on the site is prohibited.

3.2.2 Items Salvaged for the Government

Remove salvaged items to remain the property of the Government in a manner to prevent damage, packed or crated to protect the items from damage, or as directed by the Contracting Officer. Repair or replace items damaged during removal or storage to match existing items. Properly label and identify containers as to contents.

3.3 CLEAN-UP

Upon completion of the work, clean portions of structure to remain and adjacent areas and structures of dust, dirt, and debris caused by salvage and demolition operations. Verify that debris and rubbish created by the work is non-hazardous. If any debris and rubbish is suspect hazardous waste characterize it in accordance with 40 CFR 261. If the debris and rubbish is determined to be hazardous materials notify the Contracting Officer. Remove and transport non-hazardous debris and rubbish in a manner that prevents spillage on streets or adjacent areas. Transport and dispose of all material in accordance with all local, state and Federal regulations. Provide copies of all disposal manifests to the the Contracting Officer.

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SECTION 04 03 00

CONSERVATION TREATMENT FOR PERIOD MASONRY
11/17

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100 (2015; Suppl 2002-2016) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2014) Standard Specification for Carbon Structural Steel

ASTM C34 (2017) Standard Specification for Structural Clay Loadbearing Wall Tile

ASTM C67/C67M (2020) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile

ASTM C170/C170M (2017) Standard Test Method for Compressive Strength of Dimension Stone

ASTM C216 (2019) Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)

ASTM C926 (2020) Standard Specification for Application of Portland Cement-Based Plaster

ASTM C1196 (2014) Standard Test Method for In Situ Compressive Stress Within Solid Unit Masonry Estimated Using Flatjack Measurements

ASTM C1197 (2014) Standard Test Method for In Situ Measurement of Masonry Deformability Properties Using the Flatjack Method

ASTM C1324 (2015) Standard Test Method for Examination and Analysis of Hardened Masonry Mortar

ASTM C1364 (2019) Standard Specification for Architectural Cast Stone

Specification Attachment 1

Building 79 2nd and 3rd Floor Renovations Option 2

1591147

ASTM C1531	(2015) Standard Test Methods for In Situ Measurement of Masonry Mortar Joint Shear Strength Index
ASTM C1601	(2014) Standard Test Method for Field Measurement of Water Penetration of Masonry Wall Surfaces
ASTM C1713	(2012) Standard Specification for Mortars for the Repair of Historic Masonry
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E2260	(2012) Standard Guide for Repointing (Tuckpointing) Historic Masonry
ASTM E2659	(2018) Standard Practice for Certificate Programs

NATIONAL PARK SERVICE (NPS)

NPS Hist Prop	(2017) National Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings
NPS TPS Brief 1	(2000) Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings
NPS TPS Brief 2	(1998) Repointing Mortar Joints in Historic Masonry Buildings

THE MASONRY SOCIETY (TMS)

TMS MSJC	(2016) Masonry Standard Joint Committee's (MSJC) Book - Building Code Requirements and Specification for Masonry Structures, Containing TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6, and Companion Commentaries
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

GSA HPTP 07656-01	Installing Lead Stone Flashing to Protect Masonry Joints
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1.2 DEFINITIONS

Terms are defined below as applicable to this project.

1.2.1 Aggregates

The sand component of mortar.

1.2.2 Biocides

A chemical treatment that inhibits, deters, or controls organic growth. Such growth is typically removed by cleaning following biocide treatment..

1.2.3 Binder

The component of mortar that binds together the aggregate particles into a cohesive material.

1.2.4 Dispersed Lime Crack Injection

A repair method in which dispersed lime material is injected into small cracks ranging in width from hairline to $1/8$ in by use of needle or syringe.

1.2.5 Consolidant

A chemical product meant to strengthen loose or deteriorated stone.

1.2.6 Dutchman

A repair method in which deteriorated stone is removed in part and replaced with salvaged, harvested or new stone to make a seamless patch.

1.2.7 Harvested

Units removed from inconspicuous areas of the building.

1.2.8 In situ

A term referencing a repair procedure in which the masonry units and mortar remain in place and are repaired without removal from the wall system

1.2.9 Joint Sealant

A flexible, chemical product that is used to create a weather-tight seal at the boundary of masonry units with other units or dissimilar materials.

1.2.10 Lead Flashing

An extruded lead material that is inserted into joints to assist in precluding water entry into the masonry.

1.2.11 Lime Wash

A protective surface treatment comprised of calcium hydroxide particles in suspension in water, along with small amounts of calcium carbonate, silica particles and other minerals.

1.2.12 Mockup

Specific area on the building approved by Contracting Officer to demonstrate the ability to apply, match and install specified materials.

1.2.13 Mortar

A mixture of binders, aggregates, and pigments used for reconstruction, repointing or stucco applications.

1.2.14 New Elements

New, non-historic materials added to masonry structures to aid in their ability to resist loads (typically seismic) or to resist water infiltration.

1.2.15 Patch

The use of substitute repair materials to treat damaged or deteriorated masonry units in situ.

1.2.16 Remediate

An intervention of a historic masonry structure and its component materials with the intent to maintain the original fabric to the greatest extent possible.

1.2.17 Remove

Specifically for historic masonry materials, the term means to detach an item from existing construction to the limits indicated.

1.2.18 Replace

To reinstall an item in its original position (or where indicated) after remedial treatment, or to duplicate and reinstall an entire item with new material; with the original item serving as the pattern for creating the duplicate.

1.2.19 Repoint

To remove existing mortar joints to the specified depth and replace with a mortar that matches in color, texture, and performance with water vapor transmission, bond, hardness, and flexibility compatible with original mortar, as assessed in accordance with [ASTM C1713](#).

1.2.20 Retool

A repair method in which a chisel is used to re-create the surrounding stone texture finish by removing loose pieces of stone.

1.2.21 Stucco

A mixture of binders and aggregates, sometimes including animal hair or fibers used for the repair treatment of existing stucco.

1.2.22 Surface Treatment

The application of traditional materials or contemporary chemical products to the surface of masonry to provide protection to the masonry units and mortar and/or reduce water infiltration.

1.2.23 Test Panel

Specific area on the building approved by the Contracting Officer to demonstrate individual applicator competency and workmanship proficiency prior to the start of restoration work.

1.2.24 Tuckpointing

Often called skim-coating, an American practice of surface repairing mortar joints without the required removal of existing deteriorated mortar beneath. This practice is not recommended for mortar joint repair work on historic masonry. There is also an acceptable British form of tuckpointing practice that involves careful thin penciling of smaller joints within larger ones to give the wall the appearance of an ashlar finish.

1.2.25 Water Repellent

A surface-applied chemical intended to reduce liquid water entry into a masonry wall without significantly affecting the vapor transmission properties of the original material.

1.2.26 Wall System

A term used to address the fact that masonry structures are comprised of different materials but function holistically, requiring that all restoration and cleaning process take into account the implications of the treatment to the adjacent materials and the building as a whole.

1.2.27 Masonry Treatment Requirement (MTR)

Defined treatments that are required by the specification (contract) documents for project specific repairs to masonry.

1.2.28 Saturated Surface Dry (SSD)

Condition of the wall surface after water has been applied sufficient to saturate more than the surface, then allowed to dry until the surface is dry but the body of the masonry still has moisture.

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Pre-Installation Meeting

Prior to beginning the work of this Section, convene a meeting with the Contracting Officer's Representative(s) to review the requirements of the Quality Control Plan, Project Training Program, installation procedures, location of required mockup areas, and all job conditions and processes. All subcontracting firms involved with this work must participate in this meeting.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan; G

Project Training Program; G

Qualifications; G

SD-02 Shop Drawings; G

Photographic Documentation

SD-03 Product Data

Qualifications

Cleaning and Restoration Methods; G

Cleaning Materials; G

Biocides

Replacement Mortar And Stucco; G

Mortar Mix; G

Water Repellents Infiltration; G

Stone Consolidants; G

SD-04 Samples

Mock-ups; G

Mortar Samples (Existing and New); G

Brick Samples (Existing and New); G

SD-06 Test Reports

Testing and Matching

Existing Sealants for Asbestos and PCBs

SD-07 Certificates

Repair Materials

1.5 QUALITY CONTROL

1.5.1 Quality Control Plan

Prior to beginning restoration and cleaning work, submit a written [Quality Control Plan](#). Do not proceed without written approval of the Quality Control Plan. At a minimum, include the following items in the Quality Control Plan:

- a. Describe methods of dust containment during the work specific to the work of this section.
- b. Describe the methods of protecting surrounding masonry, windows, doors, roof, and building trim as well as surrounding landscape. Provide drawings of protection when requested.

- c. Describe the work procedures, materials, and proposed tools to use for each Masonry Treatment Requirement (MTR) specified.
- d. Describe the sequence of each MTR.
- e. Describe how each MTR sequence and the overall construction schedule changes with weather variations and how completed work will be protected.
- f. Describe the methods for surveying original layout and collecting datum points and plumb lines for rebuilding masonry.
- g. Describe the methods for shoring and providing a safe working environment.
- h. Describe the methods for select deconstruction of individual masonry units and tools/methods for cleaning the masonry for reuse.
- i. Describe the method and approach to mortar joint removal.
- j. Describe the method and approach for assuring repair material compatibility with original materials.
- k. Describe the method and approach to cleaning mortar, coating, smears and old patching materials from the masonry surfaces.
- l. Describe, in detail, the procedures relating to techniques and tools proposed for masonry matching.
- m. Describe the complete masonry removal and matching procedures; include equipment, approach, length of time the masonry will be out of the wall, documentation on mapping the location, and where (on-site or in shop) the masonry units will be repaired.
- n. Describe the procedure for matching of different colors at different locations.
- o. Describe the procedure for mixing and matching of repair materials.
- p. Describe the methods and system by which the use of reclaimed masonry units can be utilized.
- q. Describe the methods for setting masonry back into its original position and maintaining the original bond patterns and joint width.
- r. Describe the methods of transition points where replacement/preservation work will meet the original historic work.
- s. Describe the on-site [project training program](#). Provide the opportunity for workers to be trained in each masonry treatment requirement (MTR) as work proceeds.

1.5.2 [Qualifications](#)

1.5.2.1 Historic Masonry Consultant

- a. Secure the services of a historic masonry consultant with a minimum of 10 years experience applying [NPS Hist Prop](#) as they relate to the work

in this section.

- b. Submit a resume that describes five relevant projects within that period and include how **NPS Hist Prop** was applied to the work of similar scope and scale and what jurisdiction or agency was involved in approving the work..
- c. The consultant's services include:
 - (1) Investigating the condition of the masonry materials and mortar.
 - (2) Arranging for material analysis in the laboratory
 - (3) Recommending appropriate cleaning methods and materials
 - (4) Recommending restoration options.
 - (5) Providing project specific specifications.
 - (6) Providing an on-site training program.
 - (7) Providing quality control services during construction.
 - (8) Recommending appropriate repair and restoration materials.

1.5.2.2 Masonry Firm

- a. The firm performing the masonry work must have a minimum of five years experience on relevant projects.
- b. The firm must have completed work similar in material, design, and extent to that indicated for this Project and demonstrate a record of successful in-service performance.
- c. Proven implementation of **NPS Hist Prop** and related Preservation Briefs are required.
- d. Submit a resume that describes the required experience.

1.5.2.3 Field Supervisor

Retain an experienced full-time supervisor on the project site at all times when masonry restoration is in progress. A single individual must be responsible for supervising the historic masonry restoration work throughout the duration of the project.

Submit a resume that describes the required experience.

1.5.2.4 Masonry Applicator

- a. Employ craftspeople who are experienced with and specialize in restoration work of the types they will be performing.
- b. All masonry restoration treatments must be performed by a craftsperson that is familiar with historic masonry construction and has worked on historic masonry projects for at least five years.
- c. Only skilled technicians who are familiar and experienced with the materials and methods specified may be used.

- d. Submit resumes for all historic masonry applicators, demonstrating the required experience.

1.5.3 Project Training Definition and Use

In addition to five years demonstrable experience on masonry restoration projects, offer workers project training certificate(s) within the framework of [ASTM E2659](#). Project training certificates are earned by individual workers and issued with the understanding that they are for limited time use, enforceable only to this specific project and for a specific MTR. It is not necessary, nor a requirement of this specification, that all restoration workers obtain all project training certificates offered. Rather it is desirable that workers be trained for each project specific task they will perform to ensure the highest quality results from the cleaning and restoration program.

1.5.4 Mortar Analyst

Laboratory mortar analysis equipment should be operated by and results analyzed by trained personnel experienced with analysis of historic masonry mortar.

1.5.5 Documentation

Submit digital [photographic documentation](#) of the all phases of masonry restoration, including prior to the start of restoration work.

Provide thorough photo documentation of the project and project details and targeted areas.

1.5.6 [Cleaning and Restoration Methods](#)

1.5.6.1 General Procedure

- a. Submit the cleaning and restoration methods, and materials selected for a specific structure for approval before work starts.
- b. Take into account the total construction system of the building to be worked upon, including different masonry and mortar materials, as well as non-masonry elements which may be affected by the work.
- c. Utilize mockups to identify the appropriate cleaning and restoration treatment and materials and set the standard for each project task.
- d. Demonstrate the correct execution of the approved cleaning and restoration methods and materials during the on-site workmanship training program within the framework of [ASTM E2659](#).

1.5.6.2 Cleaning Products and Procedures

1.5.6.2.1 General Cleaning Requirements

- a. Establish cleaning products and procedures during the mockup process.
- b. Select the least aggressive method used to achieve the desired level of cleanliness.
- c. Where chemical products are selected for cleaning, use them in

accordance with the manufacturer's instructions.

1.5.6.2.2 Cleaning Mock-Ups

- a. Demonstrate the materials, equipment, and methods to be used in cleaning in a test section approximately 3 feet by 3 feet.
- b. Locate test patches in inconspicuous areas of the building. The areas tested are subject to approval by the Contracting Officer. The areas tested must exhibit soiling characteristics representative of those larger areas to be cleaned.
- c. Adjust the cleaning process as required and the test section rerun until an acceptable process is obtained.
- d. Conduct tests on areas to be stripped of paint.
- e. Allow tested areas to dry before a determination is made on the effectiveness of a particular treatment.

1.5.7 Masonry Restoration Products and Procedures

1.5.7.1 General Restoration Requirements

- a. Do not use masonry or mortar in the work until the mock-ups and the represented material and workmanship have been submitted and approved.
- b. Demonstrate the methods and quality of workmanship to be performed in each masonry treatment requirement (MTR). Provide a mock-up for each MTR indicated.

1.5.7.2 General Restoration Mock-Up Requirements

- a. Throughout restoration, retain approved mock-up panels in undisturbed condition, suitably marked, as a standard for judging completed work.
- b. Review manufacturer's product data sheets to determine suitability of each product for each surface.
- c. Apply products using manufacturer-approved application methods, determining actual requirements for application.
- d. Obtain approval as to the preservation treatment approach, design, and workmanship to include, but not limited to the verification of all material applications and finishes as specified to the requirements of color, texture, profiles, and finishes before proceeding with work.

1.5.7.2.1 Mock-ups

May be performed on inconspicuous sections of actual construction under the same weather conditions expected the remainder of the work.

- a. Location and number as directed.
- b. Size: 3 feet by 3 feet or as appropriate for the repair specified.
- c. Repair unacceptable work.

1.5.7.3 Restoration Mock-Ups

1.5.7.3.1 Repointing

Repoint mortar joints, minimum acceptable mock up dimensions: twelve feet in length - 2/3 horizontal joints and 1/3 vertical joints. Demonstrate method for cutting out mortar joints, preparing wall for repointing, mixing mortar, installing mortar and curing the mortar. Prepare and place repointing mortar in accordance with [NPS TPS Brief 2](#) and in compliance with [NPS Hist Prop](#).

1.5.7.3.2 Retooling Stone Masonry In Situ

Demonstrate treatment technique and methods to retool three deteriorated stone faces in situ in all known historic profile textures identified.

1.5.7.3.3 Masonry Removal and Replacement

Fully remove masonry and replace to specified dimensions and texture. Select size of masonry units representing typical conditions. Return one masonry unit to same location, set to surrounding profile joint width and bond pattern. Set masonry unit using specified mortar. Confirm with Contracting Officer's Representative that the replacement masonry units meet specification requirements for matching and that sufficient quantity required for the work have been identified. Leave one stone dry-set into opening set on wood shims for evaluation and approval of preparation conditions.

1.5.7.3.4 Repair Material

1.5.7.3.4.1 Patching

Apply repair material on at least two masonry units for repair. Include one masonry unit on which to demonstrate proficiency in removing previous patching material and repairing with new substitute repair material. Include the removal of metal anchors at two locations and fill in the holes with repair material on the second masonry unit (where applicable).

1.5.7.3.4.2 Dutchman

Undertake dutchman repairs in two locations, including one that is only cut and prepared for application. Demonstrate the quality of the stone insert, as well as the workmanship and techniques to be performed in the dutchman repairs. Do not proceed with other dutchman repairs until the technique has been approved.

1.5.7.3.5 Crack Repair

Repair one crack, [2 feet](#) in length, using mortar. Repair one crack, [2 feet](#) in length, using dispersed hydrated lime injection technique with appropriate repair material.

1.5.7.3.6 Surface Treatments

Install a minimum [1.5 square meter](#) [16 square foot](#) mockup for each surface treatment on each substrate to be treated. For stucco, demonstrate the means for installing each coat; including mechanical support systems such as wood or metal lath. For water repellents and/or consolidants, demonstrate the equipment and installation procedure. Allow 48 hours for

limewash applications to dry to their final color and appearance.

1.5.7.3.7 New Masonry Elements

Install new components in a manner demonstrating their final installation on the structure.

1.6 DELIVERY, STORAGE, AND HANDLING

- a. Furnish cement in suitable bags used for packaging cements.
- b. Provide packages with labeling that clearly defines contents, manufacturer, and batch identification.
- c. Provide detergents, masonry cleaners, paint removers, solvents, epoxies and other chemicals used for masonry cleaning in sealed containers that legibly show the designated name, formula or specification number, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer.
- d. Store materials in weathertight structures which will protect all materials from moisture and contaminants.
- e. Store accessories to avoid contamination and deterioration.
- f. Do not use admixtures which have been in storage onsite for six months or longer, or which have been subjected to freezing, unless retested and proven to meet the specified requirements.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Environmental Requirements

- a. Do not place materials when weather conditions adversely affect the quality of the finished product.
- b. Do not place masonry or mortar when the air or surface temperature is below 40 degrees F in the shade and will remain so for at least 48 hours after completion of the work. Heated enclosures may be used to overcome ambient weather restrictions, where such enclosures are feasible.
- c. Do not place masonry or mortar when air or surface temperature is above 90 degrees F with a wind speed above 8 miles per hour and will remain so for at least 48 hours after completion of the work.
- d. Do not place masonry or mortar when air or surface temperature is above 100 degrees F with or without wind and will remain so for at least 48 hours after completion of the work.
- e. Do not product or place materials during periods of rain or other precipitation. Stop material placements, and protect all in-place material from exposure, during periods of rain or other precipitation.
- f. Clean masonry surfaces when air temperatures are above 40 degrees F and will remain so until masonry has dried out, but for not less than 7 days after completion of the work.

- g. Do not perform work in wind conditions that may blow materials onto surfaces not intended to be treated.

1.7.2 Masonry Installation Requirements

- a. Phase work during hot weather by performing work on the shady side(s) of the building during daylight hours and on the daylight side(s) of the building during cooler evening hours to prevent premature evaporation of the water from the mortar.
- b. Do not use frozen materials or materials mixed or coated with ice or frost. Do not apply materials to frozen surfaces; allow complete thawing prior to installation.
- c. Do not lower the freezing point of mortar by the use of admixtures or anti-freeze agents. Do not add chlorides or admixtures containing greater than 0.2 percent chlorides to the mortar, per TMS MSJC.
- d. Prevent mortar from staining the face of the masonry or other exposed surfaces. Immediately remove mortar that comes in contact with such surfaces. Cover partially completed work when work is not in progress. Protect sills, ledges and projections from mortar droppings. Building damage resulting from work of this Section is the Contractor's responsibility. Restore damaged areas to the satisfaction of the Owner at no expense to the Owner. Do not apply products under conditions outside product manufacturer's requirements.

1.8 WARRANTY

1.8.1 Cleaning Warranty

Warrant cleaning procedures for a period of two years against harm to substrate (masonry and mortar) or to adjacent materials including, but not limited to discoloration of substrate from improper procedures or usage, chemical damage from inadequate rinse procedures, and abrasive damage from improper procedures.

1.8.2 Repair Warranty

Warrant repair procedures, including repointing, for a period of two years against: discoloration or mismatch of new mortar to adjacent original historic mortar, discoloration or damage to masonry from improper mortar clean-up, loss of bond between masonry and mortar, fracturing of masonry edges from improper mortar joint preparation procedures or improper mortar formulation, and occurrence of efflorescence from improper repair procedures.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS

2.1.1 General Requirements

Selection of appropriate cleaning products requires a clear understanding of the masonry materials to be cleaned, a rationale for the cleaning, and an understanding of the anticipated level of cleanliness expected from the cleaning program. Overly aggressive cleaning methods and materials can cause subtle, long-term damage to masonry units. Use products that have a minimum 5 year performance record on relevant projects. Select the

products predicated on long-term negative effects to the masonry rather than current level of cleanliness of the comparable structure.

2.1.2 Paint Removers

- a. Provide chemical paint removers that are water soluble, low toxicity products, effective for removal of paint on masonry without altering, damaging, or discoloring the masonry surface.
- b. Provide commercially available poulticing materials designed to adhere to and peel off paint without damaging the underlying masonry or project specific mixtures that include absorbent materials and cleaning solutions which can be demonstrated to do no harm to the masonry.

2.1.3 Chemical Cleaners

- a. Provide commercially available products that have a proven record of cleaning masonry without altering, damaging or discoloring the masonry units, mortar or surrounding materials.
- b. Provide the associated pre and post treatment material to neutralize the long term effects of the chemicals.

2.1.4 Biocides

Provide commercially available biocides with accompanying product literature containing information on the product as well as the expected service life of the material and any detrimental effects it may have on the masonry or mortar.

2.1.5 Liquid Strippable Masking Agent

Provide manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from the damaging effect of acidic and alkaline masonry cleaners.

2.1.6 Cleaning Implements

Furnish brushes that contain natural or nylon fiber bristles only. Do not use metallic wire brushes. Use scrapers and application paddles made of wood with rounded edges. Metallic tools are not permitted.

2.1.7 Water

Obtain potable water from a local source.

2.2 REPAIR MATERIALS

2.2.1 General

Use repair materials of one type and from one source, when used in repair treatments that will have surfaces exposed in the finished structure.

2.2.2 Mortar and Stucco

2.2.2.1 Testing and Matching

- a. Take test specimens of existing mortar and stucco from a sound and

intact representative portion of the structure, at locations indicated by the Contracting Officer's Representative and assess in accordance with ASTM C1713 and ASTM C1324.

- b. Subject a part of the historic mortar sample to petrographic examination and differential thermal analysis, or X-ray diffraction, or analytical chemistry to determine the binder components.
- c. Aggregate Analysis
 - (1) Separate aggregate of the mortar sample from the binder by taking the crushed mortar sample and either gently blowing away the fine binder material, placing the crushed sample in a centrifuge, or chemically separating the aggregate from the binder.
 - (2) Rinse the separated aggregate clean with water and dry. Examine the aggregate with a magnifying glass, and record the component materials as to range of materials, sizes, colors, as well as the presence of other materials.
 - (3) Perform sand analysis using a sieve analysis of the aggregate as part of the ASTM C1324 process.
- d. Match the replacement mortar and stucco to the original existing material in color, texture and tooling.

2.2.2.2 Replacement Mortar and Stucco

Provide replacement mortar and stucco that will:

- a. Coexist with the old in a sympathetic, supportive and, if necessary, sacrificial capacity.
- b. Have greater vapor permeability and be softer (measured in compressive strength) than the masonry units.
 - (1) Measure water vapor transmission in accordance with ASTM E96/E96M.
 - (2) Prepare ASTM E96/E96M water vapor transmission specimens with thickness similar to that expected in service, or a maximum of 1/2 inch, whichever is thinner.
- c. Be as vapor permeable, and as soft, or softer, (measured in compressive strength) than the existing historic mortar or stucco.

2.2.2.3 Binder Content

Provide binder type or mixture of mortar (and stucco) with a cement, lime, or combination thereof consistent with the original existing mortar (and stucco) content in order to provide uniform durability, weathering characteristics, and the same, or better, life-cycle performance expectations.

2.2.2.4 Repointing Mortar

To match original existing material in color, texture and tooling.

2.2.2.5 Admixtures

Do not use admixtures in the mortar or stucco unless specifically approved in writing by the Contracting Officer.

2.2.3 Crack Injection

- a. Comply with the dispersed hydrated lime manufacturer's written instructions.
- b. Inject cracks that are no greater than 1/8 inch in width and masonry is soundly bonded but cracked.
- c. Inject the full length of the cracks unless specifically instructed otherwise.

2.2.4 Replacement Masonry Materials

2.2.4.1 Clay Brick

- a. Provide replacement brick matching color, shape, size, texture, appearance, and thermal expansion properties of the existing historic brick.
- b. Test brick in comparison to the original existing historic brick using [ASTM C67/C67M](#).
- c. Do not use reclaimed brick unless approved by Contracting Officer.
- d. Provide brick meeting the requirements of [ASTM C216](#) Grade SW, including a rating of "not effloresced", unless otherwise specified.

2.2.4.2 Stone

- a. Provide replacement stone matching type, color, shape, size, texture, finish-profile, and compressive strength of the existing historic stone units.
- b. Test replacement stone in comparison to the existing historic stone using [ASTM C170/C170M](#).

2.2.4.3 Terra Cotta

- a. Provide replacement terra cotta matching color, shape, size, texture and finish-profile of the existing historic terra cotta units.
- b. Test replacement terra cotta in comparison to the existing historic terra cotta using [ASTM C34](#).

2.2.4.4 Architectural Precast Stone

- a. Provide replacement architectural precast stone matching color, shape, size, texture and finish-profile of the existing historic architectural precast stone units.
- b. Test replacement architectural precast stone in comparison to the existing historic architectural precast stone using [ASTM C1364](#).

2.2.5 Surface Treatments

2.2.5.1 General

Provide commercially available coatings with water vapor permeability of 0.98 or greater, as measured in accordance with [ASTM E96/E96M](#), including silanes and siloxanes.

2.2.5.2 Consolidants

Provide commercially available consolidants designed to strengthen loose or deteriorated stone without damaging intact stone or reducing water vapor permeability below 0.98, as measured in accordance with [ASTM E96/E96M](#).

2.2.5.3 Water Repellents

Provide commercially available water repellents designed to preclude water droplet entry into the masonry walls without reducing water vapor permeability below 0.98. as measured in accordance with [ASTM E96/E96M](#).

2.2.6 Miscellaneous Materials

2.2.6.1 Cementitious Grout

Use cementitious grout, recommended by the manufacturer for the application, to bond steel anchors to masonry.

2.2.6.2 Metal Attachments

- a. Provide threaded or deformed stainless steel anchors for spall repairs, size as indicated.
- b. Provide other plates, angles, anchors, and embedments conforming to [ASTM A36/A36M](#), prime painted with inorganic zinc primer.

2.2.6.3 Lead Flashing

Provide commercially available lead flashing conforming to [GSA HPTP 07656-01](#).

2.3 EQUIPMENT

2.3.1 Cleaning Equipment

Provide cleaning equipment that does not cause staining, erosion, marring, or other damage or changes in the appearance of the surfaces to be cleaned.

2.3.1.1 Sandblasting

Use of sandblasting equipment is not allowed for cleaning masonry surfaces.

2.3.1.2 Water Blasting

- a. Provide water blasting equipment including a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water re-supply equipment.
- b. Do not operate the equipment at a pressure which will cause etching or other damage to the masonry surface or mortar joints. Operate the equipment at a discharge capacity of 55 to 400 psi and 2.5 to 3 gpm for

general surface cleaning operations.

- c. Provide water tank and auxiliary re-supply equipment of sufficient capacity to permit continuous operations.
- d. Provide protective covers and barriers as required to prevent over-spray onto adjacent surfaces.

2.3.1.3 Alternative Blasting Equipment

- a. Alternative blasting methods require equipment designed to discharge sponges, walnut shells, ice, soda and other friable materials.
- b. Operate equipment in accordance with manufacturer's recommendations and maintain in good working order.
- c. Do not operate equipment at a pressure which will cause etching or other damage to the masonry surface or mortar joints.
- d. Determine discharge capacity on a case by case basis during the mockup test panel demonstration and approval process.
- e. Provide protective covers and barriers as required to prevent over-spray onto adjacent surfaces.

2.3.2 Spray Equipment

- a. Provide spray equipment for chemical cleaners with low-pressure tanks or chemical pumps suitable for chemical cleaner indicated, and equipped with stainless steel, cone-shaped spray-tip.
- b. Disperse water through a fan-shaped spray tip at an angle of not less than 15 degrees.
- c. Deliver water at a pressure not greater than 400 psi and at a volume between 2.5 and 3 gpm.
- d. Deliver heated water at flow rates indicated maintaining between 140 and 180 degrees F.

2.3.3 Drilling Equipment

- a. Use standard small, powered, handheld masonry drills, commonly used for drilling small holes in concrete and masonry to drill holes in masonry for patch anchors and other applications.
- b. Use drills in rotary mode only. Do not use impact type drills.

2.3.4 Compressed Air Supplies

- a. Use compressed air equipment that delivers clean, oil and moisture free compressed air at the surface to be cleaned. Use a minimum of two in-line air filters to remove oil and moisture from the air supply.
- b. Test the compressed air supply during each shift for the presence of oil and moisture.

2.3.5 Material Handling and Associated Equipment

2.3.5.1 Mixing, Transporting, and Placing Job Materials

- a. Provide equipment used for mixing, transporting, placing, and confining masonry and mortar placements capable of satisfactorily mixing material and supporting uninterrupted placement operations.
- b. Provide equipment used for mixing, conveying, and placing of materials that is clean, free of old materials and contaminants, and in conformance with material manufacturer's recommendations.

2.3.5.2 Associated Equipment

Provide associated equipment, such as mixer timing equipment, valves, pressure gauges, pressure hoses, other hardware, and tools, as required to ensure a continuous supply of material and operation control.

2.4 Mortar Mix

2.4.1 General

- a. Proportion materials appropriately with regard to the effect of moisture content on the individual components (cement, sand and lime).
- b. Batch materials using volumetric measurement devices and consistently consolidate the material in these devices to ensure the uniformity of the mortar. Do not batch by shovel counts.

2.4.2 Batching

- a. Utilize a calibrated measuring device for batching Portland cement.
- b. Utilize a calibrated measuring device for batching hydrated lime or lime putty.
- c. Utilize a calibrated measuring device for batching the sand.

2.4.3 Cement and Lime Proportions

- a. Fill the measuring device with portland cement, hydrated lime or lime putty.
- b. Briskly strike the bottom of the measuring device against the ground a minimum of ten times and then strike the top flush.
- c. For dry hydrate lime, fill the measuring device using a minimum of three lifts, strike the bottom of the measuring device against the ground a minimum of ten times for each lift and then strike the top flush. Mix dry hydrate lime to a wet paste that is 40 to 42 percent solid.
- d. For lime putty briskly strike the bottom of the measuring device against the ground a minimum of ten times and then strike the top flush. No additional lime is required when measuring from putty.

2.4.4 Sand Proportions

- a. Proportion sand when the sand is in saturated surface dry (SSD), loose

damp condition.

- b. Proportion the sand by filling a measuring device using a minimum of three lifts, striking the sides a minimum of ten times, and then striking the top flush.

PART 3 EXECUTION

3.1 EXAMINATION

- a. Undertake masonry renovation only after complete evaluation and analysis of the areas to be repaired are completed, including sampling and testing of the existing mortar to determine its composition and qualities. Do not start repair work until conditions that have caused masonry deterioration have been identified and corrected.
- b. Use the gentlest means to perform the work and take the greatest of care to ensure that the historic materials are not damaged in the process of the work, as established by mock-ups and testing.
- c. In addition to requirements in this Section, comply with NPS Hist Prop.

3.1.1 Field (In Situ) Mortar Examination

- a. Detect cracks, degradation and de-bonding from the surrounding masonry.
- b. Determine previous surface coating treatments that may be contributing to the current conditions.
- c. Compare the bedding mortar with the pointing mortar and determine the cross-sectional characteristics of the wall.
- d. Determine the level of moisture movement in the in situ mortar, and if the mortar or masonry units are handling the brunt of the water movement through the wall.
- e. Evaluate in situ mortar joint shear strength in accordance with [ASTM C1531](#).

3.1.2 Taking and Preparation of Samples

- a. Take and analyze samples of unweathered original historic mortar and different types of mortar in the structure in order to match the new mortar to be used for repointing.
- b. Remove three or four samples of each type of mortar to be matched with a hand chisel from several locations on the building. Mortar samples to be intact pieces with a minimum size of [1 ounce](#).
- c. Set aside the largest sample for comparison with the repointing mortar.
- d. Place the remaining samples in labeled, sealed sample bags for transport to the laboratory for evaluation per Part 2 of this Specification.

3.2 PREPARATION

3.2.1 Protection

- a. Protect persons, motor vehicles, adjacent surfaces, surrounding buildings, equipment, and landscape materials from chemicals used and runoff from cleaning and paint removal operations.
- b. Erect temporary protection covers, which will remain in operation during the course of the work, over pedestrian walkways and at personnel and vehicular points of entrance and exit.
- c. Protect the interior of buildings from the weather, cleaning, and repair operations at all times.
- d. Do not expose workers to chemical substances in excess of the limits established by [ACGIH 0100](#). Comply with more stringent regulations where applicable.

3.2.2 Surface Preparation

- a. Do not proceed with cleaning until mock-ups have been approved.
- b. Do not proceed with repointing or stucco until existing mortar and stucco have been analyzed and suitable repair materials have been determined.
- c. Do not proceed with restoration work until the cause of observed distresses have been identified and corrected.
- d. Do not proceed with surface treatments until all other restoration work has been completed.

3.2.3 Equipment and Techniques Demonstration

- a. Demonstrate equipment and techniques of operation in an approved location.
- b. Assemble dependable and sufficient equipment, appropriate and adequate to accomplish the work specified, at the work site with sufficient lead time before the start of the work to permit inspection, calibration of weighing and measuring devices, adjustment of parts, and the making of any repairs that may be required.
- c. Maintain the equipment in good working condition throughout the project.

3.3 MASONRY CLEANING

3.3.1 General

- a. Exercise caution against over-cleaning of surfaces, which may be detrimental, and which may remove desirable historic surface details or patinas. For example, if cleaning reveals unexpected joint painting or historic signage; suspend the cleaning action, protect the exposed area and notify the Contracting Officer.
- b. Do not damage or mar historic materials in the process of cleaning.
- c. Perform cleaning per [NPS TPS Brief 1](#).

- d. Protect open joints to prevent water and cleaner intrusion into the interior of the structure.
- e. Protect non-masonry materials and severely deteriorated masonry by approved methods prior to initiation of cleaning operations.
- f. Remove all organic and inorganic contaminants from the surface and pores of the substrate, without causing any short or long-term negative consequences.
- g. Clean surfaces evenly with no evidence of streaking or bleaching.
- h. Do not affect the density, porosity, or color of the existing masonry or mortar.
- i. Maintain a neutral pH on surface of cleaned masonry units.
- j. Use the gentlest methods possible for cleaning historic masonry to achieve the desired results.
- k. Proceed with cleaning in an orderly manner, working from top to bottom of each scaffold width and from one end of each elevation to the other.
- l. Perform cleaning in a manner which results in uniform coverage of all surfaces, including corners, moldings, interstices and which produces an even effect without streaking or damage to masonry.
- m. Use the following sequence of methods to determine the least aggressive, effective cleaning method:
 - (1) Water with non-metallic brushes (cold water).
 - (2) Water with mild soap
 - (3) Water with stronger soap
 - (4) Water with stronger soap plus ammonia
 - (5) Water with stronger soap plus vinegar (but not on calcareous masonry)
 - (6) Stronger chemical cleaners, only when above methods are determined to be ineffective by the Contracting Officer

3.3.2 Chemical Cleaners

- a. Do not use chemical cleaners without approval from the Contracting Officer.
- b. Do not use acidic chemical cleaners on limestone, marble, concrete and other calcareous (calcium containing) masonry materials. If chemical cleaners are used on such materials, use alkaline based cleaners with neutralizing afterwashes.

3.3.3 Paint Removal

- a. Prior to removal, test existing paint for lead in accordance with Section 02 83 00 LEAD REMEDIATION.
- b. Clean areas where paint is to be removed with water and detergent solution to remove surface dirt. Rinse and allow to dry.
- c. Remove paint and other coatings from masonry surfaces in areas

indicated prior to general cleaning.

- d. Do not damage or mar masonry in the process of paint removal.
- e. Apply chemical paint removers in accordance with manufacturer's instructions.
- f. Protect surrounding painted surfaces from exposure to chemical paint removers to avoid damage.
- g. Remove paint containing lead in accordance with Section 02 83 00 LEAD REMEDIATION.

3.3.4 Water Cleaning

3.3.4.1 Pressure Spraying

- a. Spray apply water to masonry surfaces to comply with requirements indicated by test patches for location, purpose, water temperature, pressure, volume, and equipment.
- b. Unless otherwise indicated, wash the surface with clean, low pressure water (pressure of less than 55 psi and 2.5 to 3 gpm discharge) and hold spray nozzle not less than 12 inches from surface of masonry.
- c. Apply water side to side and top to bottom in overlapping bands to produce uniform coverage.

3.3.4.2 Hand Scrubbing

- a. Scrub surfaces to be cleaned to remove surface contaminants.
- b. Pre-wet surfaces and use hand-held natural bristle or nylon brushes.
- c. Do not use wire brushes.

3.3.4.3 Rinsing

- a. Rinse scrubbed surfaces clean of all contaminants and cleaning solutions with water in a low-to-moderate pressure spray, working from top to bottom of each treated area.
- b. Remove all traces of contaminants and cleaning solutions.

3.3.5 Chemical Cleaning

3.3.5.1 General

- a. Chemical cleaning is the use of any product in addition to water, including detergents, ammonia, vinegar, and bleach.
- b. Use gentlest means possible to achieve the desired result as determined by test patches.
- c. Proceed in an orderly manner, working from top to bottom of each scaffold width and from one end of each elevation to the other.
- d. Provide uniform coverage of all surfaces, including corners, moldings, interstices and produce an even effect without streaking or damage to

masonry.

- e. Do not apply chemical cleaners to the same masonry surfaces more than twice.

3.3.5.2 Surface Prewetting

- a. Wet masonry surfaces to be cleaned with chemical cleaners with water using a low pressure spray before application of any cleaner.
- b. Prewet walls working from top to bottom, except work bottom to top on one-story walls.
- c. Do not prewet masonry surface prior to applying biocides.

3.3.5.3 Acidic Chemical Cleaning

- a. Apply acidic chemical cleaners according to manufacturer's instructions.
- b. Do not apply acidic chemical cleaners to masonry with high calcium content (e.g. marble, limestone).
- c. Apply acidic cleaners to masonry surfaces by low pressure spray 50 psi max., roller, or brush.
- d. Leave cleaner on on masonry surface for the time period recommended by the manufacturer.
- e. Employ manual scrubbing by brushes as indicated by test patches for the specific location.
- f. Rinse cleaned surfaces with a low-to-moderate pressure spray of water to remove all traces of chemical cleaner.

3.3.5.4 Alkaline Chemical Cleaning

3.3.5.4.1 Prewash Phase

- a. Apply alkaline chemical cleaners to masonry surfaces according to manufacturer's instructions, by low pressure spray 50 psi max., roller, or brush.
- b. Leave cleaner on masonry surface for the time period recommended by the manufacturer.
- c. Employ manual scrubbing by brushes as indicated by test patches for the specific location.
- d. Rinse cleaned surfaces with a low-to-moderate pressure spray of water.

3.3.5.4.2 Afterwash Phase

- a. Immediately after rinsing of alkaline cleaned surfaces, apply a neutralizing afterwash to the cleaned masonry areas.
- b. Apply neutralizing afterwash according to manufacturer's instructions, by low pressure spray 50 psi max., roller, or brush.
- c. Leave afterwash on masonry surface for the time period recommended by

manufacturer.

- d. Rinse cleaned surfaces with a low-to-moderate pressure spray of water to remove all traces of chemical cleaners.

3.3.5.5 Rinsing and pH Testing

- a. Determine the pH of masonry surfaces that have been chemically cleaned using pH monitoring pencils or papers.
- b. Rinse chemically cleaned masonry, using a low pressure spray, until a neutral pH (7) reading is obtained from the masonry unit surface.

3.4 MASONRY REPAIR

3.4.1 General

- a. Match repaired surfaces with adjacent existing surfaces in all respects.
- b. Demonstrate the materials, methods and equipment proposed for use in the repair work in mock-ups, as specified in PART 2.
- c. Use products in accordance with the manufacturer's instructions.
- d. Proceed with masonry repair only after the cause of deterioration has been corrected.
- e. Assist Historic Masonry Consultant with performing field investigation to determine the causes and extent of degradation. Utilize the following techniques.
 - (1) Employ a field microscope to closely assess the conditions at the surface of the mortar and masonry units. Detect cracks and assess for degradation and debonding from the surrounding masonry. Detect previous surface coating treatments on the mortar and masonry that may be contributing to the current conditions.
 - (2) Employ a boroscope to examine mortar deeper in the joint. Compare the bedding mortar with the pointing mortar and ascertain the cross-sectional characteristics of the wall.
 - (3) Employ moisture meters to determine the level of moisture in the mortar and masonry, and if the mortar or masonry units are handling the brunt of the water movement through the wall. Infrared thermography, employed by a trained investigator, can provide additional information on the moisture conditions.
 - (4) Employ RILEM tubes using the method of RILEM II.4 or water penetration testing in accordance with [ASTM C1601](#) to determine the rate of water uptake into the masonry.
 - (5) To access the physical characteristics of hard mortar, use a spring loaded or pendulum impact device to determine surface hardness as an indicator of relative compressive strength. For evaluating softer mortars, mortar integrity deeper in the wall, and the condition of the masonry units, use a drill resistance tool by an experienced consultant.
 - (6) Utilize technologies such as ground penetrating radar or metal

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detection equipment to map metal reinforcement and embedments in the wall.

- (7) Use flat jack or jacks and rams to gather information on in situ compressive stress (ASTM C1196, masonry compressive response ASTM C1197, and mortar joint shear strength ASTM C1531).

3.4.2 Repointing Masonry

Repoint masonry in accordance with NPS TPS Brief 2, using ASTM E2260 as a reference guide.

3.4.2.1 Wall Preparation

- a. Remove old caulking, grout, or non-original mortar from previously repaired joints to a minimum depth of 2.5 times the width of the joint. Cut all joints (unless otherwise noted) back to sound, solid, back up material. Leave a clean, square face at the back of the joint to provide for maximum contact of repointing mortar.
- b. Shallow or feather edging is not permitted. Remove loose particles from joints. Clean joints, followed by blowing with filtered, dry, compressed air or vacuum.
- c. Cut out existing horizontal mortar joints (bed joints) that are filled with a hard Portland mortar using a diamond blade that is narrower than the joint width. Cut out the middle one-third of the mortar joint using a rotary power saw. Remove the remaining mortar from the masonry joints by hand using masonry chisels or pneumatic carving tools.
- d. Do not use rotary power saws to cut out vertical joints (head joints). Remove all vertical head joints by hand using a pneumatic carving tool, or hammer and chisel.
- e. Remove existing historic lime-based mortar using only small-headed chisels that are no wider than half the width of the existing masonry joints. Pneumatic air carving chisels are permitted as are specially designed mortar removal reciprocating tools (i.e. Arbortech Saw).
- f. Do not widen the existing masonry joints. Do not chip or spall the surrounding masonry edges in the process of mortar removal. Damage to surrounding masonry units resulting from rotary blade over running is not permitted. Damages to adjacent materials exceeding 1/8 inch in size are the responsibility of the contractor and must be repaired by removal and replacement of damaged materials.
- g. Permit applicators to be trained at the project site in this masonry treatment requirement.

3.4.2.2 Presoaking Masonry / Mortar Consistency / Lifts

- a. Use the same mortar as the repointing mortar for setting the replacement masonry.
- b. Soak exposed surfaces of historic masonry adjacent to joint with water prior to repointing.
- c. Allow time for excess water to run off and evaporate prior to repointing. Joint surfaces must be damp but free from standing water.

- d. Maintain a water sprayer on site at all times during the repointing process.
- e. The mortar material must resemble the consistency of brown sugar during installation. This drier consistency enables the material to be tightly packed into the joint, allows for cleaner work, and prevents shrinkage cracks as the mortar cures.
- f. Allow mixed repointing mortar to stand for not less than one-half hour and not more than one and one-half hours for pre-hydration to reduce post-curing shrinkage. After this time, water can be added to small batches by hand to bring the mortar to a stiff yet workable consistency. Use repointing mortar within two and one-half hours after initial mixing and within one hour after adding water to bring the mortar to a working consistency. Retempering of the mortar to replace evaporated water is permitted within these time frames.
- g. Point joints in layers or "lifts" where the joints are deeper than 1-1/4 inch. Apply in layers not less than 1/2 the depth but not more than 1-1/4 inch or until a uniform depth is formed.

3.4.2.3 Compression / Joint Finish / Curing

- a. Compress each layer thoroughly.
- b. When mortar is thumbprint hard at the surface of the wall, finish the joints to match the original historic joint profile.
- c. For Type L mortar:
 - (1) Allow water evaporation from the freshly repointed walls in order to initiate the carbonation process in high lime content mortars. The carbonation of lime mortar initially requires wet-and-dry cycles, which can be created by water misting the joints after the mortar application when dry weather conditions prevail. Finish the joint profile before these cycles are started.
 - (2) Depending on the environmental conditions (temperature and humidity), carry out water misting until a full nine alternating wet-and-dry cycles are completed.
 - (3) Adjust curing methods to ensure that the repointing mortar is damp without eroding the surface of the mortar.

3.4.2.4 Protection

- a. Keep the mortar from drying out too quickly or from becoming too wet.
- b. Protect mortar from direct sun and high winds for the first 72 hours after installation or from driving rain for the first 24 hours, using plastic sheeting if necessary. Do not create a greenhouse effect by sealing off air movement in an attempt to protect the wall with plastic. Allow for air circulation to facilitate the carbonation process.

3.4.3 Retooling Stone Masonry In situ

- a. Scale off all loose pieces of original stone from masonry intended to

remain in place, including surface material in powder or granular form and detachments of planer elements, spalls and chips.

- b. Assess all stone on building by sounding (tapping with a small hammer) or by using impact echo (for massive stones), surface penetrating radar, or infrared thermography in order to distinguish fully intact stone from those in which delamination may be hidden or pieces of unstable material may not be immediately visible.
- c. Remove and replace stone units that are designated for retooling in situ, but develop a solid stone substrate that is no longer in plane or plumb with the surrounding stone masonry surfaces after chiseling is complete.

3.4.4 Masonry Removal and Replacement

- a. Before removing any deteriorated masonry units, establish bonding patterns, levels and coursings. Remove masonry that has deteriorated or is damaged beyond repair, as determined through investigation and evaluation. Carefully demolish or remove entire units from joint to joint, without damaging surrounding units in a manner that permits replacement with full-size units. Support and protect remaining masonry work that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Notify Contracting Officer of unforeseen detrimental conditions including voids, cracks, bulges, and loose masonry units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items. Remove as many whole masonry units as possible without damage.
- b. Remove mortar, loose particles, and soil from masonry by cleaning with hand chisels, non-metallic brushes, and water.
- c. Remove sealants by cutting close to masonry units with utility knife and cleaning with solvents. Clean surrounding masonry areas by removing mortar, dust, and loose particles in preparation for replacement.
- d. Replace removed masonry with masonry units removed from inconspicuous areas of the building, where possible, or with new masonry units matching the existing units. Butter vertical joints for full width before setting and set units in full bed of mortar, unless otherwise indicated. Remove mortar used for laying/setting masonry units before mortar sets to the repointing depth of the surrounding area. Repoint new mortar joints in repaired area to comply with requirements for repointing at existing masonry units.
- e. If a few isolated masonry units are to be replaced, remove each without disturbing the surrounding masonry. Remove deteriorated masonry units and mortar requiring replacement by hand chiseling. Do not damage adjoining masonry units during the removal of deteriorated units and mortar.
- f. Test the new element for fitting into its space without mortar. Use wedges made from non-expanding, non-corrosive material such as plastic to support and align the new unit, cover them with at least 1-1/2 inches of mortar when pointing is complete.
- g. Cover the four sides of the space with sufficient mortar to ensure that

there will be no air spaces when the new unit is set. Fill the back of the space with mortar only if it matches existing construction.

- h. Line up and set the new unit by tapping it into place with a wooden or rubber mallet. Align the face of new unit with that of existing masonry.
- i. Repoint joints to match the rest of the wall after new units have been properly installed and adjusted.
- j. Clean replacement areas with a non-metallic brush and water to remove excess mortar.

3.4.5 Material Repair

Repair or replace original historic masonry materials only if surfaces are extensively deteriorated (surface missing to a depth of 4 inches or more) or are threatening the safety of the structure or individuals. If additional damage is found, notify the Contracting Officer. Repairs and replacements must match the materials, colors, and finish of the existing historic masonry as closely as possible.

3.4.5.1 Selective Demolition

- a. Remove unsound, weak, or damaged masonry and mortar in areas as indicated.
- b. Remove loose particles, laitance, spalling, cracked, or debonded masonry and mortar and foreign materials with hand tools unless otherwise noted.
- c. Clean surfaces prepared for repair free of dust, dirt, masonry chips, oil or other contaminants, rinsed with water, and dried before repair work is begun.
- d. Protect surfaces of the structure, and surfaces adjacent to the work area from damage which may result from removal, cleaning, and repair operations.

3.4.5.2 Application of Substitute Repair Materials

- a. Place repair materials to rebuild spalled or damaged areas to match the original surface finish, level, texture, bonding patterns, color and porosity. Match the finished appearance of the substitute repair material patch with the adjacent existing surface. Apply samples to the masonry units in situ.
- b. Do not install repair material in thicknesses exceeding 2 inches. Utilize a Dutchman repair approach or replacement unit for masonry repairs in excess of 2 inches.
- c. Remove loose mortar and masonry prior to installation of the repair material. "Sound" the masonry with a hammer to verify its integrity. If necessary, cut away an additional 1/2 inch of the masonry substrate to ensure the surface to be repaired is solid and stable.
- d. Remove all deteriorated stone, mortar, sealant residue, and previous repair materials back to sound substrate using hammer and chisel or power equipment. Finish edges square to a minimum depth of 1/2 inch.

Do not feather edges. Roughen substrate surface to achieve surface roughness required by manufacturer for good bond, but do not overly damage the substrate surface.

- e. Remove sealant residue. Cut out used anchors, threaded rod anchors and/or dowels within the damaged masonry area. Any anchors that are free of rust, solidly embedded, and do not project beyond the solid masonry surface may remain.
- f. Using clean water and a non-metallic scrub brush, clean dust from surface and pores of the substrate.
- g. Pre-wet the substrate with water prior to the application of the repair material to prevent the substrate from drawing out the moisture too quickly. Re-wet the surface with water again immediately before applying the repair material. Use methods approved by the repair material manufacturer to deliver the substitute repair work as demonstrated.
- h. Follow manufacturers' instructions pertaining to the placement of materials. If the manufacturer requires that installers of a specified product be trained, provide this documentation to the Contracting Officer. Training certificates previously issued by product companies for the application of specified products cannot be substituted for the Project Training "Substitute Repair Material Certificate" on this project.
- i. Masonry and Material Repair Finishes and Color
 - (1) Match the exposed surfaces of masonry and substitute material repair finish, color, texture, and surface detail with the original surface. Mechanical finishing and texturing may be required to produce the required finish and appearance.
 - (2) Conceal bond lines between the repaired area and adjacent surfaces.
 - (3) Replicate all surface details, including tooling and machine marks.
 - (4) Use low-impact energy type equipment in finishing and texturing, which will not weaken the patch or damage the patch bond and the adjacent masonry.

3.4.5.3 Patch Anchors

- a. Provide patch anchors to ensure that the patch is tied to the existing masonry structure at a frequency of at least one patch anchor per 4 square inches of patch plan surface area; specific locations for patch anchors must be as indicated.
- b. Use small handheld, low-speed rotary masonry drills to produce holes in the existing masonry, within the limits for the patch anchor installation.
 - (1) Drill holes into the existing substrate material of the masonry using rotary (non-hammer) drills making holes with a diameter of 1/8 inch larger than the anchor diameter and a depth of 4 inches, except as otherwise indicated or directed.
 - (2) Drill holes must not penetrate completely through the masonry, and

must provide at least 1 inch of cover around the drill hole.

(3) Clean holes by water blasting to remove drill dust and other debris and then blow dry with filtered, dry, compressed air.

(4) Condition drill holes in accordance with the epoxy adhesive manufacturer's recommendations.

c. Clean anchors to remove all contaminants which may hinder epoxy bond.

d. Pressure inject adhesive into the back of the drilled holes.

(1) Fill holes without spilling excess grout when the anchors are inserted.

(2) Insert anchors immediately into the holes.

(3) Set back anchors from the exterior face at least 1 inch.

(4) Install anchors without breaking or chipping the exposed masonry surface.

(5) Use socked or screen tube anchors where voids exist in the masonry units or between the wythes.

3.4.5.4 Cleanup

a. Protect masonry surfaces from excess grout adhesive and spills.

b. Leave the surface of the masonry in a clean and uncontaminated condition.

3.4.6 Dutchman Repairs

a. Select stone for Dutchman repairs from the following three sources listed in order of priority:

(1) Stone harvested from the same elevation and stone type.

(2) Approved salvaged stone.

(3) New stone made from a similar stone type.

b. Fit the new piece into place with tolerances of no more than plus or minus 1/16-inch.

c. Provide supporting rods of stainless steel as necessary for the extent of the repair and the location.

d. Closely blend repairs in with the surrounding original materials.

3.4.7 Crack Injection with Dispersed Hydrated Lime (DHL)

3.4.7.1 General

a. Notify the Contracting Officer as to when and where the installation will occur at least 48 hours prior to start.

b. Provide samples to the Government representative from the dispenser

during the course of the injection.

- c. Apply in accordance with the manufacturer's instructions.

3.4.7.2 Application of DHL

- a. Drill $1/8$ -inch diameter, downward-sloping injection holes. For transverse cracks less than $1/8$ inch wide, drill holes through center of crack at 1 to 1.5 inches on center.
- b. Clean out drill holes and cracks with compressed air and potable water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.
- c. Inject Dispersed Hydrated Lime using hypodermic needles or pressure ports through holes sequentially, beginning at one end of area and working to opposite end. Do not exceed 10 psi injection pressure. Where possible begin at lower end of injection area and work upward. Inject Dispersed Hydrated Lime until it extrudes from adjacent holes. After Dispersed Hydrated Lime has set, remove excess material and patch injection holes and surface of cracks with appropriate surface treatment.

3.4.7.3 Tools and Equipment

Do not use tools and equipment that have not been cleaned of set dispersed hydrated lime.

3.4.8 Surface Treatments

3.4.8.1 Stucco

- a. Apply stucco on a clean surface in accordance with ASTM C926 at a thickness matching surrounding historic surfaces.
- b. Soak the substrate with water to saturated surface dry (SSD) condition prior to application of scratch-coat.
- c. Apply the scratch-coat and allow to partially-set on the wall surface.
- d. Use a scratch rake to create the keys into the scratch coat for acceptance of the finish coat.
- e. Apply the finish coat approximately 24 hours after the scratch coat application.
- f. Soak the scratch coat with water to SSD condition prior to the application of the finish coat.
- g. Apply the textured finish and profile to match the surrounding historic surfaces.

3.4.8.2 Limewashes

- a. Apply limewash using fiber brushes in three thin coats on saturated surface dry (SSD) raw masonry surfaces.
- b. Do not allow the material to dry out before it has had a chance to absorb into the masonry surfaces.

- c. Work from top to bottom of the wall working from the dry-edge.
- d. Allow six hours drying time between coats
- e. Where colors are desired, use natural earth pigments.
- f. Verify all applications, materials and colors through mock ups panels applied to the substrate prior to the start of the work.

3.4.8.3 Water Repellents Infiltration

Application of water proofing is not allowed.

Application of water repellents may be performed upon Contracting Officer approval of the recommendation and justification, by the historic masonry consultant, that no other means will control water infiltration. Apply water repellents per manufacturer's instructions.

3.4.8.4 Stone Consolidants

Use of stone consolidants requires Contracting Officer approval of the historic masonry consultants recommendation, including justifying data. Apply stone consolidants per manufacturer's instructions.

3.5 INSTALLATION OF NEW ELEMENTS

Evaluate new materials and components for both functional and aesthetic impacts on historic structures.

3.5.1 Joint Sealant and Lead Flashing

- a. Test [existing sealants for asbestos and PCBs](#) before performing demolition.
- b. Provide joint sealing as specified in Section [07 92 00 JOINT SEALANTS](#).
 - (1) Augmentation with lead flashing is allowed for upward facing joints exposed to weather.
 - (2) Install sealants and lead flashing in accordance with manufacturer's recommendations.

3.6 FINAL CLEANING

- a. No sooner than 72 hours after completion of the repair work and after joints are sealed, wash down faces and other exposed surfaces of masonry with water applied with a soft bristle brush, then rinse with clean water.
- b. Discolorations that cannot be removed by these procedures, are considered defective work.
- c. Perform cleaning work when temperature and humidity conditions allow the surfaces to dry rapidly.
- d. Protect adjacent surfaces from damage during cleaning operations.

3.7 PROTECTION OF WORK

Protect work against damage from subsequent operations.

3.8 DEFECTIVE WORK

Repair or replace defective work as directed by Contracting Officer, using approved procedures.

3.9 FINAL INSPECTION

Following completion of the work, inspect the structure for damage, staining, and other distresses. Inspect the patches for cracking, crazing, delamination, unsoundness, staining and other defects. Inspect the finish, texture, color and shade, and surface tolerances of the patches to verify that all requirements have been met. Repair surfaces exhibiting defects as directed.

- a. Following completion of the work, inspect the structure for damage, staining, and other distresses.
 - (1) Inspect patches for cracking, crazing, delamination, unsoundness, staining and other defects.
 - (2) Inspect finish, texture, color and shade, and surface tolerances of the patches to verify that all requirements have been met.
- b. Repair surfaces exhibiting defects as directed by Contracting Officer.

-- End of Section --

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DIVISION 04 - MASONRY

SECTION 04 20 00

UNIT MASONRY

11/15

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UNIT MASONRY

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2019) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A951/A951M	(2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement
ASTM A1008/A1008M	(2016) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C67/C67M	(2020) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C207	(2018) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C216	(2019) Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2019) Standard Specification for Grout for Masonry

ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C780	(2019) Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C979/C979M	(2016) Standard Specification for Pigments for Integrally Colored Concrete
ASTM C1019	(2019) Standard Test Method for Sampling and Testing Grout
ASTM C1384	(2012a) Standard Specification for Admixtures for Masonry Mortars
ASTM C1611/C1611M	(2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete
THE MASONRY SOCIETY (TMS)	
TMS MSJC	(2016) Masonry Standard Joint Committee's (MSJC) Book - Building Code Requirements and Specification for Masonry Structures, Containing TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6, and Companion Commentaries

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval.

SD-03 Product Data

Hot Weather Procedures; G

Cold Weather Procedures; G

Brick; G

Salvaged Brick; G

Weep Baffles; G

SD-04 Samples

Mortar Color (Existing and New); G

Brick Color (Existing and New); G Admixtures for Masonry Mortar; G

SD-05 Design Data

Masonry Compressive Strength; G

Bracing Calculations; GSD-06 Test Reports

Efflorescence Test

Field Testing of Mortar

Field Testing of Grout

SD-07 Certificates

Special Masonry Inspector Qualifications

Joint Reinforcement

SD-10 Operation and Maintenance Data

Take-Back Program

1.3 QUALITY ASSURANCE

1.3.1 Special Masonry Inspector Qualifications

Refer to Section 01 45 35 SPECIAL INSPECTIONS for qualifications and responsibilities of the masonry special inspector.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

- a. Pack glazed brick, glazed structural clay tile, and prefaced concrete masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.
- b. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to **TMS MSJC** for hot and cold weather masonry erection.

1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F and the wind velocity is greater than 8 mph, comply with **TMS MSJC** Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

1.5.2 Cold Weather Procedures

When ambient temperature is below 40 degrees F, comply with **TMS MSJC** Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, f'_m , is as indicated for each type of masonry.

2.1.2 Performance - Verify **Masonry Compressive Strength**

Verify specified compressive strength of masonry using the "Unit Strength Method" of **TMS MSJC**. Submit calculations and certifications of unit and mortar strength.

Verify specified compressive strength of masonry using the "Prism Test Method" of **TMS MSJC** when the "Unit Strength Method" cannot be used. Submit test results.

2.2 MANUFACTURED UNITS

2.2.1 General Requirements

Do not change the source of materials, which will affect the appearance of the finished work, after the work has started except with Contracting Officer's approval. Submit test reports from an approved independent laboratory. Certify test reports on a previously tested material as the same materials as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2.2 Brick

2.2.2.1 General

2.2.2.1.1 Sample Submittal

Submit brick samples as specified, showing the color range and texture of clay or shale brick. Limit units used on the project to those that conform to the approved sample. Submit sample of colored mortar with applicable

masonry unit and color samples of three stretcher units and one unit for each type of special shape.

2.2.2.1.2 Uniformity

Deliver clay or shale brick units factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.2.1.3 Efflorescence Test

Test clay brick that will be exposed to weathering for efflorescence in accordance with [ASTM C67/C67M](#). Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Units meeting the definition of "effloresced" are subject to rejection.

2.2.2.2 Solid Clay or Shale Brick

Provide solid clay or shale brick that conforms to [ASTM C216](#).

Provide brick with sizes to match existing construction.

2.3 EQUIPMENT

2.3.1 Vibrators

Maintain at least one spare vibrator on site at all times.

2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

2.4 MATERIALS

2.4.1 Mortar Materials

2.4.1.1 Cementitious Materials

Provide cementitious materials that conform to those permitted by [ASTM C270](#).

2.4.1.2 Hydrated Lime and Alternates

Provide lime that conforms to one of the materials permitted by [ASTM C207](#) for use in combination with portland cement, hydraulic cement, and blended hydraulic cement. Do not use lime in combination with masonry cement or mortar cement.

2.4.1.3 Colored Mortar

Use mortar pigment that conforms to [ASTM C979/C979M](#). Add pigment to mortar to produce a uniform color matching existing construction. Furnish pigments in accurately pre-measured and packaged units that can be added to a measured amount of cementitious materials or supply pigments via preblended cementitious materials or dry mortar mix.

- a. In masonry cement or mortar cement, do not exceed 5 percent of cement weight for mineral oxide pigment; do not exceed 1 percent of cement weight for carbon black pigment.

2.4.1.4 Admixtures for Masonry Mortar

In cold weather, use a non-chloride based accelerating admixture that conforms to [ASTM C1384](#), unless Type III portland cement is used in the mortar.

In showers and kitchens, use mortar that contains a water-repellent admixture that conforms to [ASTM C1384](#). Provide a water-repellent admixture, conforming to [ASTM C1384](#) and of the same brand and manufacturer as the block's integral water-repellent, in the mortar used to place concrete masonry units that have an integral water-repellent admixture.

2.4.1.5 Aggregate and Water

Provide aggregate (sand) and water that conform to materials permitted by [ASTM C270](#).

2.4.2 Grout and Ready-Mix Grout Materials

2.4.2.1 Cementitious Materials for Grout

Provide cementitious materials that conform to those permitted by [ASTM C476](#).

2.4.2.2 Admixtures for Grout

Water-reducing admixtures that conform to [ASTM C494/C494M](#) Type F or G and viscosity-modifying admixtures that conform to [ASTM C494/C494M](#) Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to [ASTM C494/C494M](#), Type C.

2.4.2.3 Aggregate and Water

Provide fine and coarse aggregates and water that conform to materials permitted by [ASTM C476](#).

2.5 MORTAR AND GROUT MIXES

2.5.1 Mortar Mix

- a. Provide mortar Type [N](#) or [O](#) unless specified otherwise herein.

2.5.2 Grout and Ready Mix Grout Mix

Use grout that conforms to [ASTM C476](#).

2.6 ACCESSORIES

2.6.1 Grout Barriers

Grout barriers for vertical cores that consist of fine mesh wire, fiberglass, or expanded metal.

2.6.2 Anchors, Ties, and Bar Positioners

2.6.2.1 General

- a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 5/8 inch mortar cover from each face of masonry.
- b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.
- c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls exposed to moist environment in conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.
- d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls exposed to moist environment in compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with ASTM A653/A653M, Coating Designation G60.
- e. Submit two anchors, ties and bar positioners of each type used, as samples.

2.6.2.2 Wall Ties for Multi-Wythe Masonry Construction

Provide rectangular-shaped wall ties, fabricated of hot-dipped galvanized W2.8 diameter steel wire. Provide rectangular wall ties no less than 4 inches wide.

Provide adjustable type wall ties, if approved for use, that consist of two essentially U-shaped elements fabricated of minimum W2.8 diameter steel wire or pintle type ties that are inserted to eyes of horizontal joint reinforcement, hot-dip galvanized. Provide adjustable ties with double pintle legs and allows a maximum offset of 1-1/4 inch between each element of the tie and maximum distance between connecting parts no more than 1/16 inch. Form the pintle and eye elements shall be formed so that both can be in the same plane. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT.

2.6.2.3 Bar Positioners

Factory-fabricate bar positioners, used to prevent displacement of reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized. Bar positioners must be suitable for intended use and be corrosion resistant steel. Bar positioners not fully contained within the wythe must be hot-dip galvanized.

2.6.3 Joint Reinforcement

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of 9 gauge. Size

joint reinforcement to provide a minimum of $5/8$ inch cover from each face. Space crosswires not more than 16 inches. Provide joint reinforcement for straight runs in flat sections not less than 10 feet long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.6.4 Through Wall Flashing and Weeps

2.6.4.1 General

Provide coated copper flashing as indicated in the drawings.

2.6.4.2 Coated-Copper Flashing

Provide 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, asphalt impregnated kraft paper or polyethylene sheets.

2.6.4.3 Weep Ventilators

Provide weep ventilators that are prefabricated from stainless steel or plastic. Provide inserts with grill or louver-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects, and with a rectangular closure strip to prevent mortar droppings from clogging the opening. Provide ventilators with compressible flanges to fit in a standard $3/8$ inch wide mortar joint and with height equal to the nominal height of the unit.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

3.2 PREPARATION

3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least $1/8$ inch. Sandblast, if

necessary, to remove laitance from pores and to expose the aggregate.

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit [bracing calculations](#), sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

3.3 ERECTION

3.3.1 General

- a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in running bond pattern [to match existing construction](#). Lay facing courses level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances is plus or minus [1/2 inch](#). Adjust each unit to its final position while mortar is still soft and has plastic consistency.
- b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.
- c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Tothing may be used only when specifically approved by the Contracting Officer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of [610 mm 2 feet](#) down on each side of the wall and hold securely in place.
- d. Ensure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Bevel mortar for veneer wythes and slope down toward the cavity side. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to [1/2 inch](#) into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.
- e. In multi-wythe construction with collar joints no more than [3/4 inch](#) wide, bring up the inner wythe not more than [16 inches](#) ahead of the outer wythe. Fill collar joints with mortar during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by back-buttering each unit as it is laid.

3.3.1.1 Jointing

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

3.3.1.1.1 Tooled Joints

Tool mortar joints in exposed exterior and interior masonry surfaces , using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint. No exterior joints are to be left un-tooled.

3.3.1.1.2 Flush Joints

Flush cut mortar joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas. Finish flush cut joints by cutting off the mortar flush with the face of the wall. Point joints in unparged masonry walls below grade tight. For architectural units, such as fluted units, completely fill both the head and bed joints and flush cut.

3.3.1.1.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of $3/8$ inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of $3/8$ inch.

3.3.1.1.4 Joint Widths

- a. Construct brick masonry with mortar joint widths equal to the difference between the specified and nominal dimensions of the unit, within tolerances permitted by TMS MSJC.
- b. Provide $3/8$ inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.
- c. Provide $3/8$ inch wide mortar joints on unfaced side of prefaced concrete masonry units and not less than $3/16$ inch nor more than $1/4$ inch wide on prefaced side.
- d. Maintain mortar joint widths within tolerances permitted by TMS MSJC

3.3.1.2 Cutting and Fitting

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

- a. Carefully make openings in the masonry so that wall plates, cover plates or escutcheons required by the installation will completely

conceal the openings and will have bottoms parallel with the masonry bed joints. Provide reinforced masonry lintels above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

- b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls, corners, and other openings.

3.3.1.3 Unfinished Work

Rack back unfinished work for joining with new work. Tothing may be resorted to only when specifically approved by the Contracting Officer. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.3.2 Clay or Shale Brick Masonry

3.3.2.1 Brick Placement

Blend all brick at the jobsite from several cubes to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable. Lay brick facing with the better face exposed. Lay brick in running bond with each course bonded at corners, unless otherwise indicated. Lay molded brick with the frog side down. Do not lay brick that is cored, recessed, or has other deformations in a manner that allows those deformations to be exposed to view; lay 100 percent solid units in these areas. Completely fill head and bed joints of solid units with mortar. Lay hollow units with mortar joints as specified for concrete masonry units.

Place exterior face of salvaged bricks towards the exterior.

3.3.2.2 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C67/C67M. Ensure that each unit is nearly saturated when wetted but surface dry when laid.

Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.3.2.3 Brick Sills

Lay brick on edge, slope not less than 3/4 inch downward to the outside, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

3.4 INSTALLATION

3.4.1 Placing Grout

3.4.1.1 General

Fill cells containing reinforcing bars with grout. Solidly grout hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

3.4.1.2 Vertical Grout Barriers for Multi-Wythe Composite Walls

In multi-wythe composite walls, provide grout barriers in the collar joint not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.4.1.3 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

3.4.1.4 Grout Holes and Cleanouts

3.4.1.4.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of hollow unit masonry is indicated. Form such openings not less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.4.1.4.2 Cleanouts for Multi-Wythe Composite Masonry Construction

Provide cleanouts for construction of walls that incorporate a grout filled cavity between solid masonry wythes, provide cleanouts at the bottom of every pour by omitting every other masonry unit from one wythe. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.1.5 Grout Placement

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

- a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 1/2 inch or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 5 feet 4 inches. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.
- b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.
- c. If the masonry has cured at least 4 hours, grout slump is maintained between 10 to 11 inches, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 12 feet 8 inches. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 5 feet 4 inches above the bottom of the lift, but do not exceed 12 feet 8 inches. If masonry has not cured at least 4 hours or grout slump is not maintained between 10 to 11 inches, place conventional grout in lifts not exceeding 5 feet 4 inches.
- d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 12 inches or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 12 inches in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation. If previous lift is not permitted to set, dip vibrator into previous lift. Do not insert vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 1-1/2 inch below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.
- e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for at least 4 hours, place SCG in lifts not exceeding 5 feet 4 inches. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.
- f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.4.2 Joint Reinforcement Installation

Install joint reinforcement at 16 inches on center unless otherwise indicated. Lap joint reinforcement not less than 6 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 5/8 inch cover to either face of the unit.

3.4.3 Bond Beams

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

3.4.4 Flashing and Weeps

- a. Install through-wall flashing at obstructions in the cavity and where indicated on Drawings. Ensure continuity of the flashing at laps and inside and outside corners by splicing in a manner approved by the flashing manufacturer. Ensure that the top edge of the flashing is sealed by turning the flashing 1/2 inch into the mortar bed joint of backup masonry. Terminate the horizontal leg of the flashing by extending the sheet metal 1/2 inch beyond the outside face of masonry and turning downward with a hemmed drip. Provide sealant below the drip edge of through-wall flashing.
- b. Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated. Provide weeps of weep ventilators. Locate weeps not more than 24 inches on centers in mortar joints of the exterior wythe directly on the horizontal leg of through-wall flashing over foundations, bond beams, and any other horizontal interruptions of the cavity. Place weep holes perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other methods may be used for providing weeps when spacing is reduced to 16 inches on center and approved by the Contracting Officer. Maintain weeps free of mortar and other obstructions.

3.5 APPLICATION

3.5.1 Insulation

Insulate cavity walls (multi-wythe noncomposite masonry walls), where shown, by installing board-type insulation on the cavity side of the inner wythe. Apply board type insulation directly to the masonry or thru-wall flashing with adhesive. Neatly fit insulation between obstructions without impaling insulation on ties or anchors. Apply insulation in parallel courses with vertical joints breaking midway over the course below and in moderate contact with adjoining units without forcing. Cut to fit neatly against adjoining surfaces.

3.5.2 Interface with Other Products

3.5.2.1 Built-In Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout, unless otherwise indicated.

3.5.2.2 Door and Window Frame Joints

On the exposed interior and exterior sides of exterior frames, rake joints between frames and abutting masonry walls to a depth of $3/8$ inch.

3.5.3 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of **TMS MSJC**, Article 3.3 F.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

3.6.1.1 Field Testing of Mortar

Perform mortar testing for each 1,000 SF of wall area. For each required mortar test, provide a minimum of three mortar samples. Perform initial mortar testing prior to construction for comparison purposes during construction.

Prepare and test mortar samples for mortar aggregate ratio in accordance with **ASTM C780** Appendix A4.

3.6.1.2 Field Testing of Grout

- a. Perform grout testing for each days placement. For each required grout property to be evaluated, provide a minimum of three specimens.
- b. Sample and test conventional and self-consolidating grout for compressive strength and temperature in accordance with **ASTM C1019**.
- c. Evaluate slump in conventional grout in accordance with **ASTM C1019**.
- d. Evaluate slump flow and visual stability index of self-consolidating grout in accordance with **ASTM C1611/C1611M**.

3.6.1.3 Clay Brick Efflorescence Test

Test clay brick that will be exposed to weathering for efflorescence in accordance with **ASTM C67/C67M**. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Units meeting the definition of "effloresced" are subject to rejection.

3.6.2 Special Inspection

Perform special inspections and testing in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

3.7 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs and splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, rake out defects in joints of masonry to be exposed or painted, fill with mortar, and tool to match existing joints. Immediately after grout work is completed, remove scum and stains that have percolated through the masonry work using a low pressure stream of water and a stiff bristled brush. Do not clean masonry surfaces, other than removing excess surface mortar, until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Do not use metal tools and metal brushes for cleaning.

3.7.1 Dry-Brushing Concrete Masonry

Dry brush exposed concrete masonry surfaces at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.7.2 Clay Brick Surfaces

Clean exposed clay brick masonry surfaces to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. Perform cleaning in accordance with the approved cleaning procedure demonstrated on the mockup.

After cleaning, examine the sample panel of similar material for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, change the method of cleaning to ensure that the masonry surfaces in the structure will not be adversely affected. Water-soak exposed masonry surfaces and then clean with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay brick manufacturer and manufacturer of the cleaning product. Apply the solution with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Use proprietary cleaning agents in conformance with the cleaning product manufacturer's printed recommendations. Remove efflorescence in conformance with the brick manufacturer's recommendations.

3.8 CLOSE-OUT TAKE-BACK PROGRAM

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial scrap and packaging to be returned to manufacturer for recycling into new product. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

3.9 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane to protect from moisture intrusion when work is not in progress. Continue covering the top of the unfinished walls until the wall is waterproofed with a complete roof or parapet system. Extend covering a minimum of 2 feet down on each side of the wall and hold securely in place. Before starting or resuming work,

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clean top surface of masonry in place of loose mortar and foreign material.

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08/16

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SECTION 07 92 00

JOINT SEALANTS
08/16

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1193	(2013) Standard Guide for Use of Joint Sealants
ASTM C1521	(2013) Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval.

SD-03 Product Data

Sealants; G

Primers; G

Bond Breakers; G

Backstops; G

SD-06 Test Reports

Field Adhesion; G

1.3 PRODUCT DATA

Include storage requirements, shelf life, curing time, instructions for mixing and application, and accessories. Provide manufacturer's Safety Data Sheets (SDS) for each solvent, primer and sealant material proposed.

1.4 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.5 DELIVERY AND STORAGE

Deliver materials to the jobsite in unopened manufacturers' sealed shipping containers, with brand name, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Handle and store materials in accordance with manufacturer's printed instructions. Prevent exposure to foreign materials or subjection to sustained temperatures exceeding 90 degrees F or lower than 0 degrees F. Keep materials and containers closed and separated from absorptive materials such as wood and insulation.

1.6 QUALITY ASSURANCE

1.6.1 Compatibility with Substrate

Verify that each sealant is compatible for use with each joint substrate in accordance with sealant manufacturer's printed recommendations for each application.

1.6.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.6.3 Mock-Up

Provide a mock-up of each type of sealant using materials, colors, and techniques approved for use on the project. Approved mock-ups may be incorporated into the Work.

1.6.4 Adhesion

Provide in accordance with ASTM C1193 or ASTM C1521.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant products that have been tested, found suitable, and documented as such by the manufacturer for the particular substrates to which they will be applied.

2.1.1 Exterior Sealants

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows. Note, color "as selected" refers to manufacturer's full range of color options:

<p>j. Joints between ends of gravel stops, fascia, copings, and adjacent walls.</p>	<p>As Selected</p>
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2.2 PRIMERS

Non-staining, quick drying type and consistency as recommended by the sealant manufacturer for the particular application. Provide primers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.3 BOND BREAKERS

Type and consistency as recommended by the sealant manufacturer to prevent adhesion of the sealant to the backing or to the bottom of the joint. Provide bond breakers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.4 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene

foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum or other types of absorptive materials as backstops.

2.4.1 Neoprene

Provide in accordance with [ASTM D1056](#), closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 for neoprene backing.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer and in accordance with environmental requirements herein. Protect adjacent aluminum and bronze surfaces from solvents. Provide solvents for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

Perform a field adhesion test in accordance with manufacturer's instructions and [ASTM C1193](#), Method A or ASTM C1521, Method A, Tail Procedure. Remove sealants that fail adhesion testing; clean substrates, reapply sealants, and re-test. Test sealants adjacent to failed sealants. Submit [field adhesion](#) test report indicating tests, locations, dates, results, and remedial actions taken.

3.2 SURFACE PREPARATION

Prepare surfaces according to manufacturer's printed installation instructions. Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would destroy or impair adhesion. Remove oil and grease with solvent; thoroughly remove solvents prior to sealant installation. Wipe surfaces dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, provide in accordance with sealant manufacturer's printed instructions for each specific surface.

3.2.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finished work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent. Remove resulting debris and solvent residue prior to sealant installation.

3.2.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity. Remove resulting debris prior to sealant installation.

3.2.4 Wood Surfaces

Ensure wood surfaces that will be in contact with sealants are free of splinters, sawdust and other loose particles.

3.2.5 Removing Existing Hazardous Sealants

For sealants applied prior to 1979, or that have been tested and found to contain polychlorinated biphenyls (PCBs), remove and dispose of these sealants in accordance with Section 02 84 33 REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBs).

3.3 SEALANT PREPARATION

Do not add liquids, solvents, or powders to sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.4 APPLICATION

3.4.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, or stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
over 1/2 inch to 1 inch	1/2 inch	5/8 inch
Over 1 inch	prohibited	

Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is prohibited at metal surfaces.

3.4.2 Unacceptable Sealant Use

Do not install sealants in lieu of other required building enclosure weatherproofing components such as flashing, drainage components, and joint closure accessories, or to close gaps between walls, floors, roofs, windows, and doors, that exceed acceptable installation tolerances. Remove sealants that have been used in an unacceptable manner and correct building enclosure deficiencies to comply with contract documents requirements.

3.4.3 Masking Tape

Place masking tape on the finished surface on one or both sides of joint cavities to protect adjacent finished surfaces from primer or sealant smears. Remove masking tape within 10 minutes of joint filling and tooling.

3.4.4 Backstops

Provide backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide joints in specified depths. Provide backstops where indicated and where backstops are not indicated but joint cavities exceed the acceptable maximum depths specified in JOINT WIDTH-TO-DEPTH RATIOS Table.

3.4.5 Primer

Clean out loose particles from joints immediately prior to application of. Apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's printed instructions. Do not apply primer to exposed finished surfaces.

3.4.6 Bond Breaker

Provide bond breakers to surfaces not intended to bond in accordance with, sealant manufacturer's printed instructions for each type of surface and sealant combination specified.

3.4.7 Sealants

Provide sealants compatible with the material(s) to which they are applied. Do not use a sealant that has exceeded its shelf life or has jelled and cannot be discharged in a continuous flow from the sealant gun. Apply sealants in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Work sealant into joints so as to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Apply sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply additional sealant, and tool smooth as specified. Apply sealer over sealants in accordance with the sealant manufacturer's printed instructions.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled and no residual tape marks remain.

3.5.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately remove fresh sealant that has been smeared on adjacent masonry, rub clean with a solvent, and remove solvent residue, in accordance with sealant manufacturer's printed instructions. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding. Remove resulting debris.
- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent moistened cloth. Remove solvent residue in accordance with solvent manufacturer's printed instructions.

-- End of Section --