

Attachment – List of Technical Specifications Submitted to the
Advisory Council on Historic Preservation for Consideration as Standard Treatments

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04510.02 Appropriate Use of Wet and Dry Abrasive Cleaning Systems

04510.03 Poulticing and Salt Removal

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Brief Overview of Federal Preservation Laws, Regulations, and Executive Orders

1.02 RELATED SECTIONS

- A. Section 01091.01 – General Building Reference Standards

1.03 DEFINITIONS

- A. Advisory Council on Historic Preservation (ACHP). An independent federal agency that promotes historic preservation nationally by providing a forum for influencing federal activities, programs, and policies that impact historic properties. The ACHP advises the President and Congress on national historic preservation policy and promotes the preservation, enhancement, and productive use of our nation's historic resources.
- B. Historic Properties. Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the National Register; such term includes artifacts, records, and remains which are related to such district, site, building, structure, or object.
- C. National Historic Landmark (NHL). Properties officially recognized by the federal government and designated by the Secretary of the Interior as being nationally significant. NHLs represent the nation's most significant historic places and possess exceptional value or quality in illustrating or interpreting the heritage of the United States in history, architecture, archaeology, engineering, and culture.
- D. National Register of Historic Places (National Register). The official federal list of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, engineering, and culture, which have local, state, or federal significance.
- E. National Trust for Historic Preservation. A federally chartered nationwide membership organization that provides a variety of preservation services.
- F. Preservation. The act or process of applying measures to sustain the existing form, integrity, and material of a building or structure and the existing form and vegetative cover of a site. Preservation may include stabilization work (as needed) and ongoing maintenance of the historic property.
- G. State Historic Preservation Officer (SHPO). Appointed by the governors of the states, the chief executives of the territories, and the mayor of the District of Columbia, to carry out the historic preservation programs of their jurisdictions. SHPOs are given responsibilities by the National Historic Preservation Act and other federal authorities, which include nominating properties to the National Register; advising and assisting federal and state agencies and local governments in historic preservation matters; and working with the

Department of the Interior, the ACHP, and others to ensure that effects on historic properties are taken into account in planning.

1.04 REFERENCES

- A. The National Park Service provides guidelines, technical briefs, and bulletins on historic preservation policy and practices, including *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*. U.S. Department of the Interior, National Park Service.
- B. U.S. General Services Administration Historic Preservation Technical Procedures
- C. The Advisory Council on Historic Preservation (ACHP) is an independent federal agency that promotes the preservation of our nation's historic resources. ACHP also provides public information on federal preservation acts and policies.
- D. The National Trust for Historic Preservation provides a variety of preservation-related services including limited grant programs, lobbying and technical assistance.

1.05 FEDERAL LAWS, REGULATIONS, AND EXECUTIVE ORDERS

- A. Antiquities Act of 1906: Earliest legislation enacted on the preservation and protection of American antiquities of historic and prehistoric remains on land owned or controlled by the federal government.
- B. National Park System Organic Act of 1916: Enacted to establish a NPS with the primary purpose to promote and regulate the use of the federal areas known as national parks, monuments, and reservations, and to conserve the scenery, the natural and historic objects, and wild life therein.
- C. Historic Sites Act of 1935:
 - 1. Establishes as national policy the preservation of historic sites, buildings, and objects of national significance for public use.
 - 2. Provides for the Secretary of the Interior, through the NPS, to keep records and lists of our most treasured historic places, which have expanded to include surveys and lists such as the Historic American Buildings Survey (HABS), the Historic American Engineering Record (HAER), the Historic American Landscapes (HAL), and the National Register. The NPS also develops standards and guidelines for historic rehabilitation projects and offers "how to" advice for hands-on preservationists.
- D. Charter of the National Trust for Historic Preservation of 1949:
 - 1. Enacted to further the policy contained in the Historic Sites Act of 1935, to facilitate public participation in the preservation of sites, buildings, and objects of national significance or interest, and provide a national trust for historic preservation.

- E. National Historic Preservation Act of 1966 (NHPA):
1. The single most important law governing federal agencies' treatment of historic properties.
 2. Encourages preservation at the state and private levels. The 1992 amendments to this act aimed to extend federal government concern to Indian tribal properties.
 3. Section 101(a) in Title I authorizes the Secretary of the Interior to establish and maintain a National Register for historically and architecturally significant buildings, structures, objects, sites, and historic districts.
 4. Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties, i.e. buildings, structures, objects, sites, or historic districts, and to provide the ACHP an opportunity to comment on the effects of the undertakings.
 5. Section 110 of the NHPA sets out the broad historic preservation responsibilities of federal agencies and is intended to ensure that historic preservation is fully integrated into the ongoing programs of all federal agencies. Section 110 expands and makes more explicit the NHPA statement of federal agency responsibility for identifying and protecting historic properties and avoiding unnecessary damage to them. It also charges each federal agency with the affirmative responsibility for considering projects and programs that further the purposes of the NHPA, and it declares that the costs of preservation activities are eligible project costs in all undertakings conducted or assisted by a federal agency.
 6. Title II established the ACHP to comment on federal actions having an effect on historic properties. The ACHP has also developed and implemented procedures (36 CFR 800) to facilitate federal agency compliance with the NHPA.
 7. Title III of the act authorizes the provision of a National Museum for the Building Arts to collect and disseminate information concerning building arts.
 8. Title IV of the 1992 amendments to the act establishes a National Center for Preservation Technology and Training to promote research and dissemination of information on historic preservation.
 9. Under the 1992 amendments to the act, Indian tribes are encouraged to preserve their cultural and historic property. A program was established whereby a tribe may assume the duties of the State Historic Preservation Officer (SHPO) and nominate traditional properties to the National Register.
- F. Section 4(f) of the Department of Transportation Act of 1966:
1. The section declares maintenance and preservation of land traversed by transportation lines a national policy goal.
 2. The section prohibits the use of a historic site for federally funded transportation programs unless (1) there is not a feasible alternative use for the site, and (2) the program includes all possible planning to minimize potential harm to the resource.

- G. National Environmental Policy Act of 1969 (NEPA):
1. The act establishes a National Environmental Policy that requires federal agencies to assess as part of their overall project planning the impact of their project on the “environment,” which includes important historic and cultural aspects of the nation’s heritage.
 2. The act directs federal agencies to consult with agencies such as the NPS and the ACHP as part of the process to assess environmental impacts of a project.
- H. Executive Order 11593, 1971
1. Established to further the purposes and policies of the NEPA through the protection and enhancement of the cultural environment.
 2. The executive order requires all federal agencies to survey properties under their jurisdiction and nominate appropriate candidates to the National Register. It also requires each agency to ensure that resources that may be eligible for inclusion in the National Register are not inadvertently damaged, destroyed, or transferred prior to such survey. When possible and economically feasible, historic properties transferred are to be used “in a manner compatible with preservation objectives.” When National Register properties will be unavoidably altered or destroyed as a result of federal action, all agencies must provide for the recordation of the property in the appropriate NPS catalog.
 3. Also requires federal agencies to institute procedures to ensure their plans and programs “contribute to the preservation and enhancement” of non-Federally owned historic properties “of . . . significance.” The act also established requirements for consultation and review of any federal actions affecting properties that might be found eligible for the National Register.
- I. Public Buildings Cooperative Use Act of 1976:
1. Encourages adaptive use of existing structures of architectural, historical, or cultural interest; encourages multiple-use facilities on the site and shared-use facilities with the host community; and authorizes an alternative to new construction for federal projects.
- J. Title 36, Part 800 of the Code of Federal Regulations (36 CFR 800) – Regulations for the Protection of Historic Properties:
1. Issued by the ACHP, these regulations establish procedures for compliance with Section 106 of the NHPA; specifically, how federal agencies should take into account the effects of their undertakings on historic properties.
 2. Pursuant to Section 106 of the NHPA, Executive Order 11593, and the President’s Memorandum of July 12, 1978, “Environmental Quality and Water Resources Management,” the ACHP has set forth regulations for their review of federal undertakings that might affect either federally owned or leased, or non-federally owned historic and cultural resources eligible for or listed in the National Register.

3. This code defines terms used in the NHPA; describes initial procedures for identifying historic properties; restates the eligibility criteria for listing in the National Register; establishes criteria for determining the effect on a property of a federal action; sets forth procedures for ACHP review of the determination of effect; and defines legal obligations for consultation, discussion of alternatives, and determination of mitigating measures.
- K. Title 36, Part 67 of the Code of Federal Regulations (36 CFR 67) and Treasury Regulation Section 1.48-12 govern the use of the Federal Rehabilitation Tax Credit Program established in 1976. The program allows up to a 20-percent tax credit for qualifying repair and restoration expenses for eligible income-producing properties.
 - L. Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) provides for funding of transportation enhancing activities including grants for restoration and preservation of historic structures and sites associated with the development of transportation in the United States.

1.06 STATE LAWS, REGULATIONS, AND EXECUTIVE ORDERS

- A. State Laws: Each state governor appoints a State Historic Preservation Officer (SHPO) pursuant to the National Historic Preservation Act of 1966. In addition to overseeing state legislated programs to protect and preserve non-federally owned historic properties, SHPOs provide consultation on the identification of historic properties, nominate properties to the National Register, and review federal, state, and local projects for potential effects on historic properties.
- B. State Antiquities Codes: An omnibus legislation providing protection for historic sites and objects. Typically established to protect relics, objects, sites, and unmarked burials discovered in archaeological explorations, state codes occasionally designate direct state control over historic properties and frequently stipulate penalties for violations.
- C. State Enabling Legislation:
 1. Enabling Legislation: Provides legal authorization for designated political subdivisions to protect historic resources, which often involves historic easements, tax abatements, and local historic districts.
 - a. Historic Easements: Legal method for preservation of private property for public use through public control over certain aspects of the property, thus protecting the character of historic places.
 - b. Historic Districts: Locally designated districts created by the state through county or local zoning ordinances that regulate exterior changes to buildings and structures in accordance with an overall comprehensive plan for maintaining the integrity of the historic district.
- D. State Historical Building Codes – Available in some states:
 1. State Historical Building Codes: Provide regulations and standards for the rehabilitation, preservation, restoration (including related reconstruction), or relocation as applicable to historical buildings, structures, and properties. These

standards and regulations are intended to facilitate preservation of original or restored elements and features, to encourage energy conservation, and to provide for compatible implementation of safety ordinances/codes such as fire, seismic forces, or other hazards.

1.07 LOCAL LAWS

A. Local Historic Regulations, Commissions, and Zoning

1. **Local Landmarks Commissions:** Locally appointed commissions that provide regulatory, project planning, and / or advisory functions in connection with their local preservation program. Commissions typically designate local landmarks and landmark districts, and require that design review procedures be integrated into local building codes. Commissions usually have a mandate to prohibit alteration, construction, reconstruction, or demolition of designated local landmarks, and are often authorized to review and approve or disapprove proposed changes to the physical environment of designated landmarks and landmark districts.
2. **Overlay Zoning:** Local governments can enact zoning ordinances for the protection of locally designated historic properties. The zoning sometimes provides an additional layer of regulations that must be adhered to over and above the standard zoning.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

PART 1 – GENERAL

1.01 SECTION INCLUDES:

- A. Definitions – Historic Preservation
- B. Standards and Guidelines for Rehabilitating Buildings.
- C. References
- D. Preservation Organizations and Abbreviations
- E. Definitions – General
- F. Industry Standards
- G. Abbreviations

1.02 RELATED SECTIONS

- A. Section 01060.01 – Preservation Laws, Regulations and Executive Orders

1.03 DEFINITIONS – HISTORIC PRESERVATION

- A. Abandonment. The relinquishment of a property and/or the discontinuance of use of a property. Abandonment may be accomplished by voluntary act or by formal procedure.
- B. Adaptive Use. The process of converting a building to a use other than that for which it was designed, e.g., a factory converted into housing, generally accomplished through varying alterations to the building.
- C. Adverse Effect. The finding of a Section 106 review in which it is determined that a proposed federal action will adversely affect historic properties. See 36 CFR 800.
- D. Building. A man-made construction created to shelter human activity, such as a house, barn, church, hotel, or similar structure. Building may refer to a historically related complex such as a courthouse and jail, or a house and barn.
- E. Character-defining Feature. A prominent or distinctive aspect, quality, or characteristic of a historic property or district that contributes significantly to its physical and historic character.
- F. Comprehensive Historic Preservation Planning. The organization into a logical sequence of preservation information pertaining to identification, evaluation, registration and treatment of historic properties, and setting priorities for accomplishing preservation activities.
- G. Conservation. Physical stabilization of building materials and finishes.

- H. Cultural Resource. See Historic Property.
- I. Demolition by Neglect. The gradual destruction of a building or structure owing to lack of maintenance. Allowing a building or structure to deteriorate to the point where it is structurally unsound, and rehabilitation is not considered economically prudent or a viable alternative in order to justify demolition of a historic property. Demolition by neglect is also an adverse effect under Section 106 of NHPA.
- J. Determination of Eligibility. A decision by the Department of the Interior that a district, site, building, structure, or object meets the criteria for evaluation although the property is not formally listed in the National Register of Historic Places.
- K. Existing Conditions. Documentation of existing conditions (conditions before the start of work) is invaluable in drafting rehabilitation plans and specifications, and in assessing the impact of changes to the property for historic preservation purposes.
- L. Ex-situ. Off-site; moved from original location.
- M. Historic Architect. A person who meets the professional qualifications standards as set forth in 36 CFR 61 for historic architecture. Minimum qualifications are a professional degree in architecture or a state license to practice architecture, and at least one year of graduate study in architectural preservation, American architectural history, preservation planning, or closely related field; or a least one year full-time professional experience in historic preservation projects.
- N. Historic Context. A unit created for planning purposes that groups information about historic properties based on a shared theme, specific time period, and geographical area.
- O. Historic Preservation. The activities of identification, evaluation, recordation, documentation, curation, acquisition, protection, management, rehabilitation, restoration, stabilization, maintenance, research, interpretation, conservation, and education and training as related to historic properties.
- P. Historic Property. A historic property is defined in the NHPA as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places, including artifacts, records, and material remains related to such a property or resource.
- Q. In-situ. In place; in original location.
- R. Integrity. The authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property's historic or prehistoric period.
- S. Inventory. A list of historic properties determined to meet specified criteria of significance.
- T. Keeper of the National Register of Historic Places (Keeper). The individual to whom the authority has been delegated to list properties and determine their eligibility for the National Register.
- U. Memorandum of Agreement (MOA). A written agreement between the SHPO and a federal agency involving a single federal undertaking; any project-specific or programmatic

memorandum of agreement signed by the SHPO that is produced when a project triggers Section 106; or any proposal for such an agreement in which the SHPO concurs in writing (see 36 CFR 800; also see Programmatic Agreement). Under the NHPA, if it is determined that a federal undertaking will have an adverse effect on a property listed or eligible for listing in the National Register of Historic Places, avoidance, minimization, or mitigation of the adverse effect must be considered before the project can go forward. Typically, the Advisory Council on Historic Preservation (ACHP) and its applicant or licensee enter into a Memorandum of Agreement (MOA) with the SHPO and other consulting parties setting forth agreed-upon mitigation measures.

- V. NPS. (National Park Service) The bureau of the Department of the Interior through which the Secretary of the Interior administers the National Historic Preservation Program.
- W. National Register Criteria. The established criteria for evaluating the eligibility of properties for inclusion in the National Register of Historic Places.
- X. No Adverse Effect. The finding of a Section 106 review that a proposed federal project will not adversely affect historic properties located within the impact area of the project. See 36 CFR 800.
- Y. No Effect on Properties. The finding of a Section 106 review that there is no effect on historic properties that are or may be located within the impact area of a proposed project. See 36 CFR 800.
- Z. Nonconforming Intrusion. Any building, structure, or addition that has a high degree of incongruity with the setting of a historic property, thus producing a negative visual effect detrimental to the cohesiveness of the property or historic district.
- AA. Preservation. The act or process of applying measures necessary to sustain the existing form, integrity, and materials of a historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project. [Protection and Stabilization have been consolidated under this treatment].
- BB. Reconstruction. The act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location.
- CC. Rehabilitation. The act or process of returning a property to a state of utility through repair or alteration that makes possible an efficient contemporary use while preserving those features of the property that are significant to its historical, architectural, and cultural values.
- DD. Rehabilitation Guide. Standards developed to assist in preservation or restoration of the historic architectural qualities of buildings, structures, and sites.

- EE. Renovation. The modernization of a historic building in which inappropriate alterations are made and important features and details are eliminated.
- FF. Research design. A statement of proposed identification, documentation, investigation, or other treatment of a historic property that identifies the project's goals, methods, and techniques, expected results, and the relationship of the expected results to other proposed activities or treatments.
- GG. Restoration. The act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period in time by means of removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project.
- HH. Significance. The meaning or value ascribed to a historic property or district based on the National Register criteria for evaluation.
- II. Site. The location of a significant event, a prehistoric or historic occupation or activity, landscape or traditional cultural property, or a building or structure, whether standing, ruined, or vanished, where the location itself maintains historical or archeological value regardless of the value of any existing structure.
- JJ. State Historic Preservation Officer (SHPO). The State Historic Preservation Officer administers the national historic preservation program at the state level, reviews National Register of Historic Places nominations, maintains data on historic properties that have been identified but not yet nominated, and consults with federal agencies during Section 106 review. The SHPO is designated by the governor of a state or territory. Federal agencies seek the views of the appropriate SHPO when identifying historic properties and assessing effects of an undertaking on historic properties.
- KK. Structure. A man-made construction built for purposes other than shelter. It can be an engineering project that is large in scale, such as a bridge or tunnel.
- LL. Stabilization. The act or process of applying measures designed to reestablish the weather-resistance of a structure and its stability while maintaining the form as it currently exists [consolidated as part of Preservation].
- MM. Surplus (Redundant) Property. Any building or site no longer needed for the use for which it was originally built.
- NN. Tribal Historic Preservation Officer (THPO). A THPO is defined as those tribes that have assumed SHPO responsibilities on their tribal lands and have been certified pursuant to Section 101(d)(2) of the NHPA.
- OO. Tribal Lands. As defined in Section 301(14) of the Act, tribal lands include: (a) all lands within the exterior boundaries of any Indian Reservation; and (b) all dependent Indian communities.
- PP. Tribal Register. A list of tribal properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization.

- QQ. **Undertaking.** A project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including: (a) those carried out by or on behalf of the agency; (b) those carried out with federal financial assistance; (c) those requiring a federal permit, license, or approval; and (d) those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency. See 36 CFR 800.

1.04 STANDARDS AND GUIDELINES FOR HISTORIC PRESERVATION

The portions of the Secretary of Interior's Standards for the Treatment of Historic Properties and Guidelines for Rehabilitating Historic Buildings are featured in this section. For the complete standards and guidelines, refer to the publication available from the NPS.

- A. **Standards for Preservation.** The Secretary of the Interior's Standards and Guidelines are the basic criteria for preservation of historic properties. Below are the eight Standards for Preservation.
1. A property will be used as it was historically, or be given a new use that maximizes the retention of distinctive materials, features, spaces, and spatial relationships. Where a treatment and use have not been identified, a property will be protected and, if necessary, stabilized until additional work may be undertaken.
 2. The historic character of a property will be retained and preserved. The replacement of intact or repairable historic materials, or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.
 3. Each property will be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate, and conserve existing historic materials and features will be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.
 4. Changes to a property that have acquired historic significance in their own right will be retained and preserved.
 5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.
 6. The existing condition of historic features will be evaluated to determine the appropriate level of intervention needed. Where the severity of deterioration requires repair or limited replacement of a distinctive feature, the new material will match the old in composition, design, color, and texture.
 7. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
 8. Archaeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.
- B. **Standards for Rehabilitation.** The Secretary of the Interior's Standards and Guidelines are the basic criteria against which restoration and rehabilitation procedures are reviewed. They also determine whether or not certification by the NPS can be granted (for those projects where certification is required). The express goal of the Standards and Guidelines

is retention of the building's existing form, features, and detailing. The Standards are to be utilized during rehabilitation/repair of historic properties. The 10 Standards for Rehabilitation are listed below (it should be noted that the online version of The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstruction Historic Buildings lists the first eight standards):

1. A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.
2. The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.
3. Each property will be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.
4. Changes to a property that have acquired historic significance in their own right will be retained and preserved.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.
6. Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.
7. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
8. Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.
9. New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.
10. New additions and adjacent or related new construction will be undertaken in a such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

- C. **Guidelines for Rehabilitating Historic Buildings.** Initially developed in 1977, these Guidelines were developed to assist property owners, developers, and federal managers to apply the Secretary of the Interior's Standards for Rehabilitation during project planning by providing general design and technical recommendations. Unlike the Standards, the Guidelines are not codified as program requirements. Together, the Standards and

Guidelines provide a model process for owners, developers, and federal agencies to follow. The Guidelines are listed below in the order in which they are to be followed:

1. **Identify, Retain, and Preserve Historic Material and Features:** Guidance for the treatment Rehabilitation begins with recommendations to identify the form and detailing of those architectural materials and features that are important in defining the building's historic character and which must be retained in order to preserve that character. Guidance on identifying, retaining, and preserving character-defining features is always given first. The character of a historic building may be defined by the form and detailing of the materials and features.
2. **Protect and Maintain Historic Materials and Features:** Protection involves the least degree of intervention possible, followed by general maintenance of historic material.
3. **Repair Historic Materials and Features:** When the physical condition of character-defining features warrants additional work, repair is recommended. Guidance for repair begins with the least degree of intervention possible. Repairing by stabilizing, consolidating, and conserving such as patching, splicing, and reinforcing materials following recognized preservation methods is recommended.
4. **Replace Deteriorated Historic Materials and Features:** When repair is inadequate, the limited replacement of extensively deteriorated or missing parts of features when surviving prototypes exist and/or replacement of an entire character-defining feature with new material due to the level of deterioration or damage of materials that precludes repair. Replacement is appropriate when the essential form and detailing are still evident so that the physical evidence can be used to re-establish the feature as an integral part of the rehabilitation project. The preferred option is always replacement of the entire feature in kind with the same material. When this approach may not be technically or economically feasible, compatible substitute materials may be considered.
5. **Design for the Replacement of Missing Historic Features:** When an entire feature (interior or exterior) is missing, it no longer plays a role in physically defining the historic character of the building unless it can be accurately recovered in form and details through the process of carefully documenting the historical appearance.
 - a. The first or preferred action is recovery of the feature. When adequate historical, pictorial, and physical documentation exists so that the feature may be accurately reproduced, and it is desirable to reestablish the feature as part of the building's historical appearance, and then design and construct a new feature based on the documentation.
 - b. The second option is to replace the feature with a new design that is compatible with the remaining character-defining features of the property. The new design should take into account the size, scale, and material of the historic building and, most importantly, should be clearly differentiated so that a false historical appearance is not created.
6. **Alterations/Additions to Historic Properties (for the New Use):** Such alterations should not radically change, obscure, or destroy character-defining spaces, materials, features, or finishes. Guidelines recommend that construction of exterior additions be avoided, if possible, and considered only after it is determined that no other viable option exists.

Additions should be designed and constructed to be clearly differentiated from the historic building so that the character-defining features are not radically changed, obscured, damaged, or destroyed.

7. Energy Efficiency, Accessibility Considerations, Health and Safety Code Considerations: This type of work is not part of the overall process of protecting or repairing character-defining features; rather such work is assessed for its potential negative impact on a building's historic character. For this reason, particular care must be taken not to radically change, obscure, damage, or destroy character-defining materials or features in the process of rehabilitation work to meet code and energy requirements. For information on rehabilitation and preservation technology, contact the appropriate preservation office of the National Park in your area.

D. Standards for Restoration.

1. A property will be used as it was historically or be given a new use which reflects the property's restoration period.
2. Materials and features from the restoration period will be retained and preserved. The removal of materials or alteration of features, spaces, and spatial relationships that characterize the period will not be undertaken.
3. Each property will be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate and conserve materials and features from the restoration period will be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.
4. Materials, features, spaces, and finishes that characterize other historical periods will be documented prior to their alteration or removal.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize the restoration period will be preserved.
6. Deteriorated features from the restoration period will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and, where possible, materials.
7. Replacement of missing features from the restoration period will be substantiated by documentary and physical evidence. A false sense of history will not be created by adding conjectural features, features from other properties, or by combining features that never existed together historically.
8. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
9. Archeological resources affected by a project will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.
10. Designs that were never executed historically will not be constructed.

1.05 PRESERVATION ORGANIZATIONS AND ABBREVIATIONS

- A. The following is a brief list of abbreviations and organizations with that are associated with historic preservation and/or provide information regarding preservation policies and practices:
1. ACHP – Advisory Council on Historic Preservation
 2. AIC – American Institute for the Conservation of Historic and Artistic Works
 3. ASLH – Association for State and Local History
 4. APT – Association for Preservation Technology
 5. FPI – Federal Preservation Institute
 6. HABS – Historic American Buildings Survey
 7. HAER – Historic American Engineering Record
 8. HALS – Historic American Landscape Survey
 9. HBIA -- Historic Building Inspectors Association
 10. NACP – National Alliance of Preservation Commissions
 11. NCPPT – National Center for Preservation Technology and Training
 12. NCSHPO – National Council of State Historic Preservation Officers
 13. NHL – National Historic Landmark
 14. NPI – National Preservation Institute
 15. NPS – National Park Service
 16. NR – National Register of Historic Places
 17. NTHP – National Trust for Historic Preservation
 18. PTN – Preservation Trades Network
 19. SHPO – State Historic Preservation Officer
 20. THPO – Tribal Historic Preservation Officer

1.06 REFERENCES

- A. *The Secretary of the Interior's Standards for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings.* (36 CFR 68) U.S. Department of the Interior. National Park Service. Washington, D.C. 1995. Available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. Preservation Briefs, National Park Service, Technical Preservation Services. Available online at <<http://www.nps.gov/history/hps/tps/briefs/presbhom.htm>>.
- C. *Maintaining Historic Buildings: An Annotated Bibliography.* Compiled by Kaye Ellen Simonson. U.S. Department of the Interior. National Park Service. Washington, D.C. 1990.
- D. Preservation Tech Notes, National Park Service, Technical Preservation Services. Available online at <<http://www.nps.gov/history/hps/tps/technotes/tnhome.htm>>.
- E. U.S. General Services Administration Historic Preservation Technical Procedures.

1.07 DEFINITIONS – GENERAL

- A. General Explanation: specification language often includes terms that are defined elsewhere in the Contract Documents, including the Construction Contract Clauses. Certain terms are defined in this section. These definitions or explanations are not necessarily complete or exclusive, but are general for the work and may be explained more explicitly in other sections.
- B. General Conditions: refer collectively to the Construction Contract Clauses, Labor Standards, and the U.S. Department of Labor Wage Decision bound into the specifications.
- C. Special Conditions: refer collectively to “Supplementary Conditions” bound into the specifications.
- D. Indicated: refers to graphic representations, notes or schedules on the Drawings, or to requirements elsewhere in the specifications or other contract documents. Terms such as “shown,” “noted,” “scheduled,” and “specified” have the same meaning as “indicated” and are used to further help locate the reference, but no limitation on location is intended except as specifically stated.
- E. Where directed, authorized, selected, approved, or a similar term is used in conjunction with the Contractor’s submittals, applications, requests and other activities, and the specifications state that an individual other than the Contracting Officer, such as the Architect or Construction Engineer, shall provide this action, it is understood that only the Contracting Officer has this authority unless the individual stated is so authorized in writing by the Contracting Officer.
 - 1. When the individual is so authorized by the Contracting Officer, the Contractor may still appeal the action to the Contracting Officer.
 - 2. The Contracting Officer’s decision will be final.
 - 3. In no case shall the Contracting Officer’s action be interpreted as releasing the Contractor from responsibility to fulfill the requirements of the contract documents.
- B. Regulations: include laws, codes, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- C. Project site: refers to the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing other work.
- D. Furnish: means to supply and deliver to the project site, ready for unloading, unpacking, assembling, installation, and similar operations.
- E. Install: describes operations at the project site, including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- F. Provide: means to furnish and install, complete in place and ready for full use.

- G. Cutting: refers to removal of material by cutting, sawing, drilling, breaking, chipping, grinding, excavating, and similar operations.
- H. Patching: refers to restoration of a surface to its original completed condition by filling, repairing, refinishing, closing, and similar operations.
- I. Installer: is the Contractor or another entity engaged by the Contractor, either directly or indirectly through subcontracting, to perform a particular construction operation at the project site, including installation, erection, application, and similar operations. Installers shall be skilled in the operations they perform. Where indicated, installers shall also be Specialists as defined in the Construction Contract Clauses.
- J. Testing agency or testing laboratory: is an independent entity engaged to perform specific inspections or tests, either at the project site or elsewhere, and to report the results of those inspections and tests.
- K. Owner: refers to the government.
- L. Building Manager: is the government employee responsible for the administration, operation and maintenance of the building.
- M. Construction Manager: is the individual or entity, under Contract to the government, responsible for performing the day-to-day coordination and administration of the construction Contract, including performing field inspections, recommending approval or rejection of material and workmanship, monitoring labor and safety provisions, maintaining inspection logs and records of defects, and similar activities.
- N. Notice to Proceed: is the Contracting Officer's notification by letter to the Contractor to proceed with the Contract, activating the time period for construction and establishing the completion date.

1.08 DRAWING SYMBOLS

- A. Except as otherwise indicated, symbols used on the drawings are those symbols recognized in the construction industry for the purposes. These include graphic symbols defined by *Architectural Graphic Standards*, published by John Wiley & Sons, Inc., ninth edition, as well as graphic symbols recommended by ASHRAE, ASME, ASPE, CSI, IEEE and similar technical organizations for mechanical and electrical drawings. Refer uncertainties as to meaning of symbols to the Contracting Officer for clarification before proceeding.

1.09 INDUSTRY STANDARDS

- A. **Applicability of Standards:** Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect, to the extent referenced, as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.
- B. **Conflicting Requirements:** Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantity or quality, comply with the most stringent requirement. Immediately refer uncertainties, and

requirements that are different but apparently equal, to the Contracting Officer in writing for a decision before proceeding.

- C. Minimum Quantity and Quality: The quantity or quality indicated shall be the minimum provided by the Contractor. The actual installation may comply exactly with the minimum quantity or quality indicated, or it may exceed the minimum levels within reasonable limits.
1. Indicated numeric values are minimum or maximum as appropriate for the context of the requirements.
 2. Refer uncertainties to the Contracting Officer for a decision before proceeding.
- D. Abbreviations: Names and titles of standards are frequently abbreviated. Abbreviations and acronyms used in the Specifications and other Contract Documents mean the recognized name of a trade association, standards-producing organization, and authority having jurisdiction or other entity applicable to the context of the particular provision. Except as otherwise indicated, refer to the current editions of the following publications for abbreviations:

Encyclopedia of Associations: National Organizations of the U.S. Gale Research.

National Trade and Professional Associations of the United States. Columbia Books.

Means Illustrated Construction Dictionary - New Unabridged Edition. R.S. Means Company, Inc.

1. AA - Aluminum Association
2. AABC - Associated Air Balance Council
3. AAMA - American Architectural Manufacturers Association
4. AAN - American Association of Nurserymen (see ANLA)
5. AASHTO - American Association of State Highway and Transportation
6. AATCC - American Association of Textile Chemists and Colorists
7. ABMA - American Bearing Manufacturers Association
8. ABMA - American Boiler Manufacturers Association
9. ACI - American Concrete Institute
10. ACIL - American Council of Independent Laboratories -
11. The Association of Independent Scientific, Engineering, and Testing Firms
12. ACPA - American Concrete Pipe Association
13. ADC - Air Diffusion Council
14. AEIC - Association of Edison Illuminating Companies
15. AFBMA - Anti-Friction Bearing Manufacturers Association (see ABMA)
16. AFPA - American Forest and Paper Association
17. AGA - American Gas Association
18. AHA - American Hardboard Association
19. AHAM - Association of Home Appliance Manufacturers
20. AI - Asphalt Institute
21. AIA - The American Institute of Architects

22. AIA - American Insurance Association
23. AIHA - American Industrial Hygiene Association
24. AISC - American Institute of Steel Construction
25. AISI - American Iron and Steel Institute
26. AITC - American Institute of Timber Construction
27. ALA - American Laminators Association (see LMA)
28. ALCA - Associated Landscape Contractors of America
29. ALI - Associated Laboratories, Inc.
30. ALSC - American Lumber Standards Committee
31. AMCA - Air Movement and Control Association International, Inc.
32. ANLA - American Nursery and Landscape Association
33. ANSI - American National Standards Institute
34. AOAC - Association of Official Analytical Chemists International
35. AOSA - Association of Official Seed Analysts
36. APA - American Plywood Association (see EWA)
37. APA - Architectural Precast Association
38. API - American Petroleum Institute
39. ARI - Air-Conditioning and Refrigeration Institute
40. ARMA - Asphalt Roofing Manufacturers Association
41. ASA - Acoustical Society of America
42. ASC - Adhesive and Sealant Council
43. ASCA - Architectural Spray Coaters Association
44. ASCE - American Society of Civil Engineers
45. ASHES - American Society for Healthcare Environmental Services - Division of the American Hospital Association
46. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
47. ASLA - American Society of Landscape Architects
48. ASME - American Society of Mechanical Engineers
49. ASPA - American Sod Producers Association (see TPI)
50. ASPE - American Society of Plumbing Engineers
51. ASQ - American Society for Quality
52. ASSE - American Society of Sanitary Engineering
53. ASTM - American Society for Testing and Materials
54. ATIS - Alliance for Telecommunications Industry Solutions
55. AWCI - Association of the Wall and Ceiling Industries International
56. AWCMA - American Window Covering Manufacturers Association (see WCMA)
57. AWI - Architectural Woodwork Institute
58. AWPA - American Wood-Preservers' Association
59. AWS - American Welding Society
60. AWWA - American Water Works Association
61. BAC - Brick Association of the Carolinas
62. BHMA - Builders Hardware Manufacturers Association
63. BIA - Brick Industry Association

64. BIFMA - The Business and Institutional Furniture Manufacturer's Association International
65. CABO - Council of American Building Officials
66. CAGI - Compressed Air and Gas Institute
67. CAUS - Color Association of the United States
68. CBHF - State of California, Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation Technical Information
69. CBMA - Certified Ballast Manufacturers Association
70. CCC - Carpet Cushion Council
71. CDA - Copper Development Association, Inc.
72. CE - Corps of Engineers (U.S. Department of the Army)
73. CFFA - Chemical Fabrics & Film Association, Inc.
74. CFR - Code of Federal Regulations (Publications available from the Government Printing Office)
75. CGA - Compressed Gas Association
76. CGSB - Canadian General Standards Board
77. CISCA - Ceilings and Interior Systems Construction Association
78. CISPI - Cast Iron Soil Pipe Institute
79. CLFMI - Chain Link Fence Manufacturers Institute
80. CPA - Composite Panel Association
81. CPPA - Corrugated Polyethylene Pipe Association
82. CPSC - Consumer Product Safety Commission
83. CRI - Carpet and Rug Institute
84. CRSI - Concrete Reinforcing Steel Institute
85. CS - Commercial Standard (U.S. Department of Commerce)
86. CSI - Construction Specifications Institute
87. CSSB - Cedar Shake and Shingle Bureau
88. CTI - Ceramic Tile Institute of America
89. CTI - Cooling Tower Institute
90. DASMA - Door and Access Systems Manufacturers Association, International
91. DHI - Door and Hardware Institute
92. DIPRA - Ductile Iron Pipe Research Association
93. DOC - Department of Commerce (Publications available from the Government Printing Office)
94. DOT - Department of Transportation
95. ECSA - Exchange Carriers Standards Association (see ATIS)
96. EIA - Electronic Industries Association
97. EIMA - EIFS Industry Members Association
98. EJMA - Expansion Joint Manufacturers Association
99. EPA - Environmental Protection Agency
100. ETL - ETL Testing Laboratories Inc. (see ITS)
101. EWA - Engineered Wood Association
102. FAA - Federal Aviation Administration
103. FCC - Federal Communications Commission

104. FCI - Fluid Controls Institute
105. FCICA - Floor Covering Installation Contractors Association
106. FDA - Federal Drug Administration
107. FGMA - Flat Glass Marketing Association (see GANA)
108. FHA - Federal Housing Administration (U.S. Department of Housing and Urban Development)
109. FM - Factory Mutual System
110. FS - Federal Specification (publications available from GSA)
111. GA - Gypsum Association
112. GANA - Glass Association of North America
113. GRI - Geosynthetic Research Institute
114. GSA - General Services Administration
115. HEI - Heat Exchange Institute
116. HFES - Human Factors and Ergonomics Society
117. HI - Hydraulic Institute
118. HI - Hydronics Institute - Division of Gas Appliance Manufacturers Association
119. HMA - Hardwood Manufacturers Association
120. HPVA - Hardwood Plywood and Veneer Association
121. IAS - International Approval Services - Division of Canadian Standards Association
122. IBD - Institute of Business Designers (see IIDA)
123. ICEA - Insulated Cable Engineers Association
124. IEC - International Electrotechnical Commission (publications available from ANSI)
125. IEEE - Institute of Electrical and Electronics Engineers
126. IESNA - Illuminating Engineering Society of North America
127. IGCC - Insulating Glass Certification Council
128. IIDA - International Interior Design Association
129. ILI - Indiana Limestone Institute of America
130. IMSA - International Municipal Signal Association
131. INCE - Institute of Noise Control Engineering
132. IRI - HSB Industrial Risk Insurers
133. ISA - International Society for Measurement and Control
134. ISEA - Industrial Safety Equipment Association
135. ISS - Iron and Steel Society
136. ITS - Intertek Testing Services
137. KCMA - Kitchen Cabinet Manufacturers Association
138. LGSi - Light Gage Structural Institute
139. LIA - Lead Industries Association, Inc.
140. LMA - Laminating Materials Association
141. LPI - Lightning Protection Institute
142. MBMA - Metal Building Manufacturers Association
143. MCAA - Mechanical Contractors Association of America
144. MFMA - Maple Flooring Manufacturers Association

145. MFMA - Metal Framing Manufacturers Association
146. MHIA - Material Handling Industry Association
147. MIA - Marble Institute of America
148. MIA - Masonry Institute of America
149. MIL - Military Standardization Documents (U.S. Department of Defense)
150. ML/SFA - Metal Lath/Steel Framing Association
151. MRCA - Midwest Roofing Contractors Association
152. MS – Military Standardized Documents
153. MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
154. NAA - National Arborist Association
155. NAAMM - National Association of Architectural Metal Manufacturers
156. NAAMM - North American Association of Mirror Manufacturers (see GANA)
157. NACE - National Association of Corrosion Engineers International
158. NAGDM - National Association of Garage Door Manufacturers (see DASMA)
159. NAIMA - North American Insulation Manufacturers Association
160. NAMI - National Accreditation & Management Institute, Inc.
161. NAPA - National Asphalt Pavement Association
162. NBHA - National Builders Hardware Association (see DHI)
163. NBGQA - National Building Granite Quarries Association, Inc.
164. NCAC - National Council of Acoustical Consultants
165. NCCA - National Coil Coaters Association
166. NCMA - National Concrete Masonry Association
167. NCPI - National Clay Pipe Institute
168. NCRPM - National Council on Radiation Protection and Measurements
169. NCSPA - National Corrugated Steel Pipe Association
170. NEBB - Natural Environmental Balancing Bureau
171. NECA - National Electrical Contractors Association
172. NEI - National Elevator Industry
173. NELMA - Northeastern Lumber Manufacturers Association
174. NEMA - National Electrical Manufacturers Association
175. NETA - InterNational Electrical Testing Association
176. NFPA - National Fire Protection Association
177. NFPA - National Forest Products Association (see AFPA)
178. NFRC - National Fenestration Rating Council Incorporated
179. NGA - National Glass Association
180. NHLA - National Hardwood Lumber Association
181. NIA - National Insulation Association
182. NIAC - National Insulation and Abatement Contractors Association (see NIA)
183. NIST - National Institute of Standards and Technology (U.S. Department of Commerce)
184. NKCA - National Kitchen Cabinet Association (see KCMA)
185. NLGA - National Lumber Grades Authority
186. NOFMA - National Oak Flooring Manufacturers Association
187. NPA - National Parking Association

188. NPCA - National Paint and Coatings Association
189. NRCA - National Roofing Contractors Association
190. NRMCA - National Ready Mixed Concrete Association
191. NSA - National Stone Association
192. NSF - National Sanitation Foundation International
193. NSSEA - National School Supply and Equipment Association
194. NTMA - National Terrazzo and Mosaic Association
195. NUSIG - National Uniform Seismic Installation Guidelines
196. NWMA - National Woodwork Manufacturers Association (see NWWDA)
197. NWWDA - National Wood Window and Door Association
198. OSHA - Occupational Safety and Health Administration (U.S. Department of Labor)
199. PATMI - Powder Actuated Tool Manufacturers' Institute
200. PCA - Portland Cement Association
201. PCI - Precast/Prestressed Concrete Institute
202. PDCA - Painting and Decorating Contractors of America
203. PDI - Plumbing and Drainage Institute
204. PEI - Porcelain Enamel Institute
205. PGI - Polyvinylchloride Geomembrane Institute - Technology Program, University of Illinois-Urbana Champaign
206. PIMA - Photographic and Imaging Manufacturers Association
207. PPFA - Plastic Pipe and Fittings Association
208. PPI - Plastics Pipe Institute (The Society of the Plastics Industry, Inc.)
209. PS - Product Standards of the National Bureau of Standards (U.S. Department of Commerce)
210. RCMA - Roof Coatings Manufacturers Association Center Park
211. RCSC - Research Council on Structural Connections
212. Sargent & Lundy
213. RFCI - Resilient Floor Covering Institute
214. RMA - Rubber Manufacturers Association
215. RUS - Rural Utilities Service
216. SAE - Society of Automotive Engineers International
217. SDI - Steel Deck Institute
218. SDI - Steel Door Institute
219. SEFA - Scientific Equipment and Furniture Association
220. SEGD - Society for Environmental Graphic Design
221. SGCC - Safety Glazing Certification Council
222. SHLMA - Southern Hardwood Lumber Manufacturers Association (see HMA)
223. SIGMA - Sealed Insulating Glass Manufacturers Association
224. SJI - Steel Joist Institute
225. SMA - Screen Manufacturers Association
226. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association
227. SPI - The Society of the Plastics Industry, Inc.
228. SPIB - Southern Pine Inspection Bureau

- 229. SPRI - Single Ply Roofing Institute
- 230. SSINA - Specialty Steel Industry of North America
- 231. SSPC - Steel Structures Painting Council - The Society for Protective Coatings
- 232. SSPMA - Sump and Sewage Pump Manufacturers Association
- 233. STI - Steel Tank Institute
- 234. SWI - Steel Window Institute
- 235. SWPA - Submersible Wastewater Pump Association
- 236. SWRI - Sealant, Waterproofing and Restoration Institute
- 237. TCA - Tile Council of America
- 238. TFS - Texas Forest Service
- 239. TIMA - Thermal Insulation Manufacturers Association (see NAIMA)
- 240. TPI - Truss Plate Institute
- 241. TPI - Turfgrass Producers International
- 242. TRB - Transportation Research Board - National Research Council
- 243. UFAC - Upholstered Furniture Action Council
- 244. UL - Underwriters Laboratories, Inc.
- 245. UNI - Uni-Bell PVC Pipe Association
- 246. USDA - U.S. Department of Agriculture
- 247. USITT - U.S. Institute of Theater Technology - The American Association of Design and Production Professionals in the Performing Arts
- 248. USP - U.S. Pharmacopeia
- 249. USPS - U.S. Postal Service
- 250. WA - Wallcoverings Association
- 251. WASTEC - Waste Equipment Technology Association
- 252. WCLIB - West Coast Lumber Inspection Bureau
- 253. WCMA - Window Covering Manufacturers Association
- 254. WEF - Water Environment Federation
- 255. WIC - Woodwork Institute of California
- 256. WMMPA - Wood Moulding & Millwork Producers Association
- 257. WPCF - Water Pollution Control Federation (see WEF)
- 258. WRI - Wire Reinforcement Institute
- 259. WSC - Water Systems Council
- 260. WSFI - Wood and Synthetic Flooring Institute (see MFMA)
- 261. WWPA - Western Wood Products Association

E. PRODUCTS (Not applicable)

F. EXECUTION (Not applicable)

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Removal of mortar joints
- B. Repointing

1.03 RELATED SECTIONS

- A. Section – 04100.02 Preparation of Lime and Cement-Amended Mortars
- B. Section – 04211 Historic Brick
- C. Section – 04214 Terra Cotta and Ceramics
- D. Section – 04500 Masonry Restoration
- E. Section – 04720 Historic Cast Stone

1.04 REFERENCES

- A. Repointing shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*, available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. Techniques employed for repointing shall be as outlined in *Preservation Brief No. 2: Repointing Masonry Joints in Historic Masonry Buildings*, available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief02.htm>>.

- C. U.S. General Services Administration Historic Preservation Technical Procedures for mortar, available online at
<http://www.gsa.gov/gsa/cm_attachments/GSA_DOCUMENT/Preservation_Note_01_R2RQ4-y_0Z5RDZ-i34K-pR.doc>;
<<http://w3.gsa.gov/web/p/hhttp.nsf/a533f1f859737bc9852565cc0058d0b6/7de342045d4c63f6852565c50054b3a7?OpenDocument>>; and
<<http://w3.gsa.gov/web/p/hhttp.nsf/a533f1f859737bc9852565cc0058d0b6/e7518da3d776f026852565c50054b3c5?OpenDocument>>.
- D. Masonry restoration work shall comply with ACI / ASCE 530.1-88. Contractor shall maintain at least one copy of ACI / ASCE 530.1-88 on site.

1.05 SUBMITTALS

The Contractor will submit a detailed schedule of the areas to be repointed, including an assessment of the problem areas and a detailed procedure for repointing, to the Architect for approval.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of five (5) years experience in the repointing of historic masonry. He/she shall demonstrate a working knowledge of the Secretary of the Interior's Standards for Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings.
- B. Mortar removal will be undertaken by an experienced mason. The mason operating power or mechanical tools shall have demonstrated proficiency with the tools prior to approved use by the Architect. The Mason/operator using the equipment must have a minimum of five (5) years experience and demonstrated expertise in their proper use on historic structures.

1.07 MOCK-UPS

- A. The Contractor shall prepare mock-up installations prepared with each of the removal methods and tools that will be used for this Work at locations selected by the Architect. Test panels should not be undertaken in areas that are highly visible. Use of power and mechanical tools shall be approved by the Architect.
- B. The Contractor shall prepare two mock-up installations of each type of masonry joint style and mortar color to be installed at locations selected by the Architect. If cleaning tests are also to take place, test panels should be placed in the same area. Test panels should not be undertaken in areas that are highly visible. Each test panel shall be executed in the same manner as the final installation. Mock-ups will be reviewed after the mortar removal and again after completion of repointing. Test panels shall be a minimum area 3x3 feet for brick facades, and larger for stone facades. Test panels will be inspected for color, texture, and installation technique.
- C. The Contractor shall prepare up to three additional mock-ups of each mortar, joint type, and mortar color without further compensation. Approved test area(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six (6) months shall not be used.
- B. Masonry materials shall be stored in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Owner prior to the delivery of materials. Masonry materials shall not be stored inside the building.

1.09 PROJECT / SITE CONDITIONS

- A. The normal temperature range for the work of this Section shall be when the air and surface temperatures are 40 degrees F and rising, or less than 90 degrees F and falling. When temperatures are expected to fall outside this range, the Contractor shall employ hot and cold weather procedures as published by the Masonry Institute of America.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work, and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in the Section.
- C. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection and shall also provide that nearby vehicles and adjacent structures will be protected from damage during the course of the work.
- D. The Contractor shall coordinate masonry repointing with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 – PRODUCTS

2.01 EQUIPMENT FOR RAKING AND REPOINTING

- A. Equipment for raking joints:
 - 1. Traditional Method: Hand chisels and mash hammers
 - 2. Modern Method: Power tools including small pneumatically-powered chisels, scaler (power chipper), and thin diamond-bladed grinders. Power saws are not recommended.
- B. Equipment for repointing:
 - 1. Mortar pan mill or equipment for mortar mixing
 - 2. Plastic buckets, hoe, wooden mallet or ax handle

3. Mortar board, hawk, trowels, pointing rod
4. Natural bristle or nylon brushes (metal bristle brushes are NOT to be used)

2.02 MORTAR SELECTION CRITERIA: See Sections 04100.02 and 04400.01.

- A. Repair mortar shall match the color, texture, and tooling of the existing pointing.
- B. Sand shall match the sand of the historic mortar.
- C. Mortar shall have greater vapor permeability and be softer, measured in compressive strength, than the masonry units.
- D. Mortar shall be as vapor permeable and be as soft or softer, measured in compressive strength, than the existing historic mortar.

PART 3 - EXECUTION

3.01 GENERAL

- A. The restoration methods and materials selected for a specific structure shall 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 that may be affected by the work.
- B. The extent of the repointing, whether partial or sectional repointing, complete facades or features, or total structure or building, shall be reviewed by the Architect on site prior to beginning operations. The Contractor shall submit a repointing schedule, including methods and materials to be used for approval before work starts.
- C. The Contractor shall complete a survey of the condition of the mortar and masonry:
 1. Existing general masonry failures that contribute mortar losses shall be noted and should be scheduled for repair prior to repointing.
 2. Analysis of mortar type and color shall be conducted, the extent and type of analysis to be determined by the Architect.
- D. The Contractor shall protect adjacent materials, installed non-masonry materials, and openings.
- E. Manufacturer's instructions for mixing and installation of masonry and equipment shall be followed. Masonry shall conform to ASTM C 270.
- F. Masonry cleaning shall be completed prior to beginning raking and repointing work.

3.02 SYSTEM FOR JOINT REMOVAL

- A. The areas selected for repointing, if partial or selective repointing is to be done, shall be designated and marked off.

B. Removal Methods:

1. Traditional Method: removal of mortar by hand with a hand chisel and mash hammer. This method produces the least damage and is preferred for masonry with thin joints and brick.
2. Modern Method: removal with power tools such as pneumatic chisels and grinders. Power saws are not recommended for use on most brick walls or thin joints. Small pneumatically powered chisels are generally effective for use on historic buildings, providing the operator is skilled. Grinders with thin diamond blades can be used for horizontal joints on hard portland cement mortars.
3. Combined Methods: combined use of power tools and hand chiseling methods are generally recommended and achieve the highest degree of success when properly executed.

C. Specifications for Removal:

1. Mortar shall be removed to a minimum depth of 2 to 2 ½ times the width of the joint but not less than ¾ inch.
2. Chisels and power tools are to be the appropriate size to fit cleanly into mortar joints without damage to surrounding surfaces.
3. Loose or disintegrated mortar beyond the minimum depth shall be removed.
4. Removal of the mortar shall be done in a manner that does not score, chip, or otherwise damage masonry units or adjacent elements.
5. Mortar should be removed cleanly from the masonry units, leaving square corners at the back of the cut.
6. If using a grinder to rake head joints, the Contractor shall switch to the smallest diameter blade possible to make the deepest cut without overrunning the ends of the joint and cutting into the bricks above or below. Top and bottom of the head joints shall be finished with a chisel.
7. Use a hand chisel to finish joints adjacent to door and window openings to avoid damage to frames and trim.
8. If work is found unacceptable, all raking shall cease without additional cost to the Owner until deficiencies in tools, workmanship, or methodology have been corrected to the Architect's satisfaction.

3.03 SYSTEM FOR REPOINTING

A. The Contractor shall inspect all joints to receive mortar prior to commencing work:

1. After removal of the old mortar, joints shall be blown clean with compressed air (40-60 psi) to remove all loose particles and dust.

2. Prior to repointing, joints shall be dampened with low pressure water (100-150 psi). Joints shall be damp with no visible standing water.
3. A continual mist of water shall be applied for a few hours prior to repointing walls of absorbent masonry units such as limestone, sandstone, and common brick.

B. Filling Joints:

1. Fill the deeper areas first, compacting the new mortar in several successive layers.
2. Apply successive amounts of mortar in ¼-inch layers.
3. Allow each layer to harden before application of the next layer.
4. Apply the final layer flush with masonry units, except where old bricks or stones have worn, rounded edges, the final mortar layer should be recessed slightly from the face of the masonry. Do not feather-edge mortar over chipped or damaged edges.

C. Finishing:

1. Allow the final layer to set until “thumb-print hard” and tool to match the historic joint. Proper timing is important for uniform color and appearance of the mortar.
2. Remove excess mortar from the edges of the joints with a natural bristle or nylon brush after mortar has dried but before the mortar is initially set (1-2 hours).

D. Curing:

1. Periodically wet mortar joints after the mortar joints are thumb-print hard and have been tooled (especially important with high-lime content mortars, such as Type O, Type K, and especially Type L). Misting with a hand sprayer with a fine nozzle for one to two days is recommended.
2. Where ambient temperatures exceed 80 degrees F or where wind speeds exceed 20 mph, cover walls with burlap after repointing to keep walls damp and protected from direct sunlight. If plastic is used, it must be tented out and not placed directly against the wall.
3. Allow new mortar to cure for at least 30 days prior to exposure to other repairs, such as masonry cleaning.

3.04 FINAL REPORT

The Contractor shall:

- A. Revisit the site after the new mortar has cured at least 30 days to compare the finish and color of the repair to see if the desired affect has been achieved.
- B. Document the work and finished product with photographs.

- C. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or is eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Mortar selection
- B. Preparation of lime mortar
- C. Preparation of cement-amended mortar

1.03 RELATED SECTIONS

- A. Section 04100.01 – Removal of Mortar Joints and Repointing
- B. Section 04211 – Historic Brick
- C. Section 04214 – Terra Cotta and Ceramics
- D. Section 04400.01 – Identifying Masonry Types and Failures
- E. Section 04500 – Masonry Restoration

1.04 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*, available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. Use and types of mortar are found in *Preservation Brief No. 2: Repointing Masonry Joints in Historic Masonry Building*, available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief02.htm>>.

- C. U.S. General Services Administration Historic Preservation Technical Procedures for Mortar, available online at
<<http://w3.gsa.gov/web/p/hhttp.nsf/a533f1f859737bc9852565cc0058d0b6/7de342045d4c63f6852565c50054b3a7?OpenDocument>> and
<<http://w3.gsa.gov/web/p/hhttp.nsf/a533f1f859737bc9852565cc0058d0b6/e7518da3d776f026852565c50054b3c5?OpenDocument>>.
- D. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- E. ASTM C207, *Standard Specification for Hydrated Lime for Masonry Purposes*.
- F. ASTM C206, *Standard Specification for Finishing Hydrated Lime*.
- G. ASTM C144, *Standard Specification for Aggregate for Masonry Mortar*.
- H. ASTM C150, Type II, *Standard Specification for Portland Cement*.
- I. ASTM C979, *Specification for Pigments for Integrally Pigmented Concrete*.

1.05 SUBMITTALS

- A. The Contractor shall submit a detailed schedule of the areas to be repointed, including an assessment of the problem areas, a historic mortar analysis, and a detailed procedure for repointing, to the Architect for approval:
 - 1. Submit data indicating proportion or property specifications used for mortar.
 - 2. Submit test reports for mortar materials and report proportions resulting from laboratory testing used to select mortar mix.
- B. Product Literature: The Contractor shall submit the manufacturer's product literature to the Architect for all proprietary products specified for repointing. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling, and use.
- C. Historic Mortar Analysis: The Contractor shall submit the laboratory report from completed mortar analysis. Mortar analysis shall be completed prior to beginning test-panel preparation. Analysis shall be limited to wet chemical and microscopic analysis to characterize the insoluble aggregate, determine binder-aggregate ratio, prepare a mix design for replacement mortar, and identify appropriate sources for sand aggregate.
- D. Samples: No masonry restoration work shall proceed until all samples are approved. The Contractor shall submit samples of the following masonry repair and replacement materials for approval of color and texture match:

Cured pointing mortar. Portable samples shall be prepared using drywall channel or similar material the approximate width of a mortar joint. Once a matching mortar color is achieved, placement of on-site mock-ups may begin.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience with historic mortars and masonry repairs and repointing. He/she shall demonstrate a working knowledge of the Secretary of the Interior's Standards for Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings.
- B. The Contractor shall not change sources or manufacturers of mortar materials during the course of the work.

1.07 MOCK-UPS

- A. The Contractor shall prepare two mock-up installations of each type of masonry and mortar color to be installed at locations selected by the Architect. If cleaning tests are also to take place, test panels should be in the same area. Test panels should not be undertaken in areas that are highly visible.
- B. Each test panel shall be executed in the same manner as the final installation. Test panels shall be a minimum area of 3x3 feet for brick facades, and larger for stone facades.
- C. After the test panels have cured for a period of two to three weeks (or otherwise specified by the Architect), the test panels will be inspected for color, texture, and installation technique.
- D. The Contractor shall prepare up to three additional mock-ups of each mortar and mortar color without further compensation. Approved test area(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall deliver all products to the site in original packaging, unopened and undamaged, with manufacturer's name and product identification visible thereon and manufacturer's instructions and Material Safety Data Sheets.
- B. The Contractor shall store products in a dry location and protected from dampness and freezing following manufacturer's instructions.
- C. The Contractor shall stockpile and handle aggregates in a manner to prevent contamination from foreign materials.

1.09 PROJECT / SITE CONDITIONS

- A. Mortar installation shall be executed only when the air and surface temperatures are 40 degrees F and rising or less than 80 degrees F and falling. Minimum temperature for masonry repointing shall be 50 degrees F and above for at least 2 hours after completion and above freezing for at least 24 hours after completion. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work, and will provide all necessary protection and follow all

necessary work procedures to avoid damage to existing material assemblies not a part of the work in the Section.

- C. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection, and shall also provide that nearby vehicles and adjacent structures are protected from damage during the course of the work.
- D. Contractor shall coordinate masonry repointing with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 - PRODUCTS

2.01 MORTAR SELECTION CRITERIA: See Sections 04100.02 and 04400.01.

- A. Repair mortar shall be compatible with the material, quality, color, and texture of the existing mortar.
- B. Sand shall match the gradation of the historic mortar and be free from impurities. The color, size, and texture of the sand should be similar to the original sand.
- C. Mortar shall have greater vapor permeability and be softer, measured in compressive strength, than the masonry units.
- D. Mortar shall be as vapor permeable and be as soft or softer, measured in compressive strength, than the existing historic mortar.
- E. Testing and Mortar Selection for Masonry Units:
 - 1. Selection of Mortar for Brick Units:
 - a. Identify type and strength of brick.
 - b. Identify the composition, strength, and hardness of the historic mortar.
 - c. Lime and Sand mortars are preferred for historic brick masonry.
 - d. Portland Cement generally should not be used for historic brick.
 - e. Mortar should have a lower compressive (psi) strength than brick.
 - f. Mortar should be harder than the historic mortar.
 - 2. Selection of Mortar for Terra Cotta and Ceramic Units:
 - a. Mortar should have a lower compressive (psi) strength than the terra cotta and ceramic units.
 - b. Hard, portland cements or coarsely screened mortars shall not be used.
 - 3. Selection of Mortar for Adobe Units: Requires special considerations. See Section 04290.

4. Stone:
 - a. Identify type of stone.
 - b. Identify geological and mineralogical nature of stone.
 - c. Identify the Compressive or Crushing Strength of stone both wet and dry: ASTM C170-87.
 - d. Mortar should have a lower compressive (psi) strength than stone: general about 1/3 the compressive or crushing strength of the stone units.
 - e. Hard, portland cements are generally not appropriate for historic mortars.
5. Concrete Block and Cast Stone Units:
 - a. Mortar should have a lower compressive (psi) strength than the masonry units.
 - b. Use of concrete amended mortars.

2.02 MORTAR TYPE AND MIX

- A. Depending on the desired strength and consistency, lime mortars should conform to ASTM C207 and ASTM C206, Mortar for Masonry, such as:
 1. Type M (2,500 PSI): 3:1:12
 2. Type S (1,800 psi): 2:1:9
 3. Type N (750 psi): 1:1:6
 4. Type O (350 psi): 1:2:9
 5. Type K (75 psi): 1:3:11
 6. Type L: 0:1:3

OR

- B. Equivalent mortar that meets comparable federal specifications.

2.03 POINTING MATERIALS AND MIXES (JOB-MIXED MORTAR)

- A. Portland Cement: ASTM C150, Type I, non-staining and without air entrainment. Gray and white Portland Cement may be combined as required to match the desired color.
 1. Non-staining white cement, preferred for historic applications, unless grey cement was used in the original mortar.
 2. Standard grey cement is generally not used for historic masonry.

- B. Hydrated Lime: ASTM C207, Type S.
 - C. Lime Putty (slaked lime): should conform to ASTM C5.
 - D. Sand: ASTM C144, free of clay, silt, soluble salts, and organic matter; shall match the color and texture of the original mortar sand. The Contractor may request from the Architect a sample of the original mortar sand for use in color and texture matching.
 - E. Water: Potable, free from injurious amounts of oil, soluble salts, alkali, acids, organic impurities and other deleterious substances which impair mortar strength or bonding.
 - F. Masonry Cement (premixed, bagged mortar): shall NOT be used.
- 2.04 PRE-MIXED MORTARS: Pre-mixed mortars may be used for repointing. All mortars must be approved by the Architect.
- 2.05 ACCESSORY MATERIALS
- A. Historic Materials include other components that enhance the color and texture matching and may include materials such as crushed oyster shells and animal hair, and historic pigments such as brick dust and lamp black.
 - B. Colorants (if required for exact color match): Non-fading, mineral oxide masonry pigment as approved by the Architect.
 - 1. Pigments should not exceed 10% by weight of the portland cement in the mix.
 - 2. Carbon black should not exceed 2% of the Portland cement in the mix.
- 2.06 ADMIXTURES
- A. No air-entraining admixtures or material containing air-entraining admixtures.
 - B. No antifreeze compounds shall be added to mortar.
 - C. No admixtures containing chlorides shall be added to mortar.
- 2.07 EQUIPMENT FOR MORTAR PREPARATION
- A. Equipment:
 - 1. Trough, plastic buckets, hoe, wooden mallet or ax handle, or similar implements
 - 2. Mortar pan mill
 - 3. Paddle or drum type mixers
 - 4. Undyed, unprinted burlap

PART 3 – EXECUTION

3.01 GENERAL

- A. Testing and Mortar Selection shall be reviewed by the Architect. The Contractor shall submit testing schedule, mortar schedule, and schedule of related repairs, including methods and materials to be used:
 - 1. Identify masonry units: Type and composition.
 - 2. Identify the crushing or compressive strength (psi) of masonry units.
 - 3. Identify properties, composition, and strength of historic mortar.
 - 4. Select mortars that match the existing in color, texture, quality, and materials.
 - 5. Select mortars that are softer than the existing mortar and the masonry units.
- B. Mortar components should be measured and mixed carefully (in a consistent manner) to assure uniformity of visual and physical characteristics.
- C. Pre-mixed mortar should be mixed and handled following manufacturer's specifications.

3.02 FIELD MORTAR MIXING LIME MORTARS

- A. Measure dry ingredients by volume.
- B. In a clean trough, wheelbarrow, or mixer (depending on quantities needed) combine and mix all dry ingredients thoroughly (before adding water).
- C. Add just enough clean water to "hold together," thus allowing the mixture to stand for a period prior to the addition of the remaining water.
- D. Prior to use, add half of the water and mix thoroughly for five (5) minutes.
- E. Add the remaining water in small portions until the desired consistency is reached. Keep the amount of water added to a minimum.
- F. Mortar should be used within approximately 30 minutes of final mixing. Do not retemper or add more water after final mixing.

3.03 FIELD MIXING FOR MORTAR USING LIME PUTTY

- A. Materials are measured by volume.
- B. Do not add additional water.
- C. Proportion sand first, and then add the lime putty.
- D. Mix in a clean trough for five (5) minutes or until all the sand is thoroughly coated with the lime putty by beating with a wood mallet or ax handle, interspersed by chopping with a hoe to achieve the maximum workability and performance.

OR

- E. Mix in a mortar pan mill when large quantities are needed, following the sequence above. Modern paddle and drum mixers do not achieve the desired results.
- F. Protect the mixture from the air by covering with wet burlap or seal in a large plastic bag.
- G. The sand/lime putty mix (which resembles brown sugar) can be stored indefinitely if placed in a sealed bag or container. Recombine mixture as specified in D above into a workable plastic state. *Do not add water.*

3.04 FIELD MIXING FOR PORTLAND CEMENT –LIME PUTTY-SAND MORTARS
(Type O or Type K)

- A. Materials are measured by volume.
- B. Combine sand and lime putty as described above and mix. Do not add water at this point.
- C. Mix the portland cement in to a slurry paste using clean water.
- D. Combine the portland cement slurry with the sand/lime putty mixture.
- E. Add color pigments, if any.
- F. Mix for five (5) minutes.
- D. Mixture should be used within 30 minutes to 1 ½ hours. Do not retemper mixture. Once portland cement is added, the mortar can no longer be stored.

3.05 FINAL REPORT

The Contractor shall:

- A. Document the work, testing, and mortar mixes used, and finished product, including photographs and final mortar schedules.
- B. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Selecting the appropriate stucco
- B. Preparation of lime-based stucco
- C. Preparation of portland cement-based stucco

1.03 RELATED SECTIONS

- A. 04110.02 – Repair and Replacement of Historic Stucco
- B. 04290 – Historic Adobe Masonry Units
- C. 04510.01 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Stains, and Biogrowth
- D. 07100.01 – Water Repellent Properties and Application
- E. 09910.01 – Surface Preparation and Repainting of Paint on Masonry

1.04 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>
- B. *Preservation Brief No. 22: The Preservation and Repair of Historic Stucco* available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief22.htm>>.

- C. Conway, Brian D. *Illinois Preservation Series Number 2: Stucco*. Springfield, Illinois: Illinois Department of Conservation, Division of Historic Sites, 1980.
- D. Portland Cement Plaster (Stucco) Manual. Skokie, Illinois: Portland Cement Association, 1980.
- E. Vieux Carre Masonry Maintenance Guidelines. Revised from the initial report prepared by Mary L. Oehrlein in 1977. New Orleans, Louisiana: Vieux Carre Commission, 1980.
- F. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes.
- G. ASTM C 144 Standard Specification for Aggregate for Masonry Mortar.
- H. ASTM C 150 Standard Specification for Portland Cement.
- I. ASTM C 1328-05 Standard Specification for Plastic (Stucco) Cement.
- J. ASTM C 979 Specification for Pigments for Integrally Pigmented Concrete.

1.05 SUBMITTALS

- A. The Contractor shall submit a detailed schedule of the areas of stucco to be patched and new areas to be installed, including an assessment of the problem areas, a historic stucco analysis, and detailed procedures for preparation and stucco application, to the Architect for approval:
 - 1. Submit data indicating proportion or property specifications used for stucco.
 - 2. Submit test reports for stucco materials and report proportions resulting from laboratory testing used to select stucco mix.
- B. Product Literature. The Contractor shall submit manufacturer's product literature to Architect for all proprietary products specified for stucco preparation. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling, and use.
- C. Historic stucco analysis. The Contractor shall submit the laboratory report from completed stucco analysis. Stucco analysis shall be completed prior to beginning test panel preparation. Analysis shall be limited to wet chemical and microscopic analysis to characterize the insoluble aggregate, determine binder-aggregate ratio, prepare a mix design for replacement stucco, and identify appropriate sources for sand aggregate.
- D. Samples. No stucco restoration work shall proceed until all samples are approved. The Contractor shall submit samples of the following stucco repair and replacement materials for approval of color and texture match:

Cured stucco samples: Prepare portable samples approximately 6x6 inches. Once a matching stucco color is achieved, placement of on-site mock-ups may begin.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience with historic stucco and mortars. He/she shall demonstrate a working knowledge of the Secretary of the Interior's Standards for Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings.
- B. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.
- C. The Contractor shall not change sources or manufacturers of stucco mortar materials during the course of the work.

1.07 MOCK-UPS

- A. After selection of a stucco color from the portable samples, the Contractor shall prepare two mock-up installations of each type of stucco to be installed at locations selected by the Architect. If cleaning tests are also to take place, test panels should in the same areas. Test panels should not be undertaken in areas that are highly visible. Each test panel shall be executed in the same manner as the final installation. Test panels shall have a minimum area of 3x3 feet. Test panels will be inspected for color, texture, and installation technique.
- B. The Contractor shall prepare up to three additional mock-ups of each stucco mortar and stucco color without further compensation. Approved test area(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be deliver all products to the site in original packaging, unopened, and undamaged, with manufacture's name and product identification visible thereon, and manufacturer's instructions and Material Safety Data Sheets.
- B. The Contractor shall store all products in a dry location and protected from dampness and freezing following manufacturer's instructions.
- C. The Contractor shall stockpile and handle all aggregates in a manner that prevents contamination from foreign materials.

1.09 PROJECT / SITE CONDITIONS

- A. Normal conditions for the work of this Section shall be defined as when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are predicted to rise above or fall below this temperature range, the Contractor shall implement hot or cold weather procedures as defined by the Masonry Institute of America.
- B. Work shall not commence when rain, snow or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.

- C. The Contractor is responsible for protecting existing adjacent materials and surfaces, and substrate during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in the Section.
- D. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection and shall also provide that nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- E. The Contractor shall coordinate stucco work with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 - PRODUCTS

2.01 EVALUATION OF EXISTING STUCCO

- A. Microscopical and chemical analysis of historic stucco.
- B. Visual inspection, conditions assessment, and documentation.

2.02 LIME STUCCO

The type of substrate must be identified (see Section 04400.01, Identifying Masonry Types and Failures). The chosen stucco composition must be compatible in color, texture, finish, and quality with the existing stucco and substrate.

- A. Lime Based Stucco
 1. Lime should conform to ASTM C 207, Type S, Hydrated Lime for Masonry Purposes: 1,800 psi.
 2. Sand should match the existing stucco as closely as possible in color, texture, and gradation, should be free from impurities, and should conform to ASTM C 144.
 3. Water should be clean and potable.
 4. Hair or fiber (if used) should be goat or cattle hair, or pure manilla fiber of good quality, ½ to 2 inches in length, clean and free of dust, dirt, oil, grease, or other impurities.
 5. Colorants (if required for exact color match) should be non-fading, mineral oxide masonry pigment as manufactured by Solomon Grind-Chem Services, Riverton Lime Co., Medusa, or Architect-approved equal.
- B. Equipment: Trough, wheelbarrow, plastic buckets, hoe, hawk, trowel, burlap (clean, undyed, and unprinted)

2.03 PORTLAND AMENDED STUCCO

The type of substrate must be identified (see Section 04400.01, Identifying Masonry Types and Failures). The chosen stucco composition must be compatible in color, texture, finish, and quality with the existing stucco and substrate.

A. Portland amended stucco

1. Lime should conform to ASTM C 207, Type S, Hydrated Lime for Masonry Purposes: 1,800 psi.

OR

2. Gypsum: It is important to note that gypsum-based stucco is NOT compatible with lime based stucco. The two should NOT be used in conjunction with each other.
3. Sand should match the existing stucco as closely as possible in color, texture and gradation; be free from impurities; and conform to ASTM C 144
4. Cement should be gray and/or white, non-staining portland cement and conform to ASTM C 150, Type II. Gray and white cements may be combined as required to achieve the required color.
5. Water should be clean and potable.
6. Hair or fiber (if used) should be goat or cattle hair, or pure manila fiber of good quality, ½ to 2 inches in length, clean and free of dust, dirt, oil, grease, or other impurities.
7. Pigment (if used) should be compatible with the stucco mix and conform to ASTM C 979.

- ### B. Equipment: Trough, wheelbarrow, plastic buckets, hoe, hawk, trowel, burlap (clean, undyed, and unprinted).

2.04 LIME AND CEMENT STUCCO MIX

- ### A. General: Except as otherwise indicated, comply with the requirements of ASTM C 926-98a for the proportioning of materials and the manner of mixing the plaster for each required application; comply with manufacturer's instructions if more stringent than ASTM C 926.

B. Lime-Based Stucco

1. Scratch and brown coats:
1 part lime
3 parts sand
Binder
2. Finish coat:
1 part lime
3 parts sand

C. Lime-Portland Cement Stucco

1. Type N:

Scratch and brown coats:

1 part lime
1 parts Portland cement
6 parts sand
Binder

Finish coat:

1 part lime
1 parts Portland cement
6 parts sand

2. Type O:

Scratch and brown coats:

2 part lime
1 parts Portland cement
9 parts sand
Binder

Finish coat:

2 part lime
1 parts Portland cement
9 parts sand

2.05 PRE-MIXED STUCCO

With the Architect's approval, pre-mixed stucco may be used for patching and new stucco, provided it is compatible with the existing stucco and/or the masonry substrate. Provide manufacturer's full color range for selection or provide custom match. Follow manufacturer's recommended mixing and preparation procedures for factory-mixed products.

PART 3 - EXECUTION

3.01 GENERAL

- A. The extent of the stucco repair work and/or new areas to be stuccoed shall be reviewed by the Architect on site prior to beginning operations. The Contractor shall submit an annotated drawing or photographs showing the affected areas, along with a written description of the methods and materials to be used.
- B. The Contractor shall protect adjacent materials, openings, and substrate.

3.02 LIME BASED STUCCO

- A. Mix stucco mortars in accordance with ASTM C 270.

- B. Measure dry ingredients by volume or equivalent weight. Do not measure by shovel. Combine in a clean, mechanical batch mixer.
- C. Mix dry ingredients thoroughly.
- D. Stucco materials shall be prehydrated to reduce shrinkage. Lime and sand shall be thoroughly mixed, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Stucco shall stand in this condition for 1 hour. Add portland cement and remainder of water and mix to provide a workable consistency. Stucco should be easily thrown from trowel and adhere to the surface for easy spreading.
- E. Do NOT over-mix (machine mix for 3-5 minutes).
- F. Stucco should be used in 1 ½ to 2 hours. Do not retemper or use partially hardened material.
- G. Wash all equipment promptly.

3.03 FINAL REPORT

The Contractor shall provide a final report of complete work including all approved submittals and photographs of the repaired areas taken before, during, and after the work.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.01 SECTION INCLUDES

- A. Selecting the appropriate stucco (see Section 04110.01)
- B. Stucco patching
- C. Stucco replacement
- D. Reattachment by injection grouting

1.02 RELATED SECTIONS

- A. 04110.01 – Preparation of Lime- or Portland-Based Stucco
- B. 04400.01 – Identifying Masonry Types and Failures
- C. 04510.01 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Stains, and Biogrowth
- D. 07100.01 – Water Repellent Properties and Application
- E. 09910.01 – Surface Preparation and Repainting of Paint on Masonry

1.03 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at http://www.nps.gov/history/hps/tps/standards_guidelines.htm.

- B. *Preservation Brief No. 22: The Preservation and Repair of Historic Stucco* available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief22.htm>>.
- C. Conway, Brian D. *Illinois Preservation Series Number 2: Stucco*. Springfield, Illinois: Illinois Department of Conservation, Division of Historic Sites, 1980.
- D. Portland Cement Plaster (Stucco) Manual. Skokie, Illinois: Portland Cement Association, 1980.
- E. Vieux Carre Masonry Maintenance Guidelines. Revised from the initial report prepared by Mary L. Oehrlein in 1977. New Orleans, Louisiana: Vieux Carre Commission, 1980.
- F. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes.
- G. ASTM C 144 Standard Specification for Aggregate for Masonry Mortar.
- H. ASTM C 150 Standard Specification for Portland Cement.
- I. ASTM C 1328-05 Standard Specification for Plastic (Stucco) Cement.
- J. ASTM C 979 Specification for Pigments for Integrally Pigmented Concrete.

1.04 SUBMITTALS

- A. The Contractor shall submit a detailed schedule of the areas to be stuccoed, including an assessment of the problem areas, a historic stucco analysis, and detailed procedures for stucco repairs, to the Architect for approval.
- B. Product Literature: The Contractor shall submit manufacturer's product literature to the Architect for all proprietary products specified for stucco patching, grouting and replacement. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling, and use.
- C. Samples: No stucco restoration work shall proceed until all samples are approved. The Contractor shall submit samples of the following stucco repair and replacement materials for approval of color and texture match:

Cured stucco samples: Prepare portable samples approximately 6x6 inches. Once a matching mortar color is achieved, placement of on-site mock-ups may begin.

1.05 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience with historic stucco and plaster. He/she shall demonstrate a working knowledge of the Secretary of the Interior's Standards for Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings.
- B. The Contractor shall not change sources or manufacturers of stucco materials during the course of the work.

- C. Warranty: Installer shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.06 MOCK-UPS

- A. The Contractor shall prepare mock-up installations of each type of stucco to be installed at locations selected by the Architect. Test panels shall have a minimum area of 3x3 feet and shall include all types of work required in the overall project, such as patching, injection grouting, and crack repair. Any special tooling and texturing should be included. If cleaning tests are also to take place, test panels should be prepared on the same area. Test panels should not be undertaken in areas that are highly visible. Test panels will be inspected for color, texture, and installation technique.
- B. After the test panels have cured for a period of two to three weeks (or otherwise specified by the Architect), the test panels will be inspected for color, texture, and installation technique.
- C. Each mechanic proposed for work on the project shall prepare a mock-up panel. Mechanics whose mock-ups are not approved shall not be permitted to work on stucco repair and replacement.
- D. Where stucco color is not acceptable, the Contractor shall prepare up to three additional mock-ups of each mortar and mortar color without further compensation. Approved test area(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall deliver all products to the site in original packaging, unopened, and undamaged with manufacturer's name and product identification visible thereon, and manufacturer's instructions and Material Safety Data Sheets.
- B. The Contractor shall store products in a dry location and protected from dampness and freezing following manufactures instructions.
- C. The Contractor shall stockpile and handle aggregates in a manner to prevent contamination from foreign materials.

1.08 PROJECT / SITE CONDITIONS

- A. Normal conditions for the work of this Section shall be defined as when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are predicted to rise above or fall below this temperature range, the Contractor shall implement hot or cold weather procedures as defined by the Masonry Institute of America.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in the Section:

1. Minimize levels of dust during stucco removal and application operations.
 2. Protect open joints and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall not be left exposed overnight or when inclement weather is predicted.
 3. Temporarily remove and store metal downspouts, window grilles, and other surface-mounted appurtenances during stucco restoration work. Install temporary drainage leaders and window protection if required. Reinstall immediately upon completion of work in the immediate area. Protect open boots at grade from accumulation of stucco debris.
 4. Protect existing built-in gutters and gutter outlets from damage and accumulation of mortar debris during work on chimneys and parapets.
 5. Protect window sashes and frames with plywood or other sturdy barrier during removal of stucco around window openings.
 6. Protect the existing roof surface from damage during the course of the stucco restoration work. Repair all damage to slates, metal roofing, gutters, flashings, etc., to the satisfaction of, and at no additional cost to, the Owner.
 7. Protect adjacent work from moisture deterioration and soiling due to stucco application operations. Provide temporary coverings as required to minimize spattering of plaster on other materials.
- C. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection and shall provide that nearby vehicles and adjacent structures are protected from damage during the course of the work.
- D. Contractor shall coordinate stucco work with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 – PRODUCTS

2.01 PATCHING HISTORIC STUCCO

The type of substrate must be identified (see section on Identifying Masonry Types and Failures 04400.01). The chosen stucco composition must be compatible with the substrate.

A. Patching Material:

1. Stucco: See Section 04110.01, Preparation of Lime or Portland-Based Stucco.
2. Bonding agent

B. Equipment:

1. Mixing: Trough, wheelbarrow, plastic buckets, hoe, hawk, trowel, burlap (clean, undyed, and unprinted)

2. Stucco Application: Plastic buckets, hoe, hawk, trowel, burlap (clean, undyed, and unprinted)
3. Stucco Removal: Chisel, mason's or chipping hammer, mallet, mortar board
4. Injection Grouting: Syringes (multiple sizes), plywood, miscellaneous lumber, foam-rubber padding

2.02 METAL SUPPORT, FURRING, LATHING, AND ACCESSORY MATERIALS FOR STUCCO

A. Metals and Finishes:

1. Exterior Components: Hot-dip galvanized finish; ASTM A653-99 for 18-gauge and lighter formed metal products; ASTM A 123-97 galvanized after fabrication for 16-gauge and heavier products.
2. Exterior Exposed Plastering Accessories: Provide zinc alloy accessories.

B. Wire Ties: Galvanized soft steel wire, gauge as required.

C. Metal Lathing Materials:

1. Product Standards: Comply with FS QQ-L-101.
2. Exterior Metal Lath: Self-furring, 3.4 lbs. per square yard, galvanized steel with black asphaltum coating.

D. Metal Plastering Accessories:

1. Square Edge Casting Beads: Manufacturer's standard, size for thickness indicated, with expanded or short flange to suit application.
2. Fasteners: Galvanized steel, of type and length suitable for adequate penetration of the substrate.

2.03 INJECTION GROUTING

A. Cementitious injection grout shall be an industry-approved, factory-mixed product. Selected products must be approved by the Architect.

B. Injection ports and surface cracks shall be sealed with removable, non-staining clay during injection grouting.

PART 3 - EXECUTION

3.01 GENERAL

- ### A. The extent of the stucco work and areas to be stuccoed shall be reviewed by the Architect on site prior to beginning operations. Contractor shall submit testing schedule and a stucco schedule, including the methods and materials to be used.

- B. The Contractor shall protect adjacent materials, openings, and substrate.

3.02 EVALUATION OF EXISTING STUCCO

- A. Visual inspection and conditions analysis: The Contractor shall:
 - 1. Identify cause and location of stucco deterioration.
 - 2. Coordinate stucco work with other repairs such as gutter and roof work, cleaning, removal of overgrown vegetation, water runoff and diversion from the building, painting and sealing.

3.03 STUCCO REPAIR OF MINOR CRACKS ($\frac{1}{8}$ inch and smaller)

- A. Crack should be free from dirt, grease, and vegetation. Blow cracks clean with compressed air.
- B. Coat crack with a bonding agent in accordance with manufacturer's instructions.
- C. Prepare a slurry coat of stucco to match the color and finish of the existing stucco.
- D. Apply a light coat of the slurry along the crack and work to match existing stucco.

3.04 STUCCO REPAIR OF LARGE CRACKS (larger than $\frac{1}{8}$ inch)

- A. Cracks to be repaired shall be routed to a minimum width and depth of $\frac{1}{4}$ inch to accommodate mortar fill. The edges of the crack shall be undercut where possible. Brush cracks clean of loose debris with a soft brush.
- B. The area to receive the mortar fill shall be thoroughly wetted to prevent dehydration of the mortar. Re-wet as necessary. Using the approved stucco mix, fill the crack proud and work mortar in as tightly as possible until flush with adjoining surface. Remove excess mortar. Protect filled areas with plastic and re-wet periodically to allow a full cure.

3.05 STUCCO REPAIR BY PATCHING

- A. Extent and area of patches shall be carefully assessed and reviewed by the Architect.
- B. Remove all loose, deteriorated, and severely cracked stucco to the masonry substrate or lath. Avoid oversounding to prevent additional damage to adjacent keys.
- C. Stucco on Masonry Substrate:
 - 1. Stucco is applied directly to masonry substrates such as brick, stone, concrete, or hollow tile without lath.
 - 2. If necessary, rake out brick or stone mortar joints to a depth of $\frac{5}{8}$ inch.
- D. Masonry on Wood Substrate:
 - 1. Wood Substrate: Determine type of lath—horizontal wood slats or wire mesh.

2. Lath should be in good condition, free of rot and / or rust.
 3. Replace areas of metal lath and underlay as approved by the Architect. New wire lath should be nailed over existing wood lath, following review by the Architect.
- E. Surface should be free of debris, dust, dirt, grease, oil, paint, and vegetation. Clean with a bristle brush.
 - F. Area should be cut on the diagonal and squared off with a butt joint to provide a neat patch. If necessary, and as reviewed by the Architect, it may be preferred to stucco the area of an entire feature.
 - G. New patch must not overlap existing stucco.
 - H. Dampen surface before applying stucco.
 - I. Apply the scratch coat to the masonry substrate or lath. Number and thickness of the repair coats should match the historic stucco. The scratch coat is generally $\frac{1}{4}$ to $\frac{3}{8}$ inch thick, and must be scratched or crosshatched with a comb to provide a key for the second coat. Allow scratch coat to dry 24 to 72 hours.
 - J. The leveling or second coat is often applied in the same thickness as the initial coat. The total thickness of the first two coats is generally $\frac{5}{8}$ inch. Roughen with a wood float with a nail protruding to provide a key for the finish coat.
 - K. The final or finish coat is applied when the leveling coat is initially set. Work the finish coat to match the texture of the historic stucco.

3.06 INJECTION GROUTING

- A. Surface preparation:
 1. Remove any surface vegetation to fully expose the delaminated area to be repaired following recommended cleaning treatments (see Section 04510). Vines should be cut at the roots and allowed to wither and dry completely before removal from the wall. After the dry plant has been carefully pulled away, wash the wall with water and a soft bristle brush. In extreme cases where the tendrils are deeply imbedded, extensive damage may have occurred, and the section involved may require replacement of the stucco. In extreme cases, consult with the Architect prior to removal of the stucco.
 2. Remove surface dirt by scrubbing with clean water and a soft bristle brush. No acidic or alkaline cleaning agents shall be employed.
 3. The crack shall be blown clean with compressed air (40 to 60 psi) prior to grouting.
- B. Injection Grouting:
 1. Seal any cracks in the delaminated area to be grouted using the approved removable clay or sealant, leaving injection ports at regular intervals per the manufacturer's instructions. Test the seal and dampen the cavity using an initial injection of plain water; re-seal as necessary.

2. Begin grouting at the lowest injection port, continuing until grout is visible at the next injection port. Plug the injection port and proceed to the next one. Discontinue grouting if leakage appears, and do not resume until seal is repaired. Continue grouting from bottom to approximately half the height of the delaminated area. Using a padded piece of plywood, push the delaminated layer gently toward the substrate until grout appears at the topmost injection port. Support in place for a minimum of 72 hours until grout is fully cured.
3. Patch injection ports with approved stucco mixture.

3.07 PREPARATIONS FOR STUCCO REPLACEMENT

- A. Remove existing stucco, lath, and accessories down to masonry substrate to allow for masonry and/or flashing repairs as required. Coordinate with other trades to ensure that repairs are completed before installing new stucco.
- B. Apply self-furring metal lath on existing masonry surfaces indicated for stucco application; nail to substrate 1 foot o.c., both directions. New and rebuilt brick surfaces may be left with the joints raked to receive stucco.
- C. Install temporary grounds and screeds as necessary to ensure accurate rodding of stucco to true surfaces; coordinate with scratch-coat work.
- D. Plastering Accessories: Anchor to substrates by nailing 8 inches o.c. along each flange. Miter corners and spline joints of exposed accessories, to form tight joints without offsets. Install metal casing beads where shown at the following locations:

Where plaster abuts other finishes and termination is not lapped by other finish. Leave $\frac{3}{8}$ -inch wide pocket for sealant unless otherwise indicated.
- E. Masonry surfaces to receive direct stucco application are to be thoroughly wetted prior to stucco application. Do not dampen metal lath where used.

3.08 INSTALLATION OF REPLACEMENT STUCCO

- A. General:
 1. Standards: Except as otherwise indicated, comply with ASTM C 926 for stucco work.
 2. Do not use materials that are frozen, caked, or lumpy, or that are contaminated by foreign materials. Use only clean water, free from impurities that may impair the plaster work; do not use water that has been used to clean tools.
 3. Do not use excessive water in the mixing and application of plaster materials.
 4. Sequence plastering applications with other work in accordance with recognized industry practices.
 5. Prepare all stucco in a mechanical mixer.

B. Plaster Applications:

1. Apply 3-coat stucco over metal lathed and masonry substrates (scratch/level, brown and finish coats). New stucco thickness to be $\frac{7}{8}$ inch thick in compliance with ASTM C 926-98a. Stucco patches are to match the level of the surrounding surface.
2. Allowable Tolerances: For flat surfaces, do not exceed $\frac{1}{4}$ inch in 8 feet for bow or warp surface, and for plumb and level.
3. Finish Coat Texture/Pattern: Patches to existing stucco shall match the existing surface texture:
 - a. Where scoring is required, utilize a straight-edge and a square-tipped tool of the same width as the existing joint scoring.
 - b. New scoring shall match the block sizes and bond of the existing pattern.
4. Curing: Protect each coat of stucco work from drying out for a period of 24 hours after placement (or until curing operation will not damage surface), and moisture cure not less than 48 hours after time of placement.

3.09 FINAL REPORT

- A. For stucco repair and replacement where no paint or other surface finish is applied, the contractor shall revisit the site with the Architect after the new stucco has cured at least 30 days to inspect the work to see if the desired effect has been achieved.
- B. The Contractor shall provide a final report of complete work including all approved submittals and photographs of the repaired areas taken before, during, and after the work.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Historic brick properties
- B. Criteria for replacement
- C. Procedure for in-kind replacement

1.03 RELATED SECTIONS

- A. 04211.02 – Repair Through Patching, Consolidating, or Injection Grouting.
- B. 04100.01 – Removal of Mortar Joints and Repointing
- C. 04100.02 – Preparation of Lime and Cement-Amended Mortars
- D. 04400.01 – Identifying Masonry Types and Failures

1.04 REFERENCES

- A. Repointing shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. Techniques employed for repointing shall be as outlined in *Preservation Brief No. 2: Repointing Masonry Joints in Historic Masonry Buildings* available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief02.htm>>.

- C. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- D. ASTM C 216, *Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)*.
- E. ASTM C 62-85A, *Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)*.
- F. ASTM C 67, *Standard Methods of Sampling and Testing Brick and Structural Clay Tile*.
- G. Technical Notes 11, *Guide Specifications for Brick Masonry Part I*. Revised. Issued August 2001. The Brick Industry Association. Available online at <http://www.bia.org/html/frmset_thnt.htm>.
- H. Technical Notes 11, *Guide Specifications for Brick Masonry Part 2*. Revised. Issued September 1988. The Brick Industry Association. Available online at <http://www.bia.org/html/frmset_thnt.htm>.

1.05 SUBMITTALS

- A. Schedule of Selection and Installation: The Contractor shall submit a detailed schedule to the Architect for approval of the areas for repair, including an assessment of the problem areas, a historic mortar analysis, and detailed procedures for brick repair.
- B. Product Data: The Contractor shall submit product data for all manufactured masonry pointing, grouting and patching materials, and replacement bricks (if new bricks are to be used). Manufacturer's product data shall include certification of compliance with specified standards and instructions for handling, storage, and installation of the material, and Material Safety Data Sheets for each material.
- C. Test Reports:
 - 1. Test reports for each type of facing brick are to be submitted to the Architect.
 - 2. Testing and reports are to be completed by an independent laboratory and will provide the following:
 - a. Compressive strength
 - b. 24-hour cold water absorption
 - c. 5-hour boil absorption
 - d. Saturation coefficient
 - e. Initial rate of absorption (suction)
 - 3. The Contractor shall a scratch-hardness test to determine firing history and soundness of brick.
- D. Samples: No masonry restoration work shall proceed until all samples are approved. The Contractor shall submit samples of the following masonry repair and replacement materials for approval of color and texture match:

1. Replacement face brick units. Product samples should show full range of color and texture available for both new manufactured bricks and for salvaged bricks.
2. Mortar shall conform with Historic Mortar Specifications 04100 and be approved by the Architect.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience with historic masonry and brick repairs. He/she shall demonstrate a working knowledge of the Secretary of the Interior's Standards for Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings.
- B. The Contractor shall not change sources or manufacturers of mortar or brick materials during the course of the work unless approved by the Architect.
- C. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.07 MOCK-UPS

- A. After completion of the masonry cleaning mock-ups specified in Section 04510, the Contractor, at locations designated by the Architect, shall prepare test panels of the following work:
 4. Brick Restoration: All personnel proposed for work on the project shall prepare 3x3-foot samples demonstrating brick restoration techniques, including mortar removal, repointing, and brick replacement. Mock-ups will be reviewed after the mortar removal and again after completion of repointing. Mock-ups shall display the full range of materials and workmanship required for completion of the project for approval by the Architect.
 - a. Color Matching: The project requires matching of the existing mortar color(s) for brick masonry. The Contractor shall place the initial sample panel using the mix from the approved sample. The sample panel must be cured in the same manner as is expected for the work based on expected temperatures.
 - b. Brick Matching: The Contractor will be responsible for identifying potential matches to the existing brick for use as replacement units, subject to the approval of the Architect.
- B. The Contractor shall prepare up to three additional mock-ups of each mortar, joint type, and mortar color without further compensation. Approved test panel(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or

temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six months shall not be used.

- B. Bricks will be protected from the ground and weather, and kept free from exposure to contaminants such as mud, dust, or materials that could cause staining.
- C. Masonry materials shall be stored in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Owner prior to the delivery of materials. Masonry materials shall not be stored inside the building.

1.09 PROJECT / SITE CONDITIONS

- A. Normal conditions for the work of this Section shall be defined as when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are predicted to rise above or fall below this temperature range, the Contractor may proceed using approved hot and cold weather procedures as defined by the Masonry Institute of America. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor shall cover the top of the wall with strong waterproof membrane at the end of each day or prior to any work shutdown. Cover partially completed walls when work is not in progress. Covering will extend a minimum of 24 inches on each side and be fastened securely.
- C. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work, and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in this Section:
 - 1. Minimize levels of dust during mortar removal and masonry repointing operations.
 - 2. Protect open copings, reglets, and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall not be left exposed overnight or when inclement weather is predicted.
 - 3. Temporarily remove and store metal downspouts during masonry restoration work. Install temporary drainage leaders if required. Reinstall immediately upon completion of work in the immediate area. Protect open boots at grade from accumulation of masonry debris.
 - 4. Protect existing gutters and gutter outlets from damage and accumulation of mortar debris during restoration of brick chimneys.
 - 5. Protect window sashes and frames with plywood or other sturdy barrier during repointing and repair of masonry around window openings.
 - 6. Protect the existing roof surfaces from damage during the course of the masonry restoration work. Repair all damage to wood and metal roofing, gutters, flashings, etc., to the satisfaction of and at no additional cost to the Owner.

7. Remove and store light fixtures, signage, security devices, and miscellaneous appurtenances from masonry surfaces to be repointed. Provide temporary protection for exposed fixture boxes.
- D. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection, and shall protect nearby vehicles and adjacent structures from damage during the course of the work.
- E. Contractor shall coordinate brick repairs with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 - PRODUCTS

2.01 MORTAR SELECTION CRITERIA: See Sections 04100.02 and 04400.01.

2.02 EQUIPMENT FOR BRICK REMOVAL, SALVAGE, AND BRICKLAYING

- A. Equipment for Brick Removal:
 1. Traditional Method: Hand chisels and mash hammers
 2. Modern Method: Power tools, including small pneumatically-powered chisels, scaler (power chipper), and thin diamond-bladed grinders. Power saws are not recommended.
- B. Equipment for Salvage, Mortar Removal, and Cleaning: Hand chisels, mason's hammers, and natural bristle or nylon brushes
- C. Equipment for Bricklaying:
 1. Mortar pan mill or equipment for mortar mixing
 2. Plastic buckets, mortar board, hawk, trowels, pointing rod, and mason's hammers
 3. Natural bristle or nylon brushes (metal bristle brushes are NOT to be used)

2.03 BRICK REMOVAL AND SALVAGE

- A. Representative samples of the removed brick shall be tested for salt content and quality.
- B. Decorative and specially molded or cut brick may be retained for consolidation and should be reviewed by the Architect.

2.04 BRICK FOR IN KIND REPLACEMENT

- A. Salvaged: Where disassembly and reconstruction of portions of the wall are required, the Contractor shall salvage any and all existing bricks that are sound and free of cracks. Bricks disfigured by mortar patching shall be salvaged for re-use with clean sides exposed. Should brick units be damaged during disassembly, the Contractor shall be responsible for

supplying approved replacements to match. All salvaged bricks shall be cleaned of loose debris and mortar on all faces.

- B. New Brick: ASTM C-216-91a, Grade SW, Type FBS. Replacement brick to match historic brick in size, color, and composition; manufacturer and product sample to be approved by the Architect.
- C. The Contractor shall have the option of providing clean, sound, salvaged antique bricks from other sites, subject to the approval of the Architect for color, size, and texture match.

2.05 ACCESSORY MATERIALS

- A. Pins for crack stitching in brick masonry shall be 18-8 stainless steel, all-thread rods. Dimensions to be as indicated on the Drawings.
- B. Through-wall flashing for window heads and sills to be rebuilt shall be composite Copper Fabric and must be approved by the Architect.
- C. Masonry Ties: The Contractor shall provide galvanized steel masonry wall ties as indicated on the Drawings. Ties shall be 18 ga., crimped metal strip in lengths as required for the application. Selection of ties and manufacturer must be approved by the Architect.

PART 3 - EXECUTION

3.01 GENERAL

- A. The extent of the brick replacement shall be reviewed by the Architect on site prior to beginning operations. The Contractor shall submit a schedule, including methods and materials to be used.
- B. The Contractor shall complete a survey of the condition of the mortar and masonry prior to repairs. Contractor survey shall include:
 - 1. Notation of existing general masonry failures that contribute brick and mortar losses and should be scheduled for repair prior to this work.
 - 2. Determination of the brick composition and density. See Test Reports under Submittals above.
 - 3. Determination of the method of bricklaying and type of bond of the historic masonry.
- C. Masonry cleaning shall be completed prior to beginning brick repair or replacement work (see Section 04500).

3.02 BRICK MASONRY REPAIRS

- A. Individual Brick Replacement:
 - 1. Remove selected cracked, spalled, or otherwise damaged bricks where indicated without causing damage to the adjacent brickwork to remain. Replacements shall be

either new matching brick or matching salvaged brick placed so as to replicate the existing bond pattern.

2. Remove all existing mortar from adjoining bricks in order to lay new brick entirely in new mortar. Clean joints of all loose mortar and flush with clean water.
3. Ensure head and bed joints are packed full with mortar. Rake construction mortar to allow space for pointing mortar. Where bedding mortar and pointing mortar are the same, tool joints to match existing.

B. Masonry Rebuilding:

1. Carefully dismantle selected areas of brick and fieldstone masonry. Dismantle adjacent assemblies as required for access to the designated masonry, salvaging components for reuse to the greatest extent possible.
2. Rake or grind mortar from joints to the greatest extent possible before attempting removal of the masonry units. Avoid excessive prying against the arrises of the selected masonry units to avoid spalling and chipping.
3. Once removed, clean old mortar from bricks and stones to be reassembled.
 - a. Bricks to be retained are to be cleaned of all mortar by lightly striking with a chisel and hammer. Salvaged brick is to be approved prior to reuse.
 - b. Properly stack and store all brick to be reused.
 - c. Salvaged brick should not be used in areas with high moisture or exposure freeze/thaw cycles, such as parapets, copings, and sills.
4. Reset masonry units to proper position, straight, and plumb and true to line and level, with full mortar bed. Ensure that vertical head joints are completely filled with mortar. Rake and point as described above.
5. Reinstall roofing, flashing, and other adjacent materials, or patch in kind as required to complete the installation.

C. Masonry Infill:

1. Remove window/door frames, flashing, and other attachments from opening to be infilled.
2. Install masonry infill where indicated to match the depth of the surrounding walls. Cut masonry units with motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to fit adjoining work neatly. Use full units without cutting wherever possible.
3. Lay bricks in full mortar bed with full coverage for horizontal bed and vertical head joints. Rake back all mortar joints ½ inch for installation of pointing mortar.

4. Brush, vacuum, or flush joints to remove all dirt and loose debris. Dampen joints prior to pointing to prevent suction of moisture from the pointing mortar.
5. Where finish mortar joints are indicated, install pointing mortar in ¼-inch-thick layers, allowing each layer to reach thumbprint hardness before applying the succeeding layer. Tool joints flush.

3.03 FINAL REPORT

The Contractor shall:

- A. Revisit the site with the Architect to compare the finish and color of the repair to see if the desired affect has been achieved after the brick repairs have been executed and new mortar has cured at least 30 days.
- B. Document the work and finished product with photographs.
- C. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Brick repair through patching
- B. Brick repair by consolidation
- C. Injection grout

1.03 RELATED SECTIONS

- A. Section 04211.01 – Historic Brick Properties and In-Kind Replacement
- B. Section 04100.01 – Removal of Mortar Joints and Repointing
- C. Section 04100.02 – Preparation of Lime and Cement-Amended Mortars
- D. Section 04400.01 – Identifying Masonry Types and Failures
- E. Section 07900.01 – Joint Sealer Properties and Application

1.04 REFERENCES

- E. Repointing shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.

- F. Techniques employed for repointing shall be as outlined in *Preservation Brief No. 2: Repointing Masonry Joints in Historic Masonry Buildings* available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief02.htm>>.
- G. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- H. *Conservation of Historic Stone Buildings and Monuments: Report of the Committee on Conservation of Historic Stone Buildings and Monuments*. National Material Advisory Board, Commission on Engineering and Technical Systems, National Research Council. Washington, D.C.: National Academy Press, 1982.
- I. Feilden, Bernard M. *Conservation of Historic Buildings*. Revised paperback edition. Boston: Reed Educational and Professional Publishing.
- J. ASTM C 207, *Standard Specification for Hydrated Lime for Masonry Purposes*.

1.05 SUBMITTALS

- A. The Contractor shall submit a detailed schedule to the Architect for approval of the areas for repair, including an assessment of the problem areas, a historic mortar analysis, and detailed procedure brick repair.
- B. Test Reports:
 - 1. Test reports for each type of facing brick are to be submitted to the Architect.
 - 2. Testing and reports are to be completed by an independent laboratory and will provide the following:
 - a. Compressive strength
 - b. 24-hour cold water absorption
 - c. 5-hour boil absorption
 - d. Saturation coefficient
 - e. Initial rate of absorption (suction)
 - 3. Conduct a scratch-hardness test to determine firing history and soundness of brick.
- C. Product Data: The Contractor shall submit product data for all manufactured masonry consolidation, grouting, and patching materials and for replacement bricks (if new bricks are to be used). Manufacturer's product data shall include certification of compliance with specified standards, instructions for handling, storage, and installation of the material, and Material Safety Data Sheets for each material.
- D. Samples: The Contractor shall submit samples of the replacement face brick units, masonry repair, and replacement materials for approval of color and texture match. No masonry restoration work shall proceed until all samples are approved.

Replacement face brick units: Product samples should show full range of color and texture available for both new manufactured bricks and for salvaged bricks.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience with historic masonry and brick repairs. He/she shall demonstrate a working knowledge of the *Secretary of the Interior's Standards for Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings*.
- B. The Contractor shall not change sources or manufacturers of mortar or brick materials during the course of the work unless approved by the Architect.
- C. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.07 MOCK-UPS

- A. After completion of the masonry cleaning mock-ups specified in Section 04510, the Contractor, at locations designated by the Architect, shall prepare test panels of the following work:
 - 1. Brick Restoration: All personnel proposed for work on the project shall prepare 3x3-foot samples demonstrating brick restoration techniques, including mortar removal, repointing, and brick replacement. Mock-ups will be reviewed after the mortar removal, and again after completion of repointing. Mock-ups shall display the full range of materials and workmanship required for completion of the project for approval by the Architect.
 - 2. Brick Consolidation: The Contractor shall prepare samples demonstrating consolidation of a segment of brick masonry (measuring approximately 2x2 feet) selected by the Architect. A sample brick will be removed from the test panel and examined for soundness, depth of consolidant penetration, and change in surface appearance. Test areas of consolidant should be given two to four hours drying time before inspection.
- B. The Contractor shall prepare up to three additional mock-ups of each mortar, joint type and mortar color without further compensation. Approved test panel(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.08 DELIVERY, STORAGE, AND HANDLING (as applied to products and materials)

- A. The Contractor shall deliver products and materials to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six months shall not be used.
- B. Liquids shall be stored at temperatures between 40 and 85 degrees. Do not allow liquids to freeze.
- C. Bricks shall be protected from the ground and weather and kept free from exposure to contaminants such as mud, dust, or materials that could cause staining.

1.09 PROJECT / SITE CONDITIONS

- A. Normal conditions for the work of this Section shall be defined as when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are predicted to rise above or fall below this temperature range, the Contractor may proceed using approved hot and cold weather procedures as defined by the Masonry Institute of America. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work and shall provide all necessary protection and follow all work procedures to avoid damage to existing material assemblies not a part of the work in the Section:
 - 1. Minimize levels of dust during mortar removal and masonry repointing operations.
 - 2. Protect open copings, reglets, and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall not be left exposed overnight or when inclement weather is predicted.
 - 3. Temporarily remove and store metal downspouts during masonry restoration work. Install temporary drainage leaders if required. Reinstall immediately upon completion of work in the immediate area. Protect open boots at grade from accumulation of masonry debris.
 - 4. Protect existing gutters and gutter outlets from damage and accumulation of mortar debris during restoration of brick chimneys.
 - 5. Protect window sashes and frames with plywood or other sturdy barrier during repointing and repair of masonry around window openings.
 - 6. Protect the existing roof surfaces from damage during the course of the masonry restoration work. Repair all damage to wood and metal roofing, gutters, flashing, etc., to the satisfaction of and at no additional cost to the Owner.
 - 7. Remove and store light fixtures, signage, security devices, and miscellaneous appurtenances from masonry surfaces to be repointed. Provide temporary protection for exposed fixture boxes.
- C. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection, and protect nearby vehicles and adjacent structures from damage during the course of the work.
- D. The Contractor shall coordinate brick repairs with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Water: Clean and potable

2.02 PATCHING HISTORIC BRICK

- A. Submit replacement brick product information and list of Manufacturer(s) for Architect approval.

- B. Equipment:

1. Hand chisels, tooth chisel, mash hammers, pneumatic chisel
2. Natural or nylon bristle brushes
3. Trough, plastic bucket, trowel, mortar board, hawk, trowels

2.02 CONSOLIDATION PRODUCTS FOR BRICK

- A. Submit consolidation material information and list of Manufacturer(s) for Architect Approval.

- B. Equipment:

1. Trough, plastic bucket
2. Natural or nylon bristle brushes
3. Brush, roller, sprayer, clean broom

2.03 INJECTION GROUT

- A. Submit injection grout material information and list of Manufacturer(s) for Architect Approval.

- B. Equipment:

1. Masonry drill
2. Grout pump and tubing
3. Trough, plastic bucket
4. Mortar mixer or slow speed drill

PART 3 - EXECUTION

3.01 GENERAL

- A. The extent of the brick repair shall be reviewed by the Architect on site prior to beginning operations. The Contractor shall submit a schedule including methods and materials to be used.
- B. The Contractor shall complete a survey of the condition of the mortar and masonry to include:
 - 1. Notation of existing general masonry failures that contribute brick and mortar losses to be scheduled for repair prior to this work.
 - 2. Analysis of brick composition and determination of density.
- C. The Contractor shall complete masonry cleaning prior to beginning brick repair or replacement work.

3.02 BRICK REPAIR - PATCHING

- A. Remove all loose material plus and additional ¼ inch to sound substrate.
- B. Cut ½-inch shoulder around patch area with a square cut at edges. Do NOT patch areas with feathered edges.
 - 1. Score the area with a toothed chisel.
- C. Clean substrate with water, removing all dust and debris.
- D. Moisten surface with clean, potable water. Substrate should be glistening wet with no pooling of water. Do NOT allow to dry before application of patch material.
- E. Mix patching material with clean, potable water following manufacturer's instructions.
- F. Apply a ⅛-inch coat of patch mix to the wet brick substrate, making sure to coat shoulders. Work on an area sufficiently small so that material does not dry out.
 - 1. If the patch material dries out before application of the mortar coat, scrape off, rewet surface, and reapply.
- G. While base patch material is still wet, apply the patch mortar coat into the base patch coat. Build up material to a minimum of ⅛ inch beyond the surface of the original brick.
 - 1. While the mortar is still damp, scrape the mortar down, leaving ⅛ inch beyond brick and allow to dry to the consistency of damp sand.
 - 2. Clean around edge of the patch with a sponge and water to remove any excess mortar.

- H. After initial set (material should not stick to tools), scrape away excess mortar a little at a time until the desired profile is achieved.
 - 1. Tool or texture to match the original brick.
- I. Clean around the edge of the patch with a sponge and water. Do NOT wet the patched area. Repeat cleaning process, using clean water, to avoid leaving residue or halo around patch.

3.03 BRICK CONSOLIDATION

- A. Contractor shall follow manufacturer's application instruction. Apply the consolidant using the same methods used to prepare the approved mock-up.
- B. Substrate must be sound, dry, clean, and free of loose particles, oils, grease, or other coatings or substances.
- C. Mix consolidant thoroughly until homogeneous, in accordance with manufacturer's instructions.
- D. Apply by brush, roller or low pressure sprayer in sufficient quantity to thoroughly saturate substrate. Do not flood or create pooling. Application to mortar joints is unnecessary and should be avoided.
 - 1. With a clean brush or broom, remove excess material.
- E. Let cure for 24 hours.
- F. Clean adjacent areas and tools immediately.

3.04 BRICK INJECTION GROUT

- A. The Contractor shall follow manufacturer's product and installation instruction. Repairs with injection grout shall be reviewed by the Architect.
- B. The Contractor shall provide the Architect with a schedule for injection grout with approved compressive strength, compatible with the brick masonry substrate.
 - 1. Cementitious grouts are not to be used to fill dynamic cracks caused by structural failures, such as ongoing settlement, structural instability, thermal expansion, or corrosion due to embedded metals.
- C. Loose brick, and unbonded mortar must be replaced and/or repaired prior to crack injection.
- D. Drill injection holes to enable delivery of grout the full length and depth of cavity to be filled.
 - 1. Transverse (perpendicular to surface) cracks or voids: Drill into the face of the crack at a downward angle to a depth of ½ the masonry thickness

2. Lateral (parallel to surface, delaminating layers) cracks: Drill near the top and bottom of the area to be filled, beginning at the upper and lower corners at 3- to 9-inch intervals along the top and lower edges of the cavity.
 3. Drill the lower row level, at a 90-degree angle; drill the upper row of holes at a downward angle.
 4. Drill holes slightly larger in diameter than the pressure hose used for grout installation (e.g., 3/4-inch hole for 1/2-inch tube, or 1/4-inch hole for 1/8-inch tube)
- E. Seal face of the crack with temporary non-staining clay, sealant, or mortar.
- F. Flush all crack and void cavities thoroughly with water to remove as much dirt, debris and contaminants as possible and to pre-saturate the areas to be grouted. Continue until clean water exits from the lowest hole.
1. Surfaces should be pre-wet for 20 minutes
 2. When more than two hours has passed or surfaces have dried, flush with water to re-wet.
- G. Mix mortar according to manufacturer's instructions.
1. Mix the amount of material that will be used in 10 to 30 minutes.
 2. Discard material once it starts to set. Do NOT re-temper or add water.
- H. Select a fill method: Fill openings either from the top holes until material is discharged at the bottom, OR fill at the bottom, then plug the opening and fill from the top.
- I. Clean adjacent areas and tools immediately.
- J. Keep repair damp through curing period, 1-7 days depending on conditions.

3.05. BRICK – VERTICAL CRACK REPAIR

- A. Rake masonry joints to approximately 12 inches on either side of the crack to be repaired and a minimum depth of 1 1/2 inches. Rake entire crack down to sound mortar (where applicable).
1. Using a grinder, begin working from the center of the joint to remove the majority of the existing mortar from the center of the joints. Use a chisel to clean remaining mortar from the edges of the joint.
 2. Use a hand chisel to finish joints adjacent to door and window openings to avoid damage to frames and trim.
 3. If work is found unacceptable, all raking shall cease without additional cost to the Owner until deficiencies in tools, workmanship, or methodology have been corrected to the Architect's satisfaction.

- B. Where cracks extend through individual bricks, remove and replace cracked bricks with new toothed into the adjacent masonry.
- C. Repoint all joints full depth. Bed reinforcing rods in the horizontal joints every fourth course. Rods shall extend at least 12 inches on either side of the crack. Leave joints slightly recessed for subsequent stucco application if required.

3.06 FINAL REPORT

The Contractor shall:

- A. Revisit the site with the Architect to compare the finish and color of the repair to see if the desired affect has been achieved after the brick repairs have been executed and work has cured at least 30 days.
- B. Document the work and finished product with photographs.
- C. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Terra-cotta and ceramic properties
- B. Replacement and substitute materials
- C. Procedures for replacement

1.03 RELATED SECTIONS

- A. Section 04214.02 – Terra-cotta Patching and Glaze Repair
- B. Section 04214.03 – Replacement Anchoring
- C. Section 04100 – Historic Mortar
- D. Section 04400.01 – Identifying Masonry Types and Failures
- E. Section 07900 – Joint Sealants

1.04 DEFINITIONS

- A. Terra-cotta. Terra-cotta is an enriched molded clay brick or block. Terra-cotta refers to a high grade of weathered or aged clay that, when mixed with sand or with pulverized fired clay, can be molded and fired at high temperatures to a hardness and compactness not obtainable with brick.

- B. Glazed Terra-cotta. Terra-cotta blocks are generally finished with a glaze—a slip glaze (clay wash) or an aqueous solution of metal salts, brushed or sprayed on the air-dried block before firing. Glazing changes the color, imitates different finishes, and produces a relatively impervious glass-like surface on the weather face of the final product.
- C. Architectural Terra-cotta. Architectural terra-cotta is a term used to distinguish the masonry material used to form and decorate buildings from other forms of terra-cotta that have been and continue to be used primarily in domestic ceramics and sculpture.
- D. Fireproof Terra-cotta. Fireproof terra-cotta is a form of hollow, unglazed (rough-finished) terra cotta block extruded as tile-like units. These inexpensive, light-weight, and fireproof units were well suited for use with I-beams and were used between floor beams, as sheathing of skeletal iron or steel frames, and inside walls and partitions.
- E. Ceramic Veneer. Ceramic veneer was developed in the 1930s and is a glazed terra-cotta tile that is ribbed on the back (similar to bathroom tile). Unlike architectural terra-cotta, ceramic veneer tiles are not hollow cast. Ceramic veneer terra-cotta is often attached to a grid of metal ties anchored to the building.

1.05 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at http://www.nps.gov/history/hps/tps/standards_guidelines.htm.
- B. *Preservation Brief No. 7: The Preservation of Historic Glazed Architectural Terra-Cotta* available online at NPS website at <http://www.nps.gov/history/hps/tps/briefs/brief07.htm>.
- C. General Services Administration. *Historic Preservation Technical Procedures for Terra Cotta* available online at <http://w3.gsa.gov/web/p/hhttp.nsf/Repair%20Procedures?OpenView&Start=1&Count=30&Expand=3.5#3.5>.
- D. Specifications contained in this section follow Susan M. Tindall. *How to Prepare Project-Specific Terra-Cotta Specifications*. *APT Bulletin*, Vol. 21, No. 1 (1989); and *Terra Cotta Replacement*. *APT Bulletin*, Vol. 20, No. 3, Anniversary Issue. (1988).
- E. ASTM C 67 Standard Methods of Sampling and Testing Brick and Structural Clay.
- F. ASTM C 126 Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units, Section 5, Properties of Finish.
- G. *Public Works Specifications: Ceramic Veneer*. Architectural Terra Cotta Institute, October 1961 (AIA File No. 9: Ceramic Veneer).

1.06 SUBMITTALS

- A. The Contractor shall submit a detailed schedule to Architect for approval of the work to be conducted, including an assessment of the problem areas, historic terra-cotta analysis, and detailed procedure for terra-cotta replacement and repair;
- B. The Contractor shall submit manufacturer's product literature to the Architect for new terra-cotta or cast stone, and anchoring material and products specified. For new terra-cotta or cast stone, provide test data as described in Paragraph 1.05B below. Product literature shall also include specification data, Material Safety Data Sheets and instructions for storage, handling, and use;
- C. The Contractor shall submit Shop Drawings to the Architect for review and approval to include the following:
 - 1. Production details, construction of the terra-cotta / cast-stone replacement units, dimensions, and relationship to adjacent material in sufficient detail to address manufacture, handling, and erection. **Field verification of required dimensions is the responsibility of the Contractor and the terra-cotta manufacturer.** Details of sections and connections for fastening the block units; anchorage, flashing, counter-flashing, and accessory items. Details shall be at least ½ full size.
 - 2. Separate identification marks assigned by the Contractor for each replacement unit. Units should be labeled with this identification mark on the shop drawings to show the location of the replacement units for installation. Each replacement unit should be permanently marked with year of manufacture and identification mark.
- D. Material Samples
 - 1. Glaze and Body: Proposed glaze and body samples for new terra-cotta or cast stone shall be submitted to the Architect within the specified time period. Samples should cover the expected range of color and texture of surface finish as required to match to match original finish. Samples selected and approved by Architect shall be standard for reproduction units.
 - 2. Anchors: Submit two of each of the dowels, anchors, bolts, and fasteners to be used in the work under this section. Samples will be approved by the Architect.
- E. Test Reports:
 - 1. The Contractor shall arrange for sampling and testing of new terra-cotta prior to shipment, allowing at least 30 days from time of sampling for completion of tests. Expense of sampling and testing is to be borne by Contractor.
 - 2. All testing should be performed by an independent testing facility meeting the requirements specified in the "Recommended Requirements for Independent Laboratory Qualifications" published by the American Council of Independent Laboratories and ASTM E 699.
- F. Statement of Application. The Contractor shall submit letter from manufacturer verifying that new terra-cotta units are suitable for intended use.

1.07 QUALITY ASSURANCE

- A. Work Experience. The Contractor to perform the work in this section shall have a minimum of ten (10) years of recent experience in terra-cotta restoration and installation. Such experience must include projects of comparable scope and extend to this project.
1. The qualifying firm must designate an individual with commensurate experience to act as the "Terra-Cotta Foreman" for purposes of this contract. Said Terra-Cotta Foreman designation must be approved by the Architect. He/she shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*.
- B. Testing: Where new terra cotta is required, a minimum of six (6) representative samples of existing terra-cotta material will be submitted for testing. The following tests will be undertaken by a laboratory that meets the conditions specified in 1.04 E above to correctly identify the characteristics of the original material:
1. Water Absorption (24 hour)
 2. Boil Absorption (1 hour)
 3. Moisture Expansion (reheat test)
 4. Water Uptake with and Without Glaze
 5. Compressive Strength
 6. Petrographic Examination
 7. Glaze Adhesion
 8. Coefficient of Thermal Expansion
- C. Manufacturers: The Contractor shall:
1. Obtain materials from manufacturers that will send a qualified technical representative to the project site for the purpose of advising the Terra-Cotta Foreman and those undertaking the installation work of the procedures and precautions for the use of their materials.
 2. Obtain terra-cotta or cast-stone units from an established specialty plant having the capacity and facilities for producing material of specified quality and finish, and in sufficient quantity so as to not delay progress of the work. Plant shall be that of a producer recognized by the industry as a manufacturer of this type of material, who can show successful completion of work of comparable quality and scope.
- D. Fabrication. Do NOT proceed with fabrication of products prior to completed review and approval of shop drawings, and approval of material samples and mock-up.

- E. Warranty: Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.08 MOCK-UPS

- A. Prior to the start of demolition and installation, the Contractor shall install a single terra-cotta / cast-stone unit at a location selected by the Architect. All methods, materials, and workmanship required for the project shall be demonstrated.
 - 1. The Contractor shall NOT proceed with demolition and replacement until mock up is approved by Architect.
 - 2. Retain mock-ups during construction as the standard for judging complete work.
 - 3. Incorporate approved mock up into the finished work as directed by the Architect.
- B. The Contractor shall prepare up to three additional mock-ups without further compensation.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six months shall not be used.
- B. The Contractor shall inspect terra-cotta / cast stone immediately upon delivery to site. The Contractor shall reject terra-cotta / cast stone units damaged in transit, or that fail to meet specifications and quality of samples, and shall notify the manufacturer in writing. Rejected units should be stored off-site or returned to manufacturer.
- C. Terra-cotta / cast-stone units shall be stored on pallets or dunnage in an area away from general construction operations to avoid damage by other trades. Units shall be stored according to sequence of installation to avoid unnecessary handling of terra-cotta / cast stone.
 - 1. Units shall stay in their original packing material until ready for use. Crates shall not be stacked and shall remain in an upright position on firm, level, and smooth surfaces. The units shall be protected from weather to prevent staining before setting.
- D. Cementitious materials shall be stored off the ground in a clean, dry location. The Contractor shall prevent contamination of materials likely to cause staining and other defects, and shall remove materials that are damaged or otherwise unsuitable for use from the job site.
- E. Materials shall be stored in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Owner prior to the delivery of materials.

1.10 SEQUENCING AND SCHEDULING

- A. The Contractor shall furnish terra-cotta / cast stone manufacturer with schedule of pieces to be manufactured and an installation sequence so that terra-cotta / cast stone may be produced in the variety and quantity needed to match the installation sequence. The Contractor shall provide:
1. A photograph or isometric sketch showing the dimensions of each type of unit to be produced. **Field verification of required dimensions is the responsibility of the Contractor and the terra-cotta/cast stone manufacturer.**
 2. Elevations and a site plan showing the location of units to be replaced.
 3. A performance specification based on original material and location conditions.
 4. An installation schedule showing piece counts and time frames for installation.
 5. At least three (3) samples of the original material to be used for color matching and compatibility of the clay body and glaze.
- B. Schedule should reflect other considerations such as costs, weather, structural repairs, and building use requirements.

1.11 PROJECT / SITE CONDITIONS

- A. The normal temperature range for the work of this Section shall be when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are expected to fall outside this range, the Contractor shall employ hot and cold weather procedures as published by the Masonry Institute of America.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work and shall provide all necessary protection and follow all work procedures to avoid damage to existing material assemblies not a part of the work in this Section. The Contractor shall:
1. Prevent masonry patching materials from staining the face of masonry or other surfaces to be left exposed. Immediately remove all patching materials that come in contact with such surfaces. Protect sills, ledges, and projections from droppings.
 2. Minimize levels of dust during mortar removal and masonry repointing operations.
 3. Protect open copings, reglets, and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall not be left exposed overnight or when inclement weather is predicted.
 4. Temporarily remove and store metal downspouts and downspout boot covers to remain during terra-cotta / cast stone work. Install temporary drainage leaders if required. Reinstall immediately upon completion of work in the immediate area.
 5. Protect existing scuppers and downspout outlets from damage and accumulation of mortar debris during restoration of terra-cotta/cast-stone parapets.

6. Where existing masonry components are to be removed, protect adjacent masonry units and surfaces from chipping and cracking during the removal process. Where components are to be reinstalled, the Contractor shall store salvaged components in a safe location. Protect from theft and damage until reassembly.
- C. The Contractor shall provide visible barriers and/or warning tape around the perimeter of the work area for visitor protection. Nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- D. The Contractor shall cover partially completed work when work is not in progress.
- E. The Contractor shall coordinate terra-cotta / cast stone installation with the other trades involved in exterior and interior restoration work including but not limited to masonry cleaning, sealants, and painting.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

Follow recommendations for the selection of product suppliers as specified above. The Contractor shall submit manufacturer information to the Architect for approval.

2.02 TERRA-COTTA / CAST STONE DESIGN

- A. Terra-cotta / cast-stone units shall be outlined on Architectural Drawings with respect to exterior appearance and profile.
 1. All pieces shall be manufactured for the particular installation conditions to minimize any cutting in the field. The Contractor shall adjust individual pieces to accommodate the setting sequence. (In concrete or steel frame building, the veneer or facing material should be fully and continuously supported at each floor level on shelf supports. The supports should be of adequate strength and stiffness to rigidly connect to the structural frame, steel shelf angles, or supports, and in all cases, should be located in the mortar joints. The strength of the terra-cotta / cast stone should not be unnecessarily reduced by cutting the webs to receive the steel.)
 2. Adjust Terra-Cotta / cast stone to accommodate relieving angles, vents, weeps, expansion joints, etc.
 - a. Proper provision should be made for expansion joints, at shelf supports, over column cases, etc., to prevent the development of disruptive stresses cause by deflection, wind pressure, temperature changes, settlement and like forces.
 - b. Properly constructed flashing should be provided.
 - c. Reglets shall be provided to receive gutter linings and flashing when the joints cannot be used for the purpose. Reglets shall be not less than ¾-inch deep, unless otherwise specified.
 - d. The volume changes incident to the setting and hardening of concrete, and the variations in volume of concrete due to humidity and temperature conditions

require provisions to allow free movement of the supporting frame and make it undesirable to completely fill a facing applied to a concrete structure.

2.03 TERRA-COTTA PROPERTIES

- A. Surface Features: Match color, texture, shape, size, profile, and other characteristics of existing original units.
- B. Terra-cotta units shall conform to the physical requirements listed below as preformed in accordance with ASTM Specifications.
 - 1. Compressive Strength – ASTM C67
 - 2. Absorption (5 hour boil) – ASTM C67
 - 3. Saturation Coefficient – ASTM C67
 - 4. Crazeing – ASTM C126
- C. Unit Sizes:
 - 1. As indicated on approved shop drawings.
 - 2. Size partial units with diamond-tipped, water-cooled blade.
 - 3. Dimension for setting with uniform joint width to match the existing or as otherwise approved by the Architect.
 - 4. Face Dimension Tolerances: Length and width of exposed face of each unit not to vary more than 1/16 inch over or under the dimensions specified on approved shop drawings.
 - 5. Warpage Tolerances: Exposed face of each unit not to vary from the true plane by more than 0.005 inch per inch of length.
- D. Chipping:
 - 1. Location, depth and diameter of chip on an exposed face or edge not to exceed ¼ inch from edges and ⅜ inch from corners.
 - 2. Maximum percentage of chipped units permissible per crate or pallet not to exceed 10% of content.
 - 3. Total number of chipped units not to exceed 10% of replacement quantity.
- E. Properties of Finish: In accordance with ASTM C126, finished faces shall be free from crazeing, blisters, pinholes, crawling, staining, or other imperfections detracting from the appearance of the unit when viewed from a normal viewing distance or a distance of 15 feet. Finish is to match the approved sample.

2.04 CAST STONE PROPERTIES

- A. Cast stone to match existing terra-cotta cornice trim shall be fabricated using Portland cement, aggregates, and pigments as required. Replacement cast stone shall meet the following requirements:
 - 1. Compressive strength: 6,500 psi minimum at 28 days in accordance with ASTM C 1194.
 - 2. Absorption: 6% maximum at 28 days in accordance with ASTM C 1195.
- B. Cast stone materials:
 - 1. Portland Cement: ASTM C 150, Type I, gray or white as required to match existing.
 - 2. Aggregate: Well-graded and washed sands and gravel meeting ASTM C 33.
 - 3. Pigments: Inorganic, lime-proof, and non-fading mineral pigments.
 - 4. Reinforcing Steel (where required): New billet steel bars ASTM A 615, Grade 40 or 60, epoxy coated in accordance with ASTM D 3963.
- C. Fabrication:
 - 1. Fabricate new cast-stone units with a minimum wall thickness of 1 inch and partitions of such thickness and so spaced as to provide maximum strength and reinforcement. Each piece shall be provided with the necessary anchor holes or slots and hand holes, formed so as to properly engage the anchor system to the substrate below.
 - 2. Fabricate new cast-stone units to exactly match the dimensions, profiles, and surface texture of the existing units. Exterior faces shall be plumb, straight, and level. Molded edges shall be straight and crisp.

2.05 ACCESSORIES

- A. Anchors: Stainless steel, ANSI A167, type 304 or type 316, ½-inch-diameter round stock or square bars of equal cross section.
- B. Dowels: Threaded stainless steel, ANSI A167, type 304, ¼-inch minimum diameter, by length required.

2.06 REPLACEMENT AND SUBSTITUTE MATERIALS:

- A. It is generally preferred to retain as much of the original fabric as possible and to replicate replacement units as closely as possible to match the original. For extensive projects, where limitations in supply (especially since most terra-cotta requires custom replication),

expense, and length of time to manufacture and install new units may hinder repairs, compatible substitute materials may be used.

- B. Substitute materials require evaluation of use and type, and should be sampled to find the material that is compatible in material properties, weight, and finish, and meets the approval of the Architect. Substitute materials for terra-cotta units include:
 - 1. Stone. Although stone can be a suitable replacement, is durable, and can be finished to match the terra-cotta units, it is a heavier material. The increased weight can cause additional stress to the building.
 - 2. Fiberglass. A viable alternative for elaborate ornamentation that has to be duplicated. Drawbacks in using fiberglass replacement are color compatibility, fire code violations, and poor weathering and aging.
 - 3. Precast Concrete Units. Precast concrete, as with fiberglass, can easily be used to replicate elaborate ornamentation in a modular fashion. They can also be cast hollow, use lightweight aggregate, and be made to accommodate metal anchoring as needed. Concrete can be colored or tinted to match the original material with excellent results; it is cost effective, and once production is in process, it can be produced quickly. Clear masonry coatings are preferred on the weather face of the precast concrete units for visual compatibility, to prevent moisture absorption, to obtain proper reflectivity, and to prevent weathering.

PART 3 - EXECUTION

3.01 GENERAL

- A. Project-specific specifications are required for all terra-cotta work contained herein. As material and methods of construction vary greatly, each building must be evaluated, and work scheduled accordingly. The Contractor shall submit schedules, including methods and materials to be used.
- B. Terra-cotta replacement shall use techniques, methods, and materials as similar as possible to those of the original. Work should be sequenced not only to assure the stability of the structure and protection of personnel during the work, but also to address a sensible order of construction to integrate new work with existing work.
- C. The Contractor shall complete a survey to determine the extent and severity of the deterioration and whether the deterioration involves visual aspects of the surface terra-cotta, the failure of joints between units, the structural failure of the terra-cotta units, the failure of support systems, or the overall structural stability of the building façade.
 - 1. Notation of existing general failures that contribute to terra-cotta deterioration shall be noted and should be scheduled for repair prior to completion of the work scheduled or in conjunction with terra-cotta replacements.
 - 2. Complete testing shall be conducted; the extent and type of analysis will be determined by the Architect.

- D. The Contractor shall protect adjacent materials, installed non-masonry materials, and openings.
- E. Manufacturer's instructions for mixing and installation of materials and equipment use shall be followed.
- F. Façade cleaning shall be completed prior to beginning replacement work.
- G. The Contractor shall stabilize deteriorated and loose units that are not scheduled to be removed or that cannot be easily removed. Areas where units are missing or have been removed should be protected against moisture penetration until replacement units can be installed.

3.02 GENERAL PROCEDURE FOR REPLACEMENT OF TERRA-COTTA

- A. When replacing glazed architectural terra-cotta, all of the original deteriorated material should be completely removed. Half bricks or similar cosmetic replacement techniques are not recommended.
 - 1. Remove the deteriorated units and anchoring. Anchoring must be replaced with new anchors when installing replacement units.
 - 2. Retain the original backfill.
- B. Prepare the area to accept new mortar. Area should be free from dust, dirt, mortar, and other debris. Brush the area free of debris and dirt with a natural or nylon bristle brush. Do NOT use metal bristle brushes.
- C. When possible and where applicable, replacement units should be anchored in a manner similar to the original. Both structural and visual compatibility are major considerations when choosing replacement materials.
 - 1. Replacement unit shall be fitted into the existing backfill by boring a hole or slot for the anchor and bedding the anchor and the unit itself in mortar. Terra-cotta units and their facsimiles cannot be simply mortared in place. Always use anchoring to install new units.
- D. Mortar Joints: The procedure for pointing terra-cotta is similar to pointing masonry joints. Surfaces should be well sealed to prevent moisture penetration. Mortar should be compatible with current building conditions as well as the existing terra-cotta units. See Section 04100, Historic Mortar.
- E. The Contractor shall protect terra-cotta from splatter when using sealants and caulking. The units must be cleaned immediately. Generally, a barrier, such as petroleum jelly, can be applied for easy clean up.

3.03 FINAL REPORT

- A. The Contractor shall revisit the site with the Architect after the new mortar has cured at least 30 days to see if desired effect has been achieved.
- B. Document the work and finished product with photographs taken before, during, and after completion of the work.
- C. The Contractor shall provide a written summary of the project and results upon final inspection and approval. The summary shall include a discussion of steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interiors Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- E. Terra-cotta patching
- F. Terra-cotta glaze repair

1.03 RELATED SECTIONS

- A. Section 04100 – Historic Mortar
- B. Section 04214.01 – Historic Terra-cotta and Ceramics Properties and In-Kind Replacement.
- C. Section 04214.03 – Replacement Anchoring
- D. Section 04510 – Masonry Cleaning
- E. Section 07900 – Joint Sealants

1.04 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. *Preservation Brief No. 7: The Preservation of Historic Glazed Architectural Terra-Cotta* available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief07.htm>>.

- C. General Services Administration. Historic Preservation Technical Procedures for Terra Cotta Repair, Patching, Sealing, Repointing, Reinforcing, and Replacing. Available online at <<http://w3.gsa.gov/web/p/hptp.nsf/Repair%20Procedures?OpenView&Start=1&Count=30&Expand=3.5#3.5>>.
- D. Specifications contained in this section follow Susan M. Tindall. How to Prepare Project-Specific Terra-Cotta Specifications. *APT Bulletin*, Vol. 21, No. 1 (1989); and Terra Cotta Replacement. *APT Bulletin*, Vol. 20, No. 3, Anniversary Issue. (1988).
- E. ASTM C 67, Standard Methods of Sampling and Testing Brick and Structural Clay.
- F. ASTM C 126, Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units, Section 5, Properties of Finish.
- G. ASTM C 144, Standard Specification for Aggregate for Masonry Mortar.
- H. ASTM C 150, Standard Specification for Portland Cement.
- I. ASTM C 207, Standard Specification for Hydrated Lime for Masonry Purposes.
- J. ASTM C 270, Standard Specification for Mortar for Unit Masonry
- K. Public Works Specifications: Ceramic Veneer. Architectural Terra Cotta Institute, October 1961 (AIA File No. 9: Ceramic Veneer).

1.05 SUBMITTALS

- A. The Contractor shall submit a detailed schedule to the Architect for approval of the work to be conducted, including an assessment of the problem areas, historic terra-cotta analysis, and detailed procedure for terra-cotta replacement and repair.
- B. Product Literature:
 - 1. The Contractor shall submit manufacturer's product literature to the Architect for coatings, patching materials, proprietary patching mortars, anchors, and other products specified. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling, and use.
- C. Material Samples:
 - 1. Coatings: Proposed glaze and coating samples for terra-cotta repair shall be submitted to the Architect for approval. Samples should cover the expected range of color and texture of surface finish as required to match original finish. Samples selected and approved by the Architect to be standard for work covered in this section.
 - 2. Patching mortars: The Contractor shall provide three cured samples of each proposed patching mortar to be used for the project. The number of colors for which samples will be required shall be consistent with the range of bisque colors found on the project. Mortar samples shall present a minimum surface of 3x3 inches or 3 inches in diameter for evaluation of color and texture.

3. Anchors: The Contractor shall submit two of each type of the dowel, anchor, bolt, and fastener to be used in the work under this section. Samples will be approved by the Architect.

D. Test Reports:

1. The Contractor shall arrange for sampling and testing of terra-cotta prior to selection of appropriate mortars. Allow at least 30 days from time of sampling for completion of tests. Expense of sampling and testing to be borne by Contractor. Testing requirements are as listed in Section 04214.01, Historic Terra-cotta and Ceramics Properties and In-Kind Replacement.
2. All testing should be performed by an independent testing facility meeting "Recommended Requirements for Independent Laboratory Qualifications" published by the American Council of Independent Laboratories and ASTM E 699.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years of recent experience in terra-cotta restoration and installation, including at least three (3) projects of comparable scope and scale completed within the previous five years.
1. The qualifying firm must designate a given individual with commensurate experience to act as the "Terra-Cotta Foreman" for purposes of this contract. Said Terra-Cotta Foreman designation must be approved by the Architect. He/she shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*. The "Terra-Cotta Foreman" shall be present at the site whenever terra-cotta work is underway and shall remain on the project for the full duration of the terra-cotta repairs.
- B. Manufacturers: The Contractor shall:
1. Obtain materials from manufactures that will send a qualified technical representative to the project site for the purpose of advising the Installer of the procedures and precautions for the use of their materials.
 2. Obtain terra -cotta coatings and patch materials from an established manufacturer. Plant to be that of a producer recognized by the industry as a manufacturer of this type of material and who can demonstrate successful completion of work of comparable quality and scope.
- C. Fabrication: Refer to Section 04214.01 for new terra-cotta replacement specifications.
- D. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.07 MOCK-UPS

- A. The Contractor shall provide test panels for terra-cotta repairs at a location selected by the Architect or on pieces of appropriate masonry, using the approved repair mortars as directed by the Architect. He/she shall demonstrate all methods, materials, and workmanship required for the project, and prepare test panels for each color, texture, and type of material to be used. Coatings and finished mortar patch mortar samples will be reviewed based on color, texture, finish, and techniques employed.
 - 1. Do not proceed with terra-cotta repairs until mock-ups are approved by the Architect.
 - 2. Retain mock-ups during construction as standard for judging complete work.
 - 3. Incorporate approved mock-up into the finished work as directed by the Architect.
- B. More than one of each type of mock-up may be required to achieve approval. The Contractor shall prepare up to three additional mock-ups of each type if required at no additional cost to the Owner.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six months shall not be used.
- B. Store cementitious materials off the ground in a clean, dry location. Prevent contamination of materials likely to cause staining and other defects. Remove materials which are damaged or otherwise unsuitable for use from the job site.
- C. Materials shall be stored in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Owner prior to the delivery of materials.

1.09 PROJECT / SITE CONDITIONS

- A. The normal temperature range for the work of this Section shall be when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are expected to fall outside this range, the Contractor shall employ hot and cold weather procedures as published by the manufacturer of the patching materials and/or the Masonry Institute of America.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in this Section. The Contractor shall:
 - 1. Prevent masonry patching materials from staining the face of masonry or other surfaces to be left exposed. Immediately remove all patching materials that come in contact with such surfaces. Protect sills, ledges and projections from droppings.

2. Minimize levels of dust during mortar removal and masonry repointing operations.
 3. Protect open copings, reglets, and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall not be left exposed overnight or when inclement weather is predicted.
 4. Temporarily remove and store metal downspouts and downspout boot covers to remain during terra cotta / cast stone work. Install temporary drainage leaders if required. Reinstall immediately upon completion of work in the immediate area.
 5. Protect existing scuppers and downspout outlets from damage and accumulation of mortar debris during restoration of terra cotta/cast stone parapets.
 6. Where existing masonry components are to be removed, protect adjacent masonry units and surfaces from chipping and cracking during the removal process. Where components are to be reinstalled, the Contractor shall store salvaged components in a safe location, and protect them from theft and damage until reassembly.
- C. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection, and shall protect nearby vehicles and adjacent structures from damage during the course of the work.
- D. The Contractor shall cover partially completed work when work is not in progress.
- E. The Contractor shall coordinate masonry repairs and repointing with the other trades involved in exterior and interior restoration work, including but not limited to roofing, masonry cleaning, sealing, and painting.

PART 2 - PRODUCTS

2.01 GLAZE REPAIR

- A. **Manufacturers:** The Contractor shall obtain materials from an established manufacturer of industry-recognized products appropriate for the work in this section. Selected materials and manufacturers shall be approved by the Architect.
- B. **Materials:**
1. **Glaze Repair Material:** One-part, opaque, water-base exterior coating, containing silicone resin binders with excellent UV stability and allowing at least 90% moisture vapor transmission in accordance with ASTM E 96. All colors to be tested and approved by Architect.
 2. **Water:** Clean, potable water, free of oils, acids, alkalis, and organic matter.
- C. **Equipment**
1. Brushes
 2. Clean sponges

2.02 FACTORY MIXED TERRA-COTTA PATCHING MATERIALS

- A. The Contractor shall obtain materials from manufacturers that will send a qualified technical representative to the project site for the purpose of advising the Terra-Cotta Foreman and those undertaking the installation work of the procedures and precautions for the use of their materials.
- B. The Contractor shall obtain materials from an established manufacturer of industry-recognized products appropriate for the work in this section. Selected materials and manufacturers shall be approved by the Architect.
- C. Materials: Factory-prepared mortar mix for small patches shall be vapor permeable, frost and salt resistant, shrink resistant, and be physically compatible with the substrate, including but not limited to porosity, tensile, and compressive strength.
 - 1. Mortar mix shall be formulated to match color and texture of existing terra-cotta bisque. Only approved samples may be used.
 - 2. Mortar mix should not contain any synthetic additives.

2.03 JOB-MIXED TERRA-COTTA PATCHING MATERIALS

- A. Job-Mixed Setting and Patching Mortar shall meet standard compressive strength and permeability requirements for terra cotta in accordance with ASTM C 270-88a.
 - 1. Portland Cement: ASTM C 150-89 Type I or II
 - 2. Hydrated Lime: ASTM C 207-79, Type S or equivalent lime putty.
 - 3. Masons Sand: ASTM C-144, Clean sand, free of contaminants. Match samples provided for proper sand color.
 - 4. Mineral Colorants: Only when approved and necessary to match terra-cotta matrix or surface color.
 - 5. Other Admixtures: No accelerators (Calcium Chloride) or additives shall be used.

2.04 ACCESSORY MATERIALS

- A. Stainless-steel wire armature, or threaded rods and bolts. All materials are to be reviewed by the Architect.
 - 1. Wire shall be 12 gauge or heavier.
 - 2. Threaded rods shall be sized according to the need and loading requirements.
 - 3. Stainless steel shall be AISI Type 316.
- B. Water: Clean, potable water, free of oils, acids, alkalis, and organic matter.

- C. Glaze replacement coating: See Paragraph 2.01 above.
- D. Biocidal solution for cleaning exposed surfaces before glaze repair. Selected product must be approved by the Architect.

2.05 EQUIPMENT

- A. Masonry drill
- B. Hacksaw blade
- C. Power drill with mixing paddle
- D. Clean bucket
- E. Stiff, natural bristle brushes
- F. Hammer and wooden mallet
- G. Chisels
- H. Trowel
- I. Putty knife
- J. Natural or synthetic bristle paint brushes

PART 3 - EXECUTION

3.01 GENERAL

- A. Project-specific specifications are required for all terra-cotta work contained herein. As material and methods of construction vary greatly, each building must be evaluated, and work scheduled accordingly. The Contractor shall submit schedules including methods and materials to be used.
- B. Terra-cotta repairs and restoration shall use techniques, methods, and materials as similar as possible to those of the original. Work should be sequenced not only to assure the stability of the structure and protection of personnel during the work, but also to address a sensible order of construction to integrate new work with existing work.
- C. The Contractor shall complete a survey to determine the extent and severity of the deterioration and whether the deterioration involves visual aspects of the surface terra-cotta, the failure of joints between units, the structural failure of the units themselves, the failure of support systems, or the overall structural stability of the building façade.
 - 1. Existing general failures that contribute to terra-cotta deterioration shall be noted and should be scheduled for repair prior to completion of the planned restoration work or in conjunction with terra-cotta replacements.

2. Complete testing shall be conducted, the extent and type of analysis to be determined by the Architect. Work shall not proceed until the test results have been submitted and reviewed.
- D. The Contractor shall protect adjacent materials, installed non-masonry materials, and openings.
- E. Manufacturer's instructions for mixing and installation of proprietary materials and equipment use shall be followed.
- F. Complete façade cleaning prior to beginning terra-cotta repair or restoration work.
- G. Stabilize deteriorated and loose units that are not scheduled to be removed or that cannot be easily removed. Areas where units are missing or have been removed should be protected against moisture penetration until replacement units can be installed.

3.02 TERRA-COTTA EXAMINATION AND CONDITION ASSESSMENT

The Contractor shall inspect surfaces for the following:

- A. Missing units
- B. Deteriorated or missing mortar
- C. Large cracks (particularly those running through multiple units)
- D. Material failures such as spalls and parallel crazing
- E. Presence or absence of water-shedding devices such as flashings, gutters, and downspouts
- F. Bulges in the terra-cotta, particularly at floor level and at piers
- G. Rust stains from failing anchors
- H. Efflorescence from excessive moisture in the wall
- I. Internal damage: Strike surface with a wooden mallet to determine internal damage. Damaged units produce a flat thud, while undamaged units give off a clear ringing sound. Check for consistent tonal values to aid in the location of damaged units.

3.03 TERRA-COTTA GLAZE REPAIR

- A. Repair only those terra-cotta surfaces that have lost their surface glaze. Do not apply coating where glaze remains intact.
- B. Lightly brush spalled areas to remove loose material and glaze that has failed but has not fallen from the face of the unit.
- C. Clean exposed terra-cotta surfaces with a sponge and biocidal solution applied in accordance with manufacturer's instructions. Allow to dry completely before application of glaze replacement coating.

- D. Prime areas to be sealed with specified primer using brush or roller application, according to manufacturers instructions. Promptly remove all primer from surrounding surfaces. Allow primer to dry 10 hours before applying masonry coating.
- E. Apply breathable masonry paint in two coats, strictly adhering to manufacturer's instructions and recommendations. Brush apply first coat, wait 24 hours, and brush apply second coat.
- F. Coatings shall only be applied to the masonry units. Do not coat or seal masonry joints with glaze or sealants.
- G. Verify color match after material has dried.

3.04 TERRA-COTTA REPAIR PATCHING

- A. Remove broken, spalled, and cracked terra-cotta and mortar at areas to be patched by scraping and chipping the damaged areas to expose sound, clean, terra-cotta surfaces.
- B. Cut back a minimum of ½ inch or to sound terra-cotta with chisel or hammer. Square off edges. Score surface to receive patch with chisel.
- C. Where the depth of patch exceeds 1½ inches and the size exceeds 6 inches square, set anchor pins (4 per square foot), and install wire armature to hold patching material. Ensure a minimum of 1 inch coverage over all reinforcing for the finished patch.
- D. Undercut at least two of the edges to provide a good key for the repair.
- E. Thoroughly clean all loose terra-cotta particles, mortar, and other dust and debris from surfaces to be repaired by blowing with compressed air and then with a soft brush and water.
- F. Pre-moisten terra-cotta with clean water and a stiff natural bristle brush to prevent patching mortar from drying out prematurely. Do not over-saturate or leave standing water.
- G. Unless indicated otherwise in mortar manufacturer's instruction, apply a thin slurry coat of mortar over the patch area.
- H. Mix patching mortar, following manufacturer's recommendations, into a stiff, workable consistency that holds its shape when applied and will not run, sag, or crumble. Mix for at least 5 minutes.
- I. Apply mortar mix with a trowel in lifts, working material under and around all reinforcing armature. Allow an initial set before proceeding with the next layer. Hand spray with water before each application. The depth of lifts should be adjusted to the type of mortar, wind, humidity, and temperature conditions for adequate curing.
- J. Slightly overfill the patch to allow for shrinkage and finishing. Do not feather edge.
- K. Throw away mixture that is not used within 30 minutes. Do not retemper mix.

- L. Finish: Allow patching material to harden for length of time recommended by manufacturer, then carefully cut back and tool to match adjacent surfaces. Maintain mortar joints; do not install patching material across mortar joints.
 - 1. Finish to match unglazed units with 1 or 2 applications of microcrystalline wax.
 - 2. For glazed surfaces, paint to match the glaze color and texture with water tolerant paint. See 3.03 – Protective Coatings above.
 - 3. For damaged areas that are smaller than ½ inch deep or for old patches where the color does not match the terra-cotta, repair by applying one coat of colored masonry acrylic-cement finish to the surface to match terra-cotta color.
- M. Wipe away all excess mortar as the work progresses. After mortar is thoroughly set and cured, clean new masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water.

3.05 FINAL REPORT

- A. The Contractor shall document the work and finished product with photographs taken before, during, and after completion of the work.
- B. The Contractor shall provide a written summary of the project and results upon final inspection and approval. The summary shall include a discussion of steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate will be provided by the Architect.
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- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Assessment of terra-cotta interior armature and anchoring system
- B. Repair and/or replacement of anchoring system

1.03 RELATED SECTIONS

- A. Section 04100 – Historic Mortar
- B. Section 04214.01 – Historic Terra-Cotta and Ceramic Properties and In-Kind Replacement
- C. Section 04214.02 – Terra-Cotta Patching and Glaze Repair
- D. Section 04510.01 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Stains, and Bio-Growth

1.04 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. *Preservation Brief No. 7: The Preservation of Historic Glazed Architectural Terra-Cotta*. Available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief07.htm>>.

- C. General Services Administration. Historic Preservation Technical Procedures for Terra Cotta Repair, Patching, Sealing, Repointing, Reinforcing, and Replacing.
- D. National Association of Architectural Metal Manufacturers (N.A.A.M.M.) Code of Standard Practice for the Architectural Metal Industry, Publication AMP – 555, December 1992.

1.05 SUBMITTALS

- A. The Contractor shall submit a detailed schedule to Architect for approval of the work to be conducted, including an assessment of the problem areas and detailed procedure for terra-cotta replacement and repair.
- B. Product Literature: The Contractor shall:
 - 1. Submit manufacturer’s product literature to the Architect for adhesives and anchoring materials specified. Product literature shall indicate conformance to referenced standards and shall also include specification data, Material Safety Data Sheets, and instructions for storage, handling and use.
 - 2. Submit product information on mortars and other products to be used for reassembly of terra-cotta masonry. See Sections 04214.01 and 04214.02.
- C. Shop Drawings: Where new metal fabrications are required for repair or replacement of terra-cotta anchorage system, provide shop drawings of all such pieces. At a minimum, drawings shall indicate dimensions, materials, connection details, piece numbers, and quantities.
- D. Material Samples: The Contractor shall submit two samples of each type of dowel, anchor, bolt, and fastener to be used in the work under this section. Samples will be approved by the Architect.

1.06 QUALITY ASSURANCE

- A. Work Experience. The Contractor to perform the work in this section shall have a minimum of ten (10) years of recent experience in terra-cotta restoration and installation including at least three (3) projects of comparable scope and scale completed within the previous five years.
 - 1. The qualifying firm must designate a given individual with commensurate experience to act as the “Terra-Cotta Foreman” for purposes of this contract. Said Terra-Cotta Foreman designation must be approved by the Architect. He/she shall demonstrate a working knowledge of the Secretary of the Interior’s Standards for Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings. The “Terra-Cotta Foreman” shall be present at the site whenever terra-cotta work is underway and shall remain on the project for the full duration of the terra-cotta repairs.
- B. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Proprietary materials shall be delivered to the site in original packaging, unopened, with manufacturer's name and product identification thereon. The Contractor shall protect materials from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used and products stored longer than six months shall not be used.
- B. Cementitious materials shall be stored off the ground in a clean, dry location. The Contractor shall prevent contamination of materials likely to cause staining and other defects, and shall remove materials that are damaged or otherwise unsuitable for use from the job site.
- C. Materials shall be stored in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Owner prior to the delivery of materials.
- D. Deliver new metal fabrications to the site in the order required for installation. Materials shall be stored in a dry, secure area off the ground on pallets or dunnage.

1.08 PROJECT / SITE CONDITIONS

- A. The normal temperature range for the work of this Section shall be when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are expected to fall outside this range, the Contractor shall employ hot and cold weather procedures as published by the Masonry Institute of America.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in this Section. The Contractor shall:
 - 1. Prevent damage to adjacent masonry or other surfaces to be left exposed. Immediately remove all debris, cavity fill and waste material to be discarded. Protect sills, ledges, and projections from falling material, scaffold, and mortar droppings.
 - 2. Minimize levels of dust during mortar removal and masonry disassembly operations.
 - 3. Protect open copings, reglets, and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall not be left exposed overnight or when inclement weather is predicted.
 - 4. Temporarily remove and store metal downspouts and downspout boot covers to remain during terra-cotta / cast stonework. Install temporary drainage leaders if required. Reinstall immediately upon completion of work in the immediate area.
 - 5. Protect existing scuppers and downspout outlets from damage and accumulation of mortar debris during restoration of terra-cotta/cast-stone parapets.
 - 6. Where existing masonry components are to be removed, protect adjacent masonry units and surfaces from chipping and cracking during the removal process. Where components are to be reinstalled, the Contractor shall store salvaged components in a

safe location in such a manner as to facilitate reinstallation and will protect them from theft and damage until reassembly.

- C. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection. Nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- D. The Contractor shall cover partially completed work when work is not in progress.
- E. The Contractor shall coordinate masonry repairs and repointing with the other trades involved in exterior and interior restoration work, including but not limited to roofing, masonry cleaning, sealing, and painting.
- F. Where welding or burning is required to install or remove building components, the Contractor shall coordinate with the Owner's representative to obtain the appropriate permits (if required). The Contractor shall ensure that all DOD safety requirements for welding/burning are in place prior to beginning work.

PART 2 - PRODUCTS

2.01 ADHESIVE MATERIALS

- A. Epoxy adhesive for embedding anchors and pins shall be a high modulus epoxy resin conforming to ASTM C-881, Type I, II, IV and V, Grade 3 epoxy resin adhesives.
- B. Resin Manufacturers: Products shall be obtained from an industry recognized manufacturer. The Contractor shall submit manufacturer information to the Architect for approval.

2.02 METAL REINFORCEMENT FOR REPLACEMENT ARMATURES

- A. New Armature Members: ASTM A36, hot-dipped galvanized in accordance with ASTM A 123. Dimensions to match existing members and approved shop drawings.
- B. Stainless-steel wire armature, or threaded rods and bolts. All materials are to be reviewed by the Architect.
 - 1. Wire shall be 12 gauge or heavier.
 - 2. Threaded rods shall be sized according to the need and loading requirements.
 - 3. Stainless steel shall be AISI Type 316.

2.03 SUPPLEMENTAL ANCHORS

- A. Prefabricated anchor systems combine stainless-steel anchors with cementitious grout to tie together masonry units without extensive disassembly. The Contractor shall provide a list of manufacturers that provide supplemental anchorage systems for veneer masonry for approval by the Architect.

2.04 ACCESSORIES

- A. Anchors, Flanges, and Inserts: The Contractor shall provide anchoring devices as required for the installation of ornamental metal items, and shall provide toothed steel or lead shield expansion bolt devices for drilled in place anchors.
- B. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic)
- C. Non-shrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout. The Contractor shall provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this procedure or an Architect approved equivalent.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94% zinc dust by weight, and complying with SSPC-Paint-20.

PART 3 - EXECUTION

3.01 GENERAL

- A. Project-specific specifications are required for all terra-cotta work contained herein. As material and methods of construction vary greatly, each building must be evaluated and work scheduled accordingly. The Contractor shall submit schedules, including methods and materials to be used.
- B. Terra-cotta repairs and restoration shall use techniques, methods and materials as similar as possible to those of the original. Work should be sequenced not only to assure the stability of the structure and protection of personnel during the work, but also to address a sensible order of construction to integrate new work with existing work.
- C. The Contractor shall complete a survey to determine the extent and severity of the deterioration and whether the deterioration involves visual aspects of the surface terra-cotta, the failure of joints between units, the structural failure of the terra-cotta units, the failure of support systems, or the overall structural stability of the building façade.
 - 1. Existing general failures that contribute to terra-cotta deterioration shall be noted and should be scheduled for repair prior to completion of the work scheduled or in conjunction with terra-cotta restoration.
 - 2. Complete testing shall be conducted. The extent and type of analysis shall be determined by the Architect. See Sections 04214.01 and 04214.02 for Terra-Cotta Testing, Analysis, Replacement, and Repair.
- D. The Contractor shall protect adjacent materials, installed non-masonry materials, and openings.
- E. Manufacturer's instructions for mixing and installation of materials and equipment use shall be followed.
- F. Complete façade cleaning prior to beginning repair or restoration work.

- G. The Contractor shall stabilize deteriorated and loose units that are not scheduled to be removed or that cannot be easily removed. Areas where units are missing or have been removed should be protected against moisture penetration until replacement units can be installed.

3.02 TERRA-COTTA ANCHORING AND ARMATURE CONDITION ASSESSMENT

- A. Deterioration of anchoring systems can be difficult to assess by visual examination alone. Visible evidence of water penetration may include staining and material spalling.
- B. Deterioration and lack of anchoring may result in loosening of the units themselves and be a sign of a serious threat to the structural integrity of the building.
- C. Visible shifting and falling terra-cotta units are symptoms of serious degradation of the anchoring system and a major safety issue.
- D. Internal damage may be located by striking surface with a wooden mallet. Damaged units produce a flat thud, while undamaged units give off a clear, ringing sound. Check for consistent tonal values to aid in the location of damaged units.
- E. Infrared Scanning: Although still considered experimental, the process appears to be effective method to locate deteriorated internal material.
- F. Metal Detection: Metal detectors are a noninvasive method for locating the position of metal anchoring. However, this technique can only indicate the location of embedded metal. It does not provide information regarding the size or condition of the members.
- G. Archival Materials: Original drawings and records of previous repairs are good source for construction-related information that can greatly aid in the analysis of a building's condition.
- H. Material Removal: Often, the only way to truly document and assess the condition of a terra-cotta anchorage system is to remove a limited amount of material in a representative, and where possible, unobtrusive location.
 - 1. Removal may be limited to opening observation ports at multiple locations through which a borescope may be inserted to view inside the terra-cotta assembly. This technique is only successful where the terra-cotta units have not been infilled.
 - 2. Where a terra-cotta installation has been grouted or otherwise filled solid, the use of a moisture probe, inserted through bore holes at regular intervals, may help to assess the level of moisture throughout the assembly. High moisture levels may highlight areas of failure in the mortar or flashings and also potential locations for structural deterioration.
- I. Where the nondestructive techniques and the limited material removals described above cannot be used or fail to provide sufficient information, and where safety and structural concerns justify more intrusive investigation, disassembly of a small portion of the terra-cotta system should be pursued.

3.03 INSTALLATION OF SUPPLEMENTAL ANCHORS

- A. Installation requirements will vary widely with the type of anchor selected and the configuration of the terra-cotta assembly. The Contractor shall provide project-specific specifications for anchor installation where required, follow anchor manufacturer's recommended installation procedures, and install all work in accordance with approved shop drawings.
- B. Any structural repairs to the terra-cotta masonry anchorage system require some level of disassembly of the masonry to access the affected anchors. Disassembly may range from creating small openings in the back-up masonry for reinforcement of selected anchors to complete disassembly, salvage, and reconstruction with new anchors.
- C. Holes:
 - 1. Drill holes shall be sized according to the wire or rod used. The hole shall be no greater in diameter than $\frac{1}{2}$ to $\frac{1}{4}$ inch larger than the pin to be embedded, and 10 to 15 bar diameters deep.
 - 2. Drill shall be non-impact type rotary drill with a masonry bit.
 - 3. Depth of hole shall be sufficient to reach sound backing material.
 - 4. Space wire armature reinforcing as indicated on the approved submittals, arranged in a grid or mesh where applicable, or as recommended by the Architect.
 - 5. Clean holes with high-pressure air (not to exceed 1,200 psi).
- D. Protect surfaces around holes from contact with adhesives. Use petroleum jelly, modeling clay, or polyethylene sheets as required.
- E. Installation:
 - 1. Verify rod length is appropriate for the depth.
 - 2. Prepare epoxy resin for setting anchors.
 - a. Automatic Pressure-Injection Equipment: Resin shall be automatically measured and mixed in the mixing nozzle. Equipment should be in accordance with manufacturer's recommendations.
 - b. For Hand Mixing: Mix each component by volume as directed by the manufacturer in a clean pail. Do not use additives. Mix thoroughly for time specified by manufacturer with low-speed drill fitted with appropriate paddle. Blend until uniform in color.
 - 3. Pack resin into holes.
 - 4. Slowly insert the wire armature or threaded rod into the resin to the full depth of the hole. Countersink head of rods.

5. Do not disturb anchor until the adhesive has cured; follow manufacturer's instructions.
 6. No gaps shall be visible between the rod and the masonry.
- F. Plug counter-sunk holes and build out face of damaged patches flush with surrounding surfaces using patching mortar. See Section 0214.02, Part 3.04, Repair Patching.
 - G. Immediately remove spills and excess adhesive with absorbent material and flush with water. Uncured material can be removed with solvent as recommended by the manufacturer. Do NOT allow excess material to cure as cured adhesive can only be removed mechanically.
 - H. Apply one coat of glaze-repair finish to protect the patched or damaged areas. See Section 04214.02.

3.04 TERRA-COTTA REMOVALS: GENERAL PROCEDURE

- A. For terra-cotta unit replacement, see Section 04214.01.
- B. Carefully dismantle selected areas of masonry where designated on the Drawings. Dismantle adjacent assemblies as required for access to the designated masonry, salvaging components for reuse to the greatest extent possible.
- C. Rake or grind mortar from joints to the greatest extent possible before attempting removal of the terra-cotta units. Avoid excessive prying against the arrises of the masonry units to avoid spalling and chipping.
- D. Carefully cut existing metal anchors and armature to release terra-cotta units. Provide padded shoring as required to hold assembly in place once anchors are removed. Remove embedded metal parts down to the terra-cotta surface by drilling or grinding. Do not burn metal next to terra-cotta surfaces.
- E. Label each unit on the concealed side with non-removable marking keyed to the Drawings to ensure reinstallation of each unit in its original location.
- F. Clean old mortar and sealants from terra-cotta units to be reassembled. Stockpile salvaged masonry units in a secure location, away from general construction operations. Store units on pallets or in sturdy crates as required for protection. Stockpile in order of reinstallation to minimize unnecessary handling.

3.05 REINSTALLATION OF TERRA-COTTA – GENERAL PROCEDURE

- A. Install new terra-cotta armature in accordance with the approved Shop Drawings and product manufacturer's recommendations, providing secure support to the finished assembly. Install salvaged terra-cotta masonry units in their original locations in accordance with the annotated drawings prepared during disassembly.
- B. Ensure each terra-cotta unit is firmly fastened to the armature with new ties and/or anchors. No original anchor materials are to remain in place.

- C. Reset masonry units to proper position, straight and plumb, and true to line and level, with full mortar bed. Ensure that vertical head joints are completely filled with mortar. Rake and point as described in Section 04100.01 Removal of Mortar Joints and Repointing except at coping head joints, which shall be pointed with flexible sealant.
- D. Complete additional surface patching and glaze repair only after all structural work has been completed.
- E. Reinstall adjacent materials or patch in kind as required to complete the installation.

3.06 FINAL REPORT

The Contractor shall:

- A. Document the work and finished product with photographs taken before, during, and after completion of the work. Document original anchors and/or armature system prior to removal.
- B. Provide a written summary of the project and results upon final inspection and approval. The summary shall include a discussion of steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Historic adobe properties
- B. Criteria for replacement
- C. Procedure for in-kind replacement

1.03 RELATED SECTIONS

- A. Section 04290.02 – Repair Through Patching, Surface Coatings, and Structural Supports
- B. Section 04100.01 – Removal of Mortar Joints and Repointing
- C. Section 04400.01 – Identifying Masonry Types and Failures

1.04 DEFINITIONS

- A. Raw Adobe or Natural Adobe. Adobe, or sun-dried bricks are never kiln fired. Unbaked adobe bricks consist of sand, silt, clay, and water mixed together by hand, formed in wooden molds, and dried by the sun.
- B. Stabilized Adobe. Stabilized adobe is common today, consisting of the same elements of raw adobe, but with the addition of stabilizers, i.e., cement, asphalt, and/or bituminous materials. Stabilized adobe differs from traditional raw adobes in appearance, permeability, and strength.
- C. Adobe Mortar. Walls composed of raw adobe bricks are laid with mud mortar. The adobe mortar shall have the same components and characteristics as the material used as raw

adobe bricks. Such mortar exhibits the same properties as the bricks: relatively weak and susceptible to the same rate of hygroscopic (moisture absorptive) swelling and shrinking, thermal expansion and contraction, and deterioration. Cement and lime mortars are incompatible with raw adobes.

1.05 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. *Preservation Brief No. 5: Preservation of Historic Adobe Buildings* available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief05.htm>>.
- C. Eyre, T.A. The Physical Properties of Adobe Used as a Building Material. *The University of New Mexico Bulletin*. Engineering Series. Vol. 1 No. 3 1935.
- D. Garrison, James W. Specifying Adobe in Restoration Work. *APT Bulletin*. Vol. XXII No. 3 1990.

1.06 SUBMITTALS

- A. The Contractor shall submit a detailed schedule of the work to be conducted, including an assessment of the problem areas, adobe analysis, and detailed procedures for adobe repairs, to the Architect for approval. Analysis shall include both microscopical examination and sieve analysis of the historic material.
- B. Product Literature: The Contractor shall submit manufacturer's product literature to the Architect for all proprietary products proposed for adobe repairs and replacement. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling, and use.
- C. Samples:
 - 1. The Contractor shall submit three (3) samples of proposed bricks for analysis by testing laboratory at the Owner's expense, to determine that the compressive strength, soil components and sieve analysis are compatible with existing adobe. Multiple trial batches and tests of submitted samples may be necessary before a product is found to be compatible with the existing adobe bricks.
 - 2. After approval of analysis, submit three (s) samples of finished bricks to the Architect to determine that the visual characteristics, texture and dimensions are compatible with existing adobe.

1.07 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience with historic adobe construction. He/she shall demonstrate a working knowledge of the *Secretary of the Interior's Standards for*

Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings.

- B. Contractor shall work in conjunction with the Architect and/or other preservation professional proficient in adobe preservation and stabilization.
- C. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.08 MOCK-UPS

- A. The Contractor shall construct a sample adobe wall on-site, in a location as directed by the Architect, 4 feet high and 4 feet long, for approval by Architect. The sample shall serve as a guide for workmanship and a quality standard for all adobe work for the project.
- B. The Contractor shall provide an adobe plaster sample, 24 inches long and 24 inches high, applied to the building as directed by the Architect. If other adobe repairs are to be conducted, the plaster sample shall be applied to a portion of the masonry repair sample. See Section 04290.02, Repair Through Patching, Surface Coatings, and Structural Supports.
- C. The Contractor shall prepare up to three additional test panels at no additional cost without further compensation. Approved test area(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.09 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall store products in a dry location and protected from dampness and freezing.
- B. The Contractor shall stockpile and handle aggregates to prevent contamination from foreign materials. Store materials in separate piles to avoid intermingling.

1.10 PROJECT / SITE CONDITIONS

- A. Adobe work shall be executed only when the air and surface temperatures are 40 degrees F and rising. Minimum temperature for adobe work shall be 40 degrees F and above for at least 2 hours after completion and above freezing for at least 24 hours after completion. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces and substrate during the execution of the work, and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in this Section.
- C. The Contractor shall maintain a supply of tarpaulins or other waterproof materials at the site sufficient to cover all exposed areas of adobe in the event of inclement weather.

- D. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection. Nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- E. The Contractor shall coordinate adobe work with the other trades involved in exterior and interior restoration work including but not limited to masonry, painting, roofing, and window and door repairs.

PART 2 - PRODUCTS

2.01 HISTORIC ADOBE PROPERTIES

- A. **Material Makeup of Adobe Brick:** Adobes are made of native soil that has sand, silt and clay as the primary components. The proportion of sand, silt, and clay determines the durability, strength, and shrinkage of the bricks. The bricks also gain strength with proper curing and length of drying time. Bricks are allowed to dry for approximately one month. Adobes may also include organic binders such as grass or straw, which can help the bricks to dry more uniformly and is important to note when replacing historic brick. Generally, the clay content of the soil should not exceed 30 percent and the sand content should be greater than 50 percent.
 - 1. “Ideal” adobe has 70 percent sand, 15 percent silt, and 15 percent clay by weight.
 - 2. Uniform Building Code for new adobes requires 55 to 75 percent sand, 25 to 45 percent fines (silt and clay).
- B. **Size:** Adobes are made by hand in forms and vary in size. Common brick sizes can range from 4x8x16 inches and weigh 28 pounds, to 5x12x18 inches and weigh 59 pounds.
- C. **Durability:** Adobes are a traditional building material used in the southwest since the sixteenth century and are well suited to arid climates. As the bricks are essentially dried mud and not fired in a kiln like clay bricks, they do not permanently harden. As a result, the adobe bricks remain unstable, are relatively weak, and are susceptible to swelling, shrinking, thermal expansion and contraction, and deterioration. Adobes continually swell and shrink with changes in moisture content, and they disintegrate when saturated in water. The strength of the adobe changes with moisture content; the greater the water content, the weaker the adobe. Adobe can also be affected by rising damp, a process where moisture (and salts) is absorbed from the ground. Salt accumulation contributes to deterioration of the adobe.
- D. **Mortar:** Adobe walls are constructed of adobe bricks laid with mud mortar. The mortar has the same soil composition as the adobe bricks and is usually made from the same material. Likewise, the mortar has the same properties as the adobe bricks. The mortar absorbs moisture and is also susceptible to swelling, shrinking, thermal expansion and contraction, and deterioration.
- E. **Surface Coatings:** Adobe requires regular and frequent maintenance. To protect the unstable and fragile nature of the adobe, traditional surface coatings are generally applied to both the interior and exterior adobe walls. Coatings include: mud plaster; lime plaster; whitewash; and stucco. Coatings applied to exterior adobe provide a renewable surface that helps to prevent surface deterioration.

F. Related Construction Systems:

1. Building Foundations: Adobe buildings are usually constructed on foundations and rarely over basements or crawl spaces. Foundations are generally large and well constructed to support the weight of the adobe walls. Construction varied according to location and traditional building practices. Early foundations were often constructed of bricks, fieldstones, or cavity walls filled with rubble stone, tile fragments, or seashells.
2. Roofs: Southwest adobe roofs constructed between the 1600s and 1800s were generally flat with low parapet walls. The roofs consisted of wooden poles supported by logs. The logs consisted of either undressed logs (called vigas) or shaped squared timbers, set 23 feet or less on center. These logs were set on the horizontal wooden member at the top of the wall or on decorated blocks (or corbels) set into the wall. The vigas or logs usually projected through the adobe wall, a traditional feature applied in later adobe revival buildings. Poles, 2 inches in diameter, or hand-split planks were placed on the vigas. Sawn boards (like those used for roof sheathing) became available after the arrival of rail transportation and were used on nineteenth- and twentieth-century buildings, as well as replacement materials on older structures. Wooden lath or twigs were applied over the poles and covered with at least six inches of packed adobe earth, which was then coated with adobe mud.

The flat roof sloped to funnel the water to drains that projected through the parapet. These drains were made from hollow logs, tile, or sheet metal. During the nineteenth and twentieth centuries, gabled roofs gained popularity. Regional revival or Territorial styles developed with corresponding regional material preferences, such as roof tiles in southern California and metal roofs in New Mexico.

3. Floors: Historically, floors of adobe buildings were installed on the ground with little or no subfloor. Flooring materials included: earth; adobe brick; fired brick; tile; flagstone; and wood.

2.02 MATERIALS

- A. Soil for adobe mud mortar and bricks: The Contractor shall provide soil to match closely the strength, component soil mixture, texture, and color of existing adobe in building walls.
 1. The mix shall approximate the relative sand-silt-clay proportions of the existing adobe within a tolerance of plus or minus 10 percent.
 2. The Contractor shall arrange for soil component hydrometer tests and compression tests of representative samples from the historic adobe brick types. The Contractor shall coordinate removal of sample bricks from the building with the Architect. The Contractor shall also arrange for hydrometer and compression tests of new bricks to confirm compatibility.
 3. Dried bricks made from such soil shall have a compressive strength similar to that of adobe bricks in the existing building, within a tolerance of plus or minus 100 psi.

4. The color of the new bricks and mortar shall match that of the existing adobe brick colors. The Contractor shall match the historic adobe bricks, NOT brick that may result from poorly matched contemporary repairs.
- B. Methods of material supply: Soil to match historic adobe may be a locally obtained material with no formal, readymade supply or suppliers.
1. Soil for adobe bricks and mortar may be tested or field matched from local soil samples; method for soil matching is to be determined by the Architect. When soil is field matched, test samples of possible soil matches are taken and placed in a glass jar (mason jar tested) with water to settle for 1 to 2 weeks. The settlement is compared with a similar test conducted on the historic brick, whereby a sample is taken, crushed, and placed in a glass jar with water to settle for 1 to 2 weeks. For commercially available materials, compare any available sieve analysis to that of historic material.
 2. Arrangement for the excavation and acquisition of soil and permission to access soil not on the Owner's property must be obtained by the Contractor with the approval of the Architect. Any additional consultation required in order to acquire the appropriate type of sand is not covered under the terms of this specification and must be completed under IAW applicable laws (NAGPRA, ARPA, NHPA).
- C. Water used in the fabrication of adobe bricks and mortar shall be clean and potable.

2.03 FABRICATION

- A. The Contractor shall form soil materials into adobe blocks:
1. Net size of blocks after drying shall match the dimension of the existing historic bricks. The Contractor shall verify size in field.
 2. The Contractor shall form bricks in solid forms using sufficient moisture to form solid compact units without causing excessive shrinkage cracks.
 3. Bricks should be dried until they reach a moisture content of less than 20 percent, OR for a minimum of 28 days prior to testing and/or laying. Dry units shall be below 20 percent moisture content before use.
 4. Drop Test: Once the adobe bricks are sun-dried, the Contractor shall randomly test blocks for strength and outcome of each batch of brick. This test shall be accomplished by holding brick shoulder height (approximately 5 feet from the ground) and dropping it on its corner. Well-made brick will remain intact; inferior blocks will break upon impact. Do NOT use the inferior adobe bricks.

2.04 EQUIPMENT

- A. Adobe Repair
1. Saw, chisel, mason's hammers

2. Trough, wheelbarrow, plastic buckets, hoe, hawk, trowel, burlap (clean, undyed, and unprinted).
3. Natural bristle or nylon brushes (metal bristle brushes are NOT to be used).
4. Trowel, large grout gun

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall document existing adobe construction data to include:
 1. Size of adobe brick units.
 2. Bonding pattern.
 3. Size of mortar joints.
 4. Coating material(s).
 5. Attachment method (if applicable).
- B. Assessment of Adobe Deterioration. The Contractor shall:
 1. Determine the nature and extent of the deterioration.
 2. Identify the source of the problem causing the deterioration. The source causing the deterioration is to be repaired prior to start of the work in this section.
 3. Develop rehabilitation and restoration plans for review by the Architect that are sensitive to the integrity of the historic adobe building. Submit a schedule of all work included in this section. Also refer to Section 04290.02, Repair Through Patching, Surface Coatings, and Structural Supports.
- C. Rehabilitation and replacement of adobe building materials shall be done with the same types of materials used originally with the same construction techniques. Building materials should be traditional materials crafted by hand as outlined above. The Contractor shall NOT substitute modern materials or add portland cement or lime to the traditional mud bricks or mortar.
- D. Existing wall repair work under this section shall be performed in phases as approved by the Architect. For large wall expanses, work shall be done in phases of 2-foot-wide vertical sections separated by at least 4 feet of wall left undisturbed during that phase. Appropriate shoring and bracing shall be provided during the wall repair work. Demolition and wall repair shall be performed in each phase, with each phase completed before commencing the following phase. No more than one third of a wall area shall be undergoing stabilization or replacement at any given time.

- E. All wall repair work under this section shall be undertaken with other Adobe repairs as outlined in Section 04290.02, Repair Through Patching, Surface Coatings, and Structural Supports.
- F. Construction of new adobe walls and/or adobe bricks to replace those that are missing shall use techniques, methods and materials as similar as possible to those of the original walls. Reconstruction of wall(s) should be sequenced not only to assure the stability of the structure and protection of personnel during the work, but also to address a sensible order of construction to integrate new work with existing work.
- G. Shoring and bracing. The Contractor shall provide sufficient appropriate bracing on both sides of the walls at high and low levels to ensure stability of the walls during repair. The Contractor shall provide bracing diagrams and a safety plan for review by the Architect.

3.02 REPLACEMENT PROCEDURES FOR HISTORIC ADOBE

- A. Plaster removal. The Contractor shall remove exterior plaster in areas to be repaired. The Contractor shall:
 - 1. Sawcut plaster to isolate the sections being repaired. For large areas, the Contractor shall cut and isolate the 2-foot section to be worked on.
 - 2. Remove plaster finish in each section. Breaking up of plaster and concrete shall be done by hand, taking care to minimize damage to the adobe wall behind.
 - 3. Retain exterior plaster finish in sections not in the phase of work undertaken. The Contractor shall NOT remove all plaster at one time from the wall to be repaired.
- B. Patching and Repair of Adobe Brick: see Section 04290.02, Repair Through Patching, Surface Coatings, and Structural Supports.
- C. Adobe Brick Unit Replacement:
 - 1. If a substantial amount of the brick has been destroyed or spalled, the Contractor shall use whole adobe bricks and half-bricks for repairs.
 - 2. The deteriorated adobe bricks shall be scraped out to insert the new bricks, and sections of deteriorated brick shall be removed.
 - 3. If most of the brick is not deteriorated, but losses are greater than ½ inch, then the deteriorated portion may be replaced with a half-brick.
 - 4. The Contractor shall cut back into the deteriorated portions of the brick to achieve a flush fit of the new brick or half-brick.
 - 5. The Contractor shall spray (DO NOT SOAK) the new brick and surrounding area lightly with water to facilitate a better bond. Too much moisture can cause swelling.

D. Replacing Adobe Mud Mortar:

1. Match the original material, color, and texture of the adobe mortar. The Contractor shall NOT replace adobe mud mortar with lime mortar or portland cement mortar. It is a common error to assume that mortar hardness or strength is a measure of its suitability in adobe repair or reconstruction. Mortars composed of portland cement or lime do not have the same thermal expansion and contraction of adobe bricks. Portland cement and lime mortars will cause the bricks—the weaker material—to crack, crumble, and eventually disintegrate.
2. Scrape out the deteriorated adobe bricks to insert the new bricks and remove sections of deteriorated brick.
3. The procedure for pointing adobe is similar to pointing masonry joints. The adobe bricks should be sprayed lightly with water to increase the cohesive bond.
4. Trowel adobe mud mortar to fill joints.
5. Allow adobe bricks and mortar to dry in place a minimum of seven (7) days before continuing with the next phase of wall repair. If wet or unusually humid weather is encountered, or if it is evident for any reason that installation is not sufficiently dry, extend drying time accordingly.
6. Protect exposed adobe with tarpaulins or other waterproof material overnight or if precipitation is expected. Do not allow exposed wall surfaces to become saturated.
7. Remove shoring and bracing after wall repairs have been completed.
8. Generally, adobe has an added layer of protection, a surface coating. The Contractor shall test the historic coating to determine its composition and apply new surface coating that matches the original in color, texture, and material composition. The surface coating shall match the existing surface treatment of the adobe brick building. See Section 04290.02, Repair Through Patching, Surface Coatings, and Structural Supports.

3.03 FINAL REPORT

The Contractor shall:

- A. Revisit the site with the Architect to compare the finish and color of the repair to see if the desired affect has been achieved after the brick repairs have been executed and new mortar has cured at least 30 days.
- B. Document the work and finished product with photographs.
- C. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Adobe repair through patching
- B. Adobe repair/maintenance through surface coatings
- C. Adobe structural repair

1.03 RELATED SECTIONS

- A. Section 04290.01 – Adobe Properties and In-Kind Replacement
- B. Section 04400.01 – Identifying Masonry Types and Failures
- C. Section 04100 – Historic Mortar
- D. Section 04110 – Historic Stucco
- E. Section 06300 – Wood Treatment
- F. Section 06310 – Preservation Treatment
- G. Section 04211 – Historic Brick
- H. Section 04400 – Stone

1.04 DEFINITIONS

- A. Raw Adobe or Natural Adobe. Adobe, or sun-dried bricks are never kiln fired. Unbaked adobe bricks consist of sand, silt, clay, and water mixed together by hand, formed in wooden molds, and dried by the sun.
- B. Stabilized Adobe. Stabilized adobe is common today, consisting of the same elements of raw adobe, but with the addition of stabilizers, i.e., cement, asphalt, and/or bituminous materials. Stabilized adobes differ from traditional raw adobes in appearance, permeability, and strength.
- C. Adobe Mortar. Walls composed of raw adobe bricks are laid with mud mortar. The adobe mortar shall have the same components and characteristics as the material used as raw adobe bricks. Such mortar exhibits the same properties as the bricks: relatively weak and susceptible to the same rate of hygroscopic (moisture absorptive) swelling and shrinking, thermal expansion and contraction, and deterioration. Cement and lime mortars are incompatible with raw adobes.

1.05 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. *Preservation Brief No. 5: Preservation of Historic Adobe Buildings* available online at NPS <website at <http://www.nps.gov/history/hps/tps/briefs/brief05.htm>>.
- C. ASTM C 207, *Standard Specification for Hydrated Lime for Masonry Purposes*
- D. ASTM C 144, *Standard Specification for Aggregate for Masonry Mortar*
- E. ASTM C 150, *Standard Specification for Portland Cement*
- F. ASTM C 1328-05 *Standard Specification for Plastic (Stucco) Cement*
- G. ASTM C 979, *Specification for Pigments for Integrally Pigmented Concrete*.

1.06 SUBMITTALS

- A. The Contractor shall submit a detailed schedule to architect for approval of the work to be conducted, including an assessment of the problem areas, historic adobe and plaster analyses, and detailed procedures for adobe and plaster repairs.
- B. The Contractor shall submit manufacturer's product literature to architect for all proprietary products proposed for adobe and plaster repair. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling, and use.

1.07 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience with historic adobe construction. He/she shall demonstrate a working knowledge of the *Secretary of the Interior's Standards for Guidelines for Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings*.
- B. The Contractor shall work in conjunction with the Architect and/or other preservation professional proficient in adobe preservation and stabilization.
- C. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.08 MOCK-UPS

The Contractor shall:

- A. Submit three (3) samples of adobe bricks for approval of color, texture, and size by the Architect. See Section 04290.01, Adobe Properties and In-Kind Replacement. Multiple trial batches and tests of submitted samples may be necessary before a product is found to be compatible with the existing adobe.
- B. Prepare mock-ups of the required adobe repairs, including repairs to cracks, brick replacement, and pointing in an area approximately 4x4 feet. Each mechanic proposed to work on the project must prepare a mock-up sample for approval. Sample shall serve as a guide for workmanship and a quality standard for all adobe work for the project.
- C. Prepare an adobe plaster sample, 24 inches long and 24 inches high, applied to the building as directed by the Architect. The plaster sample shall be applied to a portion of the masonry repair sample. Each mechanic proposed to work on the project must prepare a mock-up sample for approval. See Section 04290.01, Adobe Properties and In-Kind Replacement.
- D. Prepare up to three additional samples of adobe mortar and plaster test panels at no additional cost without further compensation. Approved test area(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.09 DELIVERY, STORAGE, AND HANDLING

The Contractor shall:

- A. Store products off the ground on pallets in a dry location and protected from dampness and freezing.
- B. Stockpile and handle soil components and plaster materials to prevent contamination from foreign materials.
- C. Deliver all products to the site in original packaging, unopened and undamaged, with manufacture's name and product identification visible thereon, and manufacturer's instructions and Material Safety Data Sheets.

1.10 PROJECT / SITE CONDITIONS

- A. Adobe work shall be executed only when the air and surface temperatures are 40 degrees F and rising. Minimum temperature for adobe work shall be 40 degrees F and above for at least two hours after completion and above freezing for at least 24 hours after completion. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor is responsible for protecting existing adjacent materials, surfaces, and substrate during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in this Section.
- C. The Contractor shall maintain a supply of tarpaulins or other waterproof materials at the site sufficient to cover all exposed areas of adobe in the event of inclement weather.
- D. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection. Nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- E. Contractor shall coordinate adobe work with the other trades involved in exterior and interior restoration work including, but not limited to, masonry, painting, roof, and window and door repairs.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Adobe Repair
 - 1. Saw, chisel, mason's hammers
 - 2. Trough, wheelbarrow, plastic buckets, hoe, hawk, trowel, burlap (clean, undyed, and unprinted)
 - 3. Natural bristle or nylon brushes (metal bristle brushes are NOT to be used)
 - 4. Towel, large grout gun
- B. Coatings
 - 1. Saw, chisel, mason's hammers
 - 2. Trough, wheelbarrow, plastic buckets, hoe, hawk, trowel
 - 3. Paint brushes, burlap (clean, undyed, and unprinted) and small round stones.
 - 4. Natural bristle or nylon brushes (metal bristle brushes are NOT to be used).
- C. Foundation and Structural Repair

1. Lumber for bracing
2. Saw, chisel, mason's hammers
3. Trough, wheelbarrow, plastic buckets, hoe, hawk, trowel
4. Burlap (clean, undyed, and unprinted) and small round stones
5. Natural bristle or nylon brushes (metal bristle brushes are NOT to be used).

2.02 MATERIALS PATCHING HISTORIC ADOBE

- A. Soil for adobe mud mortar: The Contractor shall provide soil to match closely the strength, component soil mixture, texture, and color of existing adobe in building walls.
 1. The mix shall approximate the relative sand-silt-clay proportions of the existing adobe within a tolerance of plus or minus 10 percent.
 2. Contractor shall arrange for soil component hydrometer tests and compression tests of representative samples from the historic adobe brick types; coordinate removal of sample bricks from building with the Architect; and arrange for hydrometer and compression tests of new bricks to confirm compatibility.
 3. Dried bricks made from such soil shall have a compressive strength similar to that of adobe bricks in the existing building within a tolerance of plus or minus 100 psi.
 4. The color of the new bricks and mortar shall match that of the existing adobe brick colors. The Contractor shall match the historic adobe bricks, NOT brick that may result from poorly matched contemporary repairs.
- B. Methods of material supply: Soil to match historic adobe may be a locally obtained material with no formal, readymade supply or suppliers.
 1. Soil for adobe bricks and mortar may be tested or field matched from local soil samples; method for soil matching is to be determined by the Architect. When soil is field matched, test samples of possible soil matches are taken and placed in a glass jar (mason jar tested) with water to settle for 1 to 2 weeks. The settlement is compared with a similar test conducted on the historic brick, whereby a sample is taken, crushed, and placed in a glass jar with water to settle for 1 to 2 weeks. For commercially available materials, compare any available sieve analysis to that of historic material.
 2. Arrangement for the excavation and acquisition of soil and permission to access soil not on the Owner's property must be obtained by the Contractor with the approval of the Architect. Any additional consultation required in order to acquire the appropriate type of sand is not covered under the terms of this specification and must be completed under IAW applicable laws (NAGPRA, ARPA, NHPA).
- C. Water used in the fabrication of adobe bricks and mortar shall be clean and potable.

2.03 PROTECTIVE COATINGS ON ADOBE

A. Mud Plaster

1. Soil for adobe mud plaster should follow the material guidelines under 2.01 above and match the adobe mix used for mortar and bricks. Soil to match historic adobe may be locally obtained material with no formal, readymade supply or suppliers. Provide soil to match closely the strength, component soil mixture, texture, and color of existing adobe in building walls.
2. Mix shall approximate the relative sand-silt-clay proportions of the existing adobe within a tolerance of plus or minus 10 percent.
3. The color of the plaster shall match that of the existing adobe mud and brick colors. The Contractor shall match the historic adobe mud, NOT the adobe mortar or brick that may result from poorly matched contemporary repairs.
4. Water used in the fabrication of mud plaster shall be clean and potable.

B. Whitewash

1. The Contractor shall select a whitewash made from ground gypsum rock, water, and clay. Avoid the use of lime as this is not compatible with adobe and will not adhere to the bricks.
2. The Contractor shall match the existing in color and texture.
3. Water used shall be clean and potable.

C. Lime Plaster

1. Although widely used beginning in the nineteenth century for both exterior and interior coating, lime plaster is much harder and less flexible than traditional mud plaster, and subject to cracking.
2. The Contractor shall test and match the existing plaster in color, texture, and composition.
3. Lime should conform to ASTM C 207, Type S, Hydrated Lime for Masonry Purposes: 1,800 psi (2:1:9).
4. Sand should match the existing stucco as closely as possible in color, texture and gradation, be free from impurities, and conform to ASTM C 144.
5. Water used shall be clean and potable.
6. Straw, hair, or fiber (if used) should be goat or cattle hair, or pure manila fiber of good quality, ½ to 2 inches in length, clean and free of dust, dirt, oil, grease, or other impurities.
7. The Contractor shall use pigment that is compatible with lime.

D. Cement Stucco

1. Although not a traditional material for application over adobe, cement stucco came into use during the early twentieth century on revival styles of Southwest adobe architecture. Cement based stuccos are not compatible with adobe and are therefore, applied to wire lath and not directly to the surface of the adobe brick.
2. The Contractor shall match the existing stucco in color and texture.
3. Lime shall conform to ASTM C 207, Type S, Hydrated Lime for Masonry Purposes: 1,800 psi;

OR

4. Gypsum: It is important to note that gypsum-based stucco is NOT compatible with lime based stucco. The two should NOT be used in conjunction with each other.
5. Sand shall match the existing stucco as closely as possible in color, texture and gradation, be free from impurities, and conform to ASTM C 144.
6. Cement shall be white, nonstaining portland cement and conform to ASTM C 150, Type II.
7. Water used shall be clean and potable.
8. Straw, hair, or fiber (if used) shall be goat or cattle hair, or pure manila fiber of good quality, ½ to 2 inches in length, clean and free of dust, dirt, oil, grease, or other impurities.
9. Pigment (if used) shall be compatible with the stucco mix and conform to ASTM C 979.
10. The Contractor shall use galvanized wire mesh, lath, and nails.

E. Other Coatings: When historic surfaces are coated with other mediums, the material shall be tested by the Contractor and matched in color, texture, and composition to the historic material. All testing results and product recommendations are to be reviewed by the Architect for approval. Other coatings may include but are not limited to:

1. Paints such as oil base, resin, or emulsion paints.
2. Coatings of plant extracts.

2.04 PRE-MIXED PLASTERS

Factory-mixed plasters may be used at the Contractors option with the approval of the Architect. Provide manufacturer's standard color range or provide custom match if required to replicate existing material.

- A. Manufacturers: The Contractor shall obtain materials from an established manufacturer of industry-recognized products appropriate for the work in this section. Selected materials and manufacturers shall be approved by the Architect.

2.05 STRUCTURAL REPAIR OF ADOBE

- A. Foundation Repair Materials
 - 1. Stone, fired brick, or other units to match the existing foundation construction.
 - 2. Mortar, see above and Section 04100 Historic Mortar
- B. Structural Wood Repair Materials
 - 1. Wood: cured, dry, and straight with no signs of warping.
 - 2. Galvanized or stainless steel nails

PART 3 - EXECUTION

3.01 GENERAL

- A. Assessment of Adobe Deterioration
 - 1. Determine the nature and extent of the deterioration.
 - 2. Identify the source of the problem causing the deterioration. The source causing the deterioration is to be repaired prior to start of the work in this section.
 - 3. Develop rehabilitation and restoration plans for review by the Architect that are sensitive to the integrity of the historic adobe building. Submit a schedule of all work included in this section. Also refer to Section 04290.02, Repair Through Patching, Surface Coatings, and Structural Supports.
- B. Rehabilitation and replacement of adobe building materials shall be done with the same types of materials used originally with the same construction techniques. Building materials should be traditional materials crafted by hand as outlined above. Do not substitute modern materials or add portland cement or lime to traditional mud bricks or mortar.
- C. The extent of the work covered in this section shall be reviewed by the Architect on-site prior to beginning operations. The Contractor shall submit a testing schedule and a schedule for adobe repairs, including the methods and materials to be used.

3.02 ADOBE REPAIR PATCHING

- A. Brick Repair. When the surface of an individual adobe brick has partially disintegrated or has minor spalling with losses of up to ½ inch, it may be patched in place.
1. See Section 04290.01, Adobe Properties and In-Kind Replacement for adobe brick and wall replacement.
 2. Scrape out the deteriorated material to solid. The excavated void must have vertical walls and a horizontal top and bottom to provide solid support for the patch.
 3. Remove loose and deteriorated materials. The area shall be free from mortar or paint chips, dust, grease, or oil. Brush clean with natural bristle or nylon brushes (metal bristle brushes are NOT to be used).
 4. Lightly spray (do not soak) the area of the patch with water to facilitate a better bond.
 5. Apply the adobe mortar to the area, building up to the level of the brick.
 6. Allow the adobe patch and mortar to dry in place a minimum of seven (7) days before continuing with the next phase of wall repair. If wet or unusually humid weather is encountered, or if it is evident for any reason that installation is not sufficiently dry, extend drying time accordingly.
 7. After repairs have been completed and the surface has dried sufficiently, proceed to Adobe Coatings (below) and finish to match the existing surface.
- B. Repair of Cracks in Adobe: A method similar to repointing masonry may be used for repair of adobe cracks. The mortar must be compatible with the historic mortar in color, texture, and composition.
1. Rake out the cracks to a depth of 2 to 3 times the width of a mortar joint to obtain a good key for the mortar to adhere to the adobe bricks.
 2. Remove loose and deteriorated materials. The area shall be free from mortar or paint chips, dust, grease, or oil. Brush clean with natural bristle or nylon brushes (metal bristle brushes are NOT to be used).
 3. Lightly spray (do not soak) the area of the patch with water to facilitate a better bond.
 4. Apply the adobe mortar to the area, building up to the level of the brick. A trowel or large grout gun may be used to apply new adobe mud mortar.
 5. Allow the patching mortar to dry in place a minimum of seven (7) days before continuing with the next phase of wall repair. If wet or unusually humid weather is encountered, or if it is evident for any reason that installation is not sufficiently dry, extend drying time accordingly.
 6. After repairs have been completed and the surface has dried sufficiently, proceed to Adobe Coatings (below) and finish to match the existing surface.

3.03 REPLACING SURFACE COATINGS

- A. Mud Plaster: Historically, almost every adobe building surface was coated.
1. The mud plaster must match the existing plaster in color, texture, and composition. Always replace with like materials and similar techniques. Do not add portland cement or lime to mud plaster.
 2. Scrape off as much of the deteriorated mud plaster surface coating as possible without causing damage to the adobe brick beneath. If the bricks are deteriorated, assess the cause of the damage and replace as outlined in Section 04290.01, Adobe Properties and In-Kind Replacement.
 3. The area shall be free from mortar or paint chips, dust, grease, or oil. Brush clean with natural bristle or nylon brushes (metal bristle brushes are NOT to be used).
 4. Never put another coat of lime or cement plaster over a deteriorated surface coating.
 5. Lightly dampen the surface with water; do NOT soak.
 6. Apply the mud plaster directly over the brick to form an even coating. Apply in coats in a method similar to application of stucco stone or brick masonry.
 7. Once the plaster has been applied, the mud plaster must be smoothed. This is done by hand, sometimes with deerskins, sheepskins, and small, slightly rounded stones. The plaster is smoothed to create a polished surface. In some cases pigments are mixed into the final layer and polished. Finish to match the existing plaster.
- B. Whitewash
1. The area shall be free from mortar or paint chips, dust, grease, or oil. Brush clean with natural bristle or nylon brushes (metal bristle brushes are NOT to be used).
 2. Apply the approved mixture to the adobe wall. It can be either brushed on or applied with large pieces of clean burlap.
 3. The Owner should renew or reapply whitewash annually.
- C. Lime Plaster
1. Replacement lime plaster shall match the existing in color, texture, and composition; consist of like materials to the existing; and be prepared and applied with similar techniques to the existing.
 2. Scrape off the deteriorated plaster surface coating without causing damage to the adobe brick beneath. If the bricks are deteriorated, assess the cause of the damage and replace as outline in Section 04290.01, Adobe Properties and In-Kind Replacement.
 3. Score the bricks with diagonal hatching for better adhesion. The grooves should be about 1 ½ inches deep.

4. The area shall be free from mortar or paint chips, dust, grease, or oil. Brush clean with natural bristle or nylon brushes (metal bristle brushes shall NOT to be used).
5. Do NOT put another coat of lime or cement plaster over a deteriorated surface coating.
6. Fill the grooves with a mixture of lime mortar and small chips of stone or broken roof tiles.
7. Apply a heavy coating of the lime plaster to the entire wall surface with a trowel and/or brush. Finish to match the historic plaster.

D. Cement Stucco

1. Match the existing stucco in color, texture, and composition. Replacement of the stucco shall use like materials and similar techniques.
2. Scrape off the deteriorated plaster surface coating without causing damage to the adobe brick beneath. If the bricks are deteriorated, assess the cause of the damage and replace as outline in Section 04290.01, Adobe Properties and In-Kind Replacement.
3. Cement stucco must be applied over wire mesh that is affixed to the adobe brick with nails. The material is generally used on twentieth-century buildings with stabilized or fired adobe brick. Cement stucco does not form a bond with adobe and requires the mesh to keep it in place. Existing wire mesh and nails should be in good condition and free from rust. The nails are not always stable in adobe; even when very long nails are used, moisture can cause the metals to rust and the nails to lose contact with the adobe.
4. With a trowel apply the stucco to cover the wire mesh. Cement stucco can be applied in from 1 to 3 coats. Finish to match the historic stucco.

E. Furring Walls. In certain cases, an option may be to fur out the walls prior to applying new lime or cement stucco to a building. The process creates a moisture barrier. Submit evaluation to the Architect for review and approval. Lime and Cement plasters should only be utilized in adobe buildings that were constructed with the same material.

1. Remove the existing plaster as outlined above.
2. Attach pressure-treated wood lath to the adobe bricks.
3. Apply the lime or cement coating as outlined above.

F. Other Coatings

1. Other coatings such as paints shall be applied to a clean, stable surface. The wall shall be free from mortar or paint chips, dust, grease, or oil. Brush clean with natural bristle or nylon brushes (metal bristle brushes shall NOT to be used).

2. Following manufacturer's instructions as appropriate, brush the coating onto the wall to achieve an even coating and finish.

3.04 ADOBE STRUCTURAL REPAIR

A. Foundation Repair

1. The Contractor shall make an assessment of the type and method of foundation construction. Early adobe buildings can have substantial foundations or barely any at all. Materials range from bricks, fieldstone, cavity walls filled with rubble stone, tile fragments, or sea shells. Adobe buildings were rarely constructed over basements or a crawl space.
2. The Contractor shall assess the cause and nature of the failure. A schedule of work associated with foundation repairs shall be submitted and reviewed by the Architect.
3. Where drainage, changes in landscaping, regrading, and plant removal is recommended, said work shall be reviewed by the Architect.
4. All foundation repairs under this section shall be undertaken with other adobe repairs as outlined in this Section and Section 04290.01, Adobe Properties and In-Kind Replacement.
5. The Contractor shall perform work under this section in phases as approved by the Architect. For large foundation/wall expanses, work shall be done in phases of 2-foot-wide vertical sections separated by at least 4 feet of wall left undisturbed during that phase. Appropriate shoring and bracing shall be provided during the repair work. Foundation repair and related wall repair are performed in each phase, with each phase completed before commencing the following phase. No more than one third of a foundation/wall area shall be undergoing stabilization or replacement at any given time.
6. Foundation repair shall use techniques, methods, and materials as similar as possible to those of the original foundations. Reconstruction of foundations shall be sequenced not only to assure the stability of the structure and protection of personnel during the work, but also to address a sensible order of construction to integrate new work with existing work.
7. Shoring and bracing: The Contractor shall provide sufficient and appropriate bracing on both sides of walls at high and low levels to ensure stability of the walls during repair. The Contractor shall provide bracing diagrams and a safety plan for review by the Architect.
8. Plaster and foundation skirt removal: Remove exterior plaster and foundation materials in areas to be repaired. Saw cut plaster at the top of the foundation to isolate the 2-foot section being repaired.
9. Remove plaster finish and loose sections of the foundation in each section. Breaking up plaster and masonry is to be done by hand to insure that adobe bricks and adjacent wall surfaces are not damaged. The excavated void must have vertical walls and horizontal top and bottom to provide solid support.

10. Retain exterior plaster finish in sections not in the phase of work undertaken. Do NOT remove all plaster at once from the wall to be repaired.
11. Rebuilding the exposed foundation section by replacing masonry units in new mortar. The area should be free of all debris, chips, dust, and dirt. Thoroughly clean edges to assure adhesion of the new mortar.
12. Match the new mortar to the existing in color, quality, texture, and composition.
13. Once foundation repairs have been completed and have cured, the Contractor shall proceed with adobe repairs in the exposed area.
14. Supports and braces can be removed after foundation and wall repairs have been completed.

B. Structural Wood Replacement and Repair

1. Adobe buildings can have a variety of structural wood such as horizontal bearing plate near the top of the wall to distribute the weight of the roof, wood sills, windows, and door openings.
2. Wood floors, windows, doors, and other original details shall be retained whenever feasible.
3. Work under this section shall be performed by the Contractor in phases as approved by the Architect. Appropriate shoring and bracing shall be provided during the repair work. Work shall be performed in conjunction with adobe repairs.
4. Structural Wood repair shall use techniques, methods, and materials as similar as possible to those of the original. Sequence wood replacement as part of wall reconstruction not only to assure the stability of the structure and protection of personnel during the work, but also to address a sensible order of construction to integrate new work with existing work.
5. See above and Section 04290.01, Adobe Properties and In-Kind Replacement.
6. See Sections 06300, Wood Treatment and Section 06310, Preservation Treatment
7. After structural repairs have been completed the Contractor shall proceed as above with adobe and finish treatments.

3.05 FINAL REPORT

The Contractor shall:

- A. Revisit the site with the Architect and compare the finish and color of the repair to see if the desired affect has been achieved after the brick repairs have been executed and new mortar has cured at least 30 days.
- B. Document the work and finished product with photographs taken before, during, and after completion of the work.

- C. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Stone identification
- B. Identification of deterioration patterns and failure modes

1.03 RELATED SECTIONS

- A. Section 04100 – Historic Mortar
- B. Section 04500 – Masonry Restoration
- C. Section 04510 – Masonry Cleaning
- D. Section 04720 – Historic Cast Stone

1.04 DEFINITIONS

- A. Igneous Rock. Rock formed under conditions of intense heat or produced by the solidification of volcanic magma on or below the Earth's surface.
- B. Metamorphic Rock. Preexisting igneous rock and sedimentary rock, and other metamorphic rock, that has undergone a transformation in physical form, appearance, or character, to form a new stone with properties distinct from the original stone. Metamorphic rock is formed through pressure, heat, or both within the Earth's crust.
- C. Sedimentary Rock. Rock that is formed from material, including debris of organic origin, deposited as sediment by water, wind, or ice, and then consolidated by pressure.

1.05 REFERENCES

- A. *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. See General Services Administration, *Historic Preservation Technical Procedures Standards for Marble, Limestone, Granite and Sandstone*.
- C. *Conservation of Historic Stone Buildings and Monuments*. Report of the Committee on Conservation of Historic Stone Buildings and Monuments. Washington: National Academy Press, 1982.
- D. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- E. Wheeler, George S., et al. *Stone Masonry. Historic Building Facades: The Manual for Maintenance and Rehabilitation*. William Foulks, editor. Prepared for the New York Landmarks Conservancy. New York: John Wiley & Sons and the Preservation Press, 1997.
- F. ASTM Standards as follows:
 - 1. C97 Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
 - 2. C99 Test Method for Modulus of Rupture of Dimension Stone
 - 3. C119 Terminology Relating to Dimension Stone
 - 4. C120 Test Methods for Flexure Testing of Slate (Modulus of Rupture, Modulus of Elasticity)
 - 5. C121 Test Method for Water Absorption of Slate
 - 6. C170 Test Method for Compressive Strength of Dimension Stone
 - 7. C217 Test Method for Weather Resistance of Slate
 - 8. C241 Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic
 - 9. C503 Specification for Marble Dimension Stone
 - 10. C568 Specification for Limestone Dimension Stone
 - 11. C615 Specification for Granite Dimension Stone
 - 12. C616 Specification for Quartz-Based Dimension Stone
 - 13. C629 Specification for Slate Dimension Stone
 - 14. C880 Test Method for Flexural Strength of Dimension Stone

15. C1201 Test Method for Structural Performance of Exterior Dimension Stone Cladding Systems by Uniform Static Air Pressure Difference
 16. C1242 Guide for Design, Selection, and Installation of Exterior Dimension Stone Anchors and Anchoring Systems
 17. C1352 Test Method for Flexural Modulus of Elasticity of Dimension Stone
 18. C1353 Test Method for Using the Taber Abraser for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic
- G. *The American Standard Specifications for Interior Marble and Dimensional Stone—Design Manual IV* as published by the Marble Institute of America.
- H. *Recommended Practices* as published by The Building Stone Institute, Elgin, Illinois.
- I. *ILI Handbook – 21st edition* as published by the Indiana Limestone Institute of America.

1.06 SUBMITTALS

- A. Samples: Stone and mortar samples shall be submitted as requested by the Architect. The Contractor shall furnish not less than five stone samples, showing variations in color, texture, and finish.
- B. Product Literature: The Contractor shall submit stone supplier's literature regarding the source of the selected building stone, and any available testing information regarding the material's physical properties, such as compressive strength, absorption, and resistance to abrasion, demonstrating conformance to the referenced standards.

1.07 QUALITY ASSURANCE

- A. Work Experience: The selected Contractor shall have a minimum of 10 years experience in masonry conservation with emphasis on Architectural Stone. The Contractor shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*, including experience in historic masonry conservation.
- B. The Contractor shall not change sources or manufacturers of mortar or stone materials during the course of the work unless approved by the Architect.
- C. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.08 DELIVERY, STORAGE, AND HANDLING (as applied to products and materials)

The Contractor shall:

- A. Transport and handle stone units in such a manner as to prevent chipping and breakage; locate storage piles, stacks, or bins to avoid and protect material from heavy and unnecessary traffic; and store stone slabs on pallets on edge.

- B. Coordinate stone deliveries with the construction schedule and sequence. Stone materials shall be delivered in an order consistent with the order of installation at the project site to avoid unnecessary handling of materials.
- C. Protect stones from the ground and weather and keep them free from exposure to contaminants such as mud, dust, or materials that could cause staining.
- D. Deliver materials to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six months shall not be used.
- E. Store masonry materials in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Owner prior to the delivery of materials. Masonry materials shall not be stored inside the building.

1.09 PROJECT / SITE CONDITIONS

- A. Stone repairs shall be executed only when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. Minimum temperature for masonry work shall be 50 degrees F and above for at least 2 hours after completion and above freezing for at least 24 hours after completion. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor shall cover the top of the wall with strong waterproof membrane at the end of each day or shutdown. The Contractor shall cover partially completed walls when work is not in progress. Covering shall extend a minimum of 24 inches on each side of openings and be fastened securely.
- C. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in this Section.
- D. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection. Nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- E. The Contractor shall coordinate stone repairs with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 – PRODUCTS

2.01 STONE TYPES AND DEFINITIONS

- A. Gneiss. A metamorphic rock with a banded or coarsely foliated structure, often commercially referred to as granite. Composed essentially of silicate minerals with interlocking and visibly granular texture in which the foliation is primarily the result of alternating layers, regular or irregular, of contrasting mineralogic composition.

- B. Granite. Commercial granite includes almost all rocks of igneous origin. True granites are a very hard, crystalline, igneous rock, gray to pink in color, composed of alkali feldspar, quartz, and lesser amounts of dark ferromagnesium materials and can include minerals such as micas and hornblende. Geologically, granite is distinguished from other rocks that it resembles on the basis of the percentages of quartz, potassium feldspar, and plagioclase feldspar. Commercially, this distinction is not utilized. Black fine-grained igneous rocks, such as basalt or traprock (diabase), are called “black granite.” Although similar to true granites in structure and texture, “black granites” and other dark “granites” are composed of different minerals.
- C. Greenstone. Greenstone is defined by ASTM as a metamorphic rock principally containing chlorite, epidote, or actinolite.
- D. Limestone. ASTM defines limestone as a sedimentary rock composed primarily of calcite (calcium carbonate) or dolomite (calcium magnesium carbonate). The texture of limestone varies greatly, from uniform grain size and color to “cemented-shell mash.” Some limestones have varying amounts of other material, such as quartz sand or clay mixed in with the carbonate minerals. Most limestones are formed of shells or shell fragments, although many commercial limestones, including oolitic and very fine-grained and compact varieties are chemical precipitates. The varieties of limestone used as dimensional stone are usually well consolidated and exhibit a minimum of graining or bedding direction. Recrystallized limestones and compact, dense, relatively pure microcrystalline varieties (or partially metamorphosed limestone) that are capable of taking a polish are commercially known as marbles.
1. Calcarenite: Calcarenite is composed of sand-sized grains of calcite, usually in the form of tiny fossils, shell aggregates and fossil debris. Some calcarenites contain oolites. When oolites are present in sufficient quantity, the stone is called oolitic limestone. Oolitic limestone is a subcategory of calcarenite.
 2. Coquina: Coquina consists of raw, unaltered shell fragments, often quite large, loosely cemented by calcite. It is generally very coarse and porous, frequently consisting of oyster shells and fragments.
 3. Dolomite: Dolomite is a sedimentary carbonate rock composed of calcium and magnesium carbonate. Limestones that contain not more than 5 percent magnesium carbonate may be termed calcite limestone; those that contain from 5 percent to 40 percent magnesium carbonate are called magnesium limestone; and those that contain in excess of 40 percent as dolomite.
 4. Microcrystalline Limestone: A limestone structure of crystals too small to be seen without magnification.
 5. Oolitic Limestone: A calcite cemented calcareous stone composed of shell fragments, practically non-crystalline in character. Generally without cleavage, and extremely uniform in composition and texture, oolitic limestone adjusts to temperature changes. Oolitic limestone, a popular building stone in the U.S., Britain, and France, consists of cemented round grains of calcite or aragonite generally under 2 millimeters in diameter.
 6. Travertine: Travertine is a variety of limestone deposited from solution in groundwaters and surface waters. Hard and compact varieties, such as that from Rome, are

quarried for building stone. Generally it is characterized by a variegated gray and white or buff color with irregularly shaped pores distributed throughout the ground-mass.

- E. Marble. According to ASTM, commercial marble includes all crystalline rocks composed predominantly of calcite, dolomite, or serpentine and capable of taking a high polish. Geologically, marble is a metamorphic (recrystallized) limestone composed predominately of crystalline grains of calcite or dolomite or both, having interlocking or mosaic texture. As a result, commercial marble includes many crystalline limestones, travertine, and serpentine, a metamorphosed ultramafic rock. The color and pattern associated with marble are due to striations of accessory minerals, such as talc, chlorite, amphiboles, and pyroxenes, as well as iron oxides, hydroxides, sulfides, and graphite.
- F. Quartzite. Quartzite is a metamorphosed sandstone consisting almost entirely of quartz. It is a locally used stone found in South Dakota and Wisconsin.
- G. Sandstone. ASTM defines sandstone as a “consolidated sand in which the grains are composed chiefly of quartz and feldspar, of fragmental texture, and with various interstitial cementing materials, including silica, iron oxides, calcite, or clay.” This sedimentary rock is durable, has a very high crushing and tensile strength and a wide range of colors or textures. Commercially used sandstone is a clastic sediment consisting almost entirely of quartz grains, 1/16 to 2 millimeters in diameter, with various types of cementing material. Enough voids generally remain in the rock to give it considerable permeability and porosity.
1. Brownstone: Deep brown, red, purple, and pink sandstones are commonly called brownstone. Brownstone is an arkosic sandstone that is rich in feldspar grains and was quarried in the Triassic basins of the eastern states. Popular from the 1840s through the early twentieth century, brownstone was used on urban row houses, commercial buildings, and churches.
- H. Schist. A foliated metamorphic rock (recrystallized) characterized by thin foliae that are composed predominantly of minerals of thin platy or prismatic habits and whose long dimensions are oriented in approximately parallel positions along the planes of foliation. Because of this foliated structure, schists split readily along these planes and so possess a pronounced rock cleavage. The more common schists are composed of the micas and other mica-like minerals (such as chlorite) and generally contain subordinate quartz and/or feldspar or comparatively fine-grained texture; all graduations exist between schist and gneiss (coarse is foliated feldspathic rocks).
- I. Shale. Shale is a dark fine-grained sedimentary rock composed of layers of compressed clay, silt, or mud that has been subjected to high pressure until it has hardened rock-like.
- J. Slate. ASTM requires a slate to possess an excellent parallel cleavage that allows the rock to be split with relative ease into thin slabs. Slate is a fine-grained metamorphic rock derived from argillaceous sediments (clay and shales) consisting of extremely fine-grained quartz, mica and other platy minerals. The color of slate is generally determined by the oxidation state of the iron or the presence of graphite or pyrite.
- K. Traprock. is a microcrystalline volcanic or dike rock that consists primarily of pyroxene and a calcic plagioclase, known for its stark black color. Commercially, traprock includes basalt, gabbro, diorite, and andesite.

2.02 CHARACTERISTICS

- A. Granite: Granite is one of the most durable stones used for artistic and architectural applications. Compared to calcareous sandstones, marble and limestone, granite is not an acid soluble stone and is much more resistant to the effects of acidic solutions, rainwater ,or cleansing agents. In general, igneous building stones, such as granite, have a more inert composition; show much lower rates of deterioration; have lower water absorption, and are harder than marbles, limestones, and sandstones.
- B. Limestone: Limestone is a soft rock and is easily scratched. It will effervesce readily in any common acid. Limestone may vary greatly in texture and porosity from coquina, which is a matrix of oyster shells loosely cemented by calcite, to oolitic limestones and microcrystalline limestone whose structures are so fine that they can be seen only under magnifications. Limestone coloration is generally a consistent pure white or off-white. Many varieties do not take a polish well, so that the surface is typically a matte finish, no-gloss surface. Limestone that does take a polish is sometimes commercially called marble. Limestones, like marble and other calcareous stones, are referred to as acid sensitive. Calcareous stones are readily dissolved in acid, therefore acidic products should not be used on limestones and marbles.
- C. Marble: Fully metamorphosed marble (not to be confused with trade marbles that are actually limestones) is an extremely hard stone composed of calcite. The stone has a very tight crystalline structure and small but definite porosity. Marble can take a very high polish. The limited porosity of marble, especially polished marble, makes it less vulnerable to the leaching effects of water. Calcium carbonate, however, of which marble is composed is highly susceptible to attack by acidic agents. Marble is readily dissolved by acids, even very dilute acids, however the actual results of acidic exposure will vary with the nature of the acid. Chlorides, nitrates, sulfates, and other chemical compounds react differently with marble and produce various by-products, which have a wide range of solubility and impact on the durability of marble. For this reason, it is always important to determine the exact type of pollutants causing marble deterioration. Marble can be of two types, one composed of calcite and the other of dolomite. Dolomitic marble is much more resistant to acid attack than calcitic marble. The color of marble ranges from brilliant white of calcite to black, including blue-gray, red, yellow, and green, depending upon the mineral composition.
- D. Sandstone: Sandstone is very porous and is easily penetrated by water. The stone weathers best when its end-grain faces the weather (naturally bedded). Face-bedded stone is subject to greater deterioration. Water damages a face-bedded stone by spalling or flaking off entire sheets. The stone is also highly subject to deterioration through freeze-thaw cycles, which can cause layers to split off. During the nineteenth century, the grain was often placed parallel to the weather side (face-bedded) for aesthetic reasons, especially around doorways. Sandstone can contain a variety of minerals, which determine the stone's color. The mineral makeup can also make the stone susceptible to some chemicals.

2.03 CONSTRUCTION TERMINOLOGY/METHODS

- A. Ashlar/Ashlar Masonry: Ashlar masonry refers to stone that has a flat-faced surface that is generally square or rectangular, and has sawed or dressed beds and joints. The rectangular blocks include a finished or rock-faced surface, contrasted with cut blocks that are accurately sized and surface tooled. Ashlar masonry is comprised of rectangular blocks of stone or equivalent, generally larger in size than a brick.

- B. Course: A layer of masonry units, bonded with mortar, that runs horizontally in a wall or much less commonly, that is curved over an arch.
- C. Coursed Ashlar/Coursed Masonry: Stone masonry in which the stones within each course are identical in height, although the courses themselves need not be the same height.
- D. Dimension Stone: Natural stone quarried for the purpose of obtaining blocks or slabs that meet specifications as to size (width, length, and thickness) and shape, color, grain texture and pattern, and surface finish. Durability (essentially based on mineral composition and hardness and past performance), strength, and the ability of the stone to take a polish are other important selection criteria. Although a variety of igneous, metamorphic, and sedimentary rocks are used as dimension stone, the principal rock types are granite, limestone, marble, sandstone, and slate.
- E. Dressed/Hand Dressed: The cutting of rough chunks of stone by hand to create a square or rectangular shape. A stone that is sold as dressed stone generally refers to stone ready for installation.
- F. Dry-Laid Stone/Drystone Masonry: Stonework constructed stone-upon-stone, without mortar, using unquarried native stone collected locally; also referred to as dry wall. The stones are tightly fitted and stacked with precision to form a strong wall. This method was utilized in wall construction for walls and foundations of buildings and structures through the first quarter of the nineteenth century.
- G. Dutchman: A small, matching piece of stone that is cut, finished, and attached with the tightest possible joint to repair or replace a missing or damaged area.
- H. Rubble/Rubble Masonry: Masonry construction in which stones of random size (sometimes roughly dressed) are used.
- I. Rusticated Stone: Any stone masonry having strongly emphasized recessed joints; the exposed face of the masonry may be smooth or roughly textured. The border of each masonry block may be beveled on all four sides, only at the top and bottom, or on adjacent sides.
- J. Veneer Stone: Any stone used as a decorative facing material that is not meant to be load bearing. A non-load-bearing stone wall that is securely anchored to the back-up wall.
- K. Wythe: A masonry wall, one stone or brick thick, that either faces a back-up or is a back-up wall and secured to its neighboring wythes by bond stone or grout; or forms either half of a cavity wall, and is attached to the other half by metal ties.

2.04 MORTAR FOR HISTORIC MASONRY (see Sections 04100.02 and 04500.02)

PART 3 – EXECUTION

3.01 GENERAL

- A. Stone masonry shall use techniques, methods and materials as similar as possible to those of the original. Work should be sequenced not only to assure the stability of the structure and protection of personnel during the work, but also to address a sensible order of construction to integrate new work with existing work.

- B. The Contractor shall coordinate stone work with the other trades involved in exterior and interior restoration work including, but not limited to, masonry cleaning, sealants, and painting.
- C. Masonry cleaning shall be completed prior to beginning repair or replacement work.

3.02 CONDITIONS ASSESSMENT

The Contractor shall:

- A. Identify each type of stone.
- B. Examine the overall surface condition and appearance.
 - 1. Note presence of staining:
 - a. Nature and color of staining
 - b. Extent and location of staining or crusting from oxidations
 - 2. Inspect structural soundness of the stone. Note extent and location of:
 - a. Cracks
 - b. Settling
 - c. Block Movement
 - d. Pointing failure
 - e. Repairs
 - f. Moisture
 - 3. Examine condition of mortar joints:
 - a. Flaking
 - b. Powdering
 - c. Leaking
 - d. Cracking and Distortion
 - 4. Note nature, location, and condition of any surface coatings:
 - a. Pigment residue
 - b. Partial erosion
 - c. Cracks and crazing of coating

- d. Cloudiness
 - e. Gilding
 - f. Flaking or peeling of coatings
 - g. Bubbles or blisters in coating
5. Note location and condition of areas where water collects or pools:
- a. Standing water
 - b. Streaking
 - c. Pockets or perforations
 - d. Areas of biological growth
6. Note any loss of finish surface as evidenced by flaking or spalling; its extent, and location:
- a. Peeling and flaking usually follow uncorrected efflorescence or sub-florescence and represent a more advanced stage of failure.
 - b. Rust or corrosion may be evident in areas left unprotected as a result of coating loss through flaking.
 - c. Is the flaking or peeling localized or general in nature?
7. Look for areas with signs of erosion and/or wear and note the nature and location.
- a. Distinguish between erosion caused by environmental factors and normal exposure, versus that caused by human factors, such as touching or vandalism.
 - b. Carefully monitor and record all noted areas of erosion and wear. Use information gathered in planning for future stone maintenance.
8. Note presence, location, and type of graffiti.
9. Identify structural and/or mechanical problems and examine surfaces for evidence of movement, cracks, and breaks in the surface:
- a. Hairline cracks/crevices. Active or inactive?
 - b. Structural Cracks. Active or inactive? Assess whether monitoring is needed.
 - c. Broken and/or missing pieces
 - d. Damaged or shifting at joints
 - e. Corrosion jacking from embedded metals

3.03 GRANITE PROBLEMS AND DETERIORATION

- A. Blistering. A swelling on the surface followed by a rupturing of a thin, uniform skin.
 - 1. Typically caused by de-icing salts and/or groundwater, and usually localized near ground level.
 - 2. The condition may stabilize and remain constant; however, frequently precedes additional problems such as exfoliation or spalling.
 - 3. No effective treatment for the condition. Discontinued use of de-icing salts may slow the progress of the condition.

- B. Chipping. The separation of small pieces or larger fragments from a masonry unit, frequently at the corners, edges, or mortar joints.
 - 1. Result of deterioration and/or repairs, especially the use of excessively hard pointing mortar.
 - 2. Caused by impact resulting from accident or vandalism.

- C. Cracking. Appearance of narrow fissures ranging from less than 1/16 inch to 1/2 inch or more in width in the stone.
 - 1. Causes include structural overloading due to settlement, use of excessively hard mortar, corrosion of embedded metals, and/or flaws in the stone.
 - 2. Minor cracks, although not necessarily harmful, can be an indication of structural problems.
 - 3. Cracks can allow water entry promoting salt migration, further corrosion jacking and/or damage from freeze-thaw cycle.
 - 4. Repairs include patching and replacement.

- D. Detachment. Results from a failure of the construction system, connectors and/or joints.
 - 1. Failure of structural anchors or metal connectors that lead to detachment may be caused and/or accelerated by rust and corrosion caused by water penetration.
 - 2. Adequate pointing and caulking is required to prevent water entry into the structural system.
 - 3. The masonry unit may be removed, and the lost or failed component may be re-installed using appropriate mechanical techniques.

- E. Efflorescence. Deposit of soluble salts on the surface of the masonry. Natural efflorescence from new stones or mortar, which is washed away by rain or water washing, is generally not a problem; however, recurring efflorescence is an indication of other problems:

1. Improper chemical cleaning, too strong a chemical and chemical residue, inadequate rinsing.
 2. Rising damp and other water/moisture problems
 3. Exposure to de-icing salts, chemical landscaping treatments, or air pollution.
 4. Run-down from calcareous stone above (seen frequently on the granite water tables of limestone and marble buildings)
- F. Erosion. The wearing away of the material surface by the natural action of wind, windblown particles, and water. As granite's composition is hard, erosion is generally a less serious problem with granite than with other stones.
- G. Flaking. The detachment of small, flat, thin pieces of the outer layers of stone from a larger piece of stone.
1. An early stage of more serious problems such as peeling, exfoliation, delamination, or spalling.
 2. Caused by capillary moisture or freeze-thaw cycles, the result of application of water-repellent coatings that can trap moisture beneath the surface, and sub-florescence.
 3. To determine whether flaking is caused by sub-florescence, check for signs of whitish salt buildup.
- H. Peeling: Flaking away of the surface from the substrate in strips or layers.
1. Can result when improper application of masonry coatings leads to failure of the coating and/or stone surface.
 2. Can follow encrustation of the surface caused by chemical reactions with environmental elements.
- I. Rising Damp: The suction of groundwater into the base of masonry through capillary action. The level of water drawn into the stone may rise and fall according to conditions of temperature, humidity, site grading, absence or failure of damp courses, and/or treatments to the masonry surfaces that affect evaporation.
1. Associated with a darkened area near ground level during active or wet periods
 2. Can cause staining and efflorescence
 3. Can lead to problems such as flaking, peeling and spalling
 4. Corrected through elimination of water source or interruption of its path into the stone by physical or chemical damp-proofing.
- J. Spalling: The separation and breaking away of layers or small pieces of stone owing to sub-florescence, freeze-thaw, improper repointing (too hard mortar or portland cement), or structural overload. Less common in granite than in softer stones.

- K. Sub-florescence: Internal accumulation of soluble salts deposited under or just beneath the masonry surface as moisture in the wall evaporates. Salts enter the stone dissolved in rainwater or groundwater via absorption, rising damp, or poor joints.
 - 1. Can be caused by de-icing salts, chemical cleaners, landscaping products, mortar, and air pollution.
 - 2. Treatments include poulticing, removal of identified salt sources, elimination of moisture in the stone, and damp-proofing.
- L. Staining: A variety of stains may appear on stone, each having different characteristics.
 - 1. Bird droppings
 - 2. Corroded connectors within the masonry (rust stains)
 - 3. Salt crystallization (white efflorescence)
 - 4. Run-off from bronze or metal sculpture/ornament (green or rust-colored stains)
 - 5. Accretion of particulates (dirt, soot, etc.)
 - 6. Graffiti

3.04 LIMESTONE PROBLEMS AND DETERIORATION

- A. Weathering: Deterioration resulting from the natural effects of wind, rain, snow, thermal change, and atmospheric pollutants. Causes surface losses and loss of detail.
- B. Erosion: Erosion can be caused by weathering or other phenomenon. In some cases, wear can result in localized areas from contact with landscaping or mowing equipment.
- C. Staining. Discoloration, whether general or localized, is staining and can result from exposure to a variety of exterior substances or to internal occlusions in the stone or structural elements. Types of staining and causative agents include:
 - 1. Oil/grease stains generally resulting from vandalism or use
 - 2. Dyes and inks generally localized around area of contact.
 - 3. Organic stains caused by direct contact with decomposing organic matter such as bird or animal droppings, flowers, and tea or coffee.
 - 4. Metallic stains
 - a. Rust Stains are caused by oxidation of iron (rust) and usually result from water penetration that activates or accelerates rusting of iron structural or connecting components.
 - b. Copper stains are caused by copper salts (from copper or bronze) that wash onto the stone and then oxidize.

- D. **Crumbling/Sugaring:** Indicative of a certain brittleness or tendency of the stone to break up or dissolve. Also called sugaring when the limestone breaks up into small crystals that look and feel like coarse sugar. Stones generally have to be replaced when crumbling occurs. Causes include:
1. An inherent weakness in the limestone
 2. Gradual breakdown of the binder
 3. External factors affecting the strength and durability of the stone such as de-icing salts (called salt fretting), or any other source of salt migration (like rising damp).
- E. **Chipping:** The separation of small pieces or larger fragments from a masonry unit, generally resulting from deterioration and repointing, the use of excessively hard mortar, accident or vandalism.
- F. **Cracking:** Appearance of narrow fissures ranging from less than 1/16 inch to 1/2 inch wide or greater in the stone. Can result from structural overloading, inappropriately hard mortars, or a flaw in the material. Cracks that allow water migration require repair or replacement.
- G. **Detachment:** A result of a failure of the structural system (the connectors and joints), generally caused by water penetration, which in turn causes rust and corrosion of anchors and metal connectors. See Detachment under Granite, above.
- H. **Efflorescence:** Surface deposits of soluble salt; causes include leaching of salts from cement mortar, improper cleaning agents, rising damp, de-icing salts, chemical landscaping treatments, air pollution and acid rain. See Efflorescence under Granite, above.
- I. **Erosion:** The wearing away of the material surface by the natural action of the wind, windblown particles, and water. Causes loss of carved and incised detail.
- J. **Flaking:** The early stage of peeling, exfoliation, delamination, or spalling, evidenced by the detachment of small, flat, thin pieces of the outer layers of stone from a larger piece of stone. Generally the result of capillary moisture or freeze-thaw cycles that occur within the masonry.
- K. **Peeling:** Flaking of the stone surface from the substrate in strips or layers. May result from improper application of masonry coatings, from a defect in the stone, or from weathering. Encrustations of the surface caused by chemical reactions with environmental elements may also peel or flake along the bedding plane.
- L. **Rising Damp:** The rise of ground water through capillary action. The amount of moisture drawn varies due to conditions of temperature, humidity, site grading, absence or failure of damp course, and/or treatments to the masonry surface that affect evaporation. Can lead to a variety of problems.
- M. **Spalling:** The separation and breaking away of pieces of stone as a result of sub-florescence, freeze-thaw, improper repointing with hard mortar or portland cement, or structural overloading. Less frequent than with softer sedimentary stones.

- N. Sub-florescence. Internal and potentially harmful accumulation of soluble salts deposited under or just beneath the masonry surface as moisture in the wall evaporates. The build-up of salts and their crystallization can cause pressures that cause pieces to break off. Efflorescence at the surface is an indication that sub-florescence may be present. See Sub-florescence under Granite above.

3.05 MARBLE PROBLEMS AND DETERIORATION

- A. Weathering: Deterioration resulting from the natural effects of wind, rain, snow, thermal change, and atmospheric pollutants. Although marble has low porosity, it is highly reactive when exposed to acids, such as acid rain; coupled with the elliptical shape of the pores that allow greater dissolution, two major problems result:
1. Loss of polish
 2. Loss of detail
- B. Erosion: As with weathering above, wind-driven, airborne abrasives such as dirt, grit, and other particles may wear away detailing.
- C. Staining: Discoloration of the stone. Some types of staining and causative agents are:
1. Oil/grease stains generally the result of vandalism or handling. Substances may be absorbed into the stone upon contact. The depth of penetration depends on the viscosity of the oil/grease, temperature, stone porosity, finish and dryness.
 2. Dyes and inks (see under Limestone).
 3. Organic stains (see under Limestone).
 4. Metallic stains (see under Limestone).
 5. General dirt, soot, and pollution. Marble can be discolored by atmospheric dirt, grim, and other airborne particulates which adhere to the material and can result in a dull or gray appearance. Dirt can become incorporated into crusts. Biological agents can collect on dirty surfaces and stimulate algal growth. Algae, lichens, and moss can produce acid by-products that damage the acid-sensitive stone. Some waterproof and water-repellent coatings increase static attraction that results in the stone getting dirty faster.
- D. Crumbling/Sugaring: The gradual disintegration of the surface of the marble possibly caused by salt migration and exposure to moisture. Excessive moisture may have the effect of dissolving the binder. Carbonate stones, especially fine-grained marbles, are particularly susceptible to this form of deterioration. The surface takes on a rough granular, dry crystalline, or sometimes powdery appearance. Also see under Limestone.
- E. Chipping (see under Limestone).
- F. Cracking (see under Limestone).
- G. Detachment (see under Granite).

- H. Efflorescence (see under Granite).
- I. Erosion (see under Limestone).
- J. Flaking (see under Limestone)
- K. Peeling (see under Limestone)
- L. Rising Damp (see under Limestone).
- M. Spalling: Less frequent with marble than with sedimentary stones, which are less dense.
- N. Sub-Florescence (see under Limestone).

3.06 SANDSTONE PROBLEMS AND DETERIORATION

A. Natural and Inherent Problems

1. Moisture-related problems. Evident in sandstone as spalling, erosion, cracking, flaking, and deteriorated mortar joints. See specific categories under Limestone.
2. Weathering. Disintegration of the stone's surface usually caused by erosion, chemical action, and moisture freezing in the stone (freeze-thaw).
3. Exfoliation. Separation and loss of large areas of stone along the bedding planes, usually caused by the stone having been face-bedded
4. Blind Exfoliation. Separation of stone along bedding planes, but where layers are still loosely attached behind the surface. It is often caused by having laid the stone with the bedding planes running parallel with the surface of the wall (face-bedding). Blind exfoliated stone will sound hollow when lightly tapped with a rubber mallet.
5. Blistering. Swelling and rupturing of a thin uniform skin caused by air-borne chemicals reacting with the stone surface, forming a hard, brittle skin. Blisters will often pop when touched.
6. Cracking. Narrow fractures in the stone (see Cracking under Limestone).
7. Detachment. A clean break in the stone often resulting from sharp impact, or from stresses concentrated in a small area of stone as a result of structural settlement.

B. Human-Induced Problems

1. Stone laid with its layers parallel to the wall plane (face-bedded) rather than perpendicular to the wall plane (naturally-bedded). Face-bedded stone is more prone to deterioration by weathering as entire sheets of stone tend to flake off.
2. Painting over a deteriorated stone surface, which leads to more serious moisture-related problems.
3. Application of cement patch over deteriorated surfaces.

3.07 FINAL REPORT

The Contractor shall provide a final report of completed work including all approved submittals and photographs of work taken before, during, and after completion.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Stone masonry repair through pinning
- B. Stone masonry repair through disassembly and rebuilding

1.03 RELATED SECTIONS

- A. Section 04100 – Historic Mortar
- B. Section 04400 – Stone
- C. Section 04500 – Masonry Restoration
- D. Section 04510 – Masonry Cleaning
- E. Section 07631 – Gutters, Drains, and Flashing
- F. Section 07900 – Joint Sealers

1.04 REFERENCES

- A. Masonry work shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.

- B. As applicable, techniques employed for masonry shall be as outlined in *Preservation Brief No. 2: Repointing Mortar Joints in Historic Masonry Buildings*. Available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief02.htm>>.
- C. See General Services Administration, Historic Preservation Technical Procedures Standards at <<http://w3.gsa.gov/web/p/hptp.nsf/>>.
- D. Masonry restoration work shall comply with ACI / ASCE 530.1-88. Contractor shall maintain at least one copy of ACI / ASCE 530.1-88 on site.
- E. ASTM C 109/C 109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
- F. ASTM C 150 Standard Specification for Portland Cement.
- G. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes.
- H. ASTM C 881/C 881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- I. ASTM C 1324 Standard Test Method for Examination and Analysis of Hardened Masonry Mortar.
- J. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- K. *Conservation of Historic Stone Buildings and Monuments: Report of the Committee on Conservation of Historic Stone Buildings and Monuments*. National Material Advisory Board, Commission on Engineering and Technical Systems, National Research Council. Washington, D.C.: National Academy Press, 1982.

1.05 SUBMITTALS

The Contractor shall submit to the Architect:

- A. A detailed schedule of the areas for repair, including an assessment of the problem areas, historic mortar analysis, and detailed procedure for masonry repair for approval.
- B. Product data for all manufactured masonry repair materials. Manufacturer's product data shall include technical data, certification of compliance with referenced standards, and instructions for handling, storage, and installation of the material. Also submit Material Safety Data Sheets for each material.
- C. Samples of the following masonry repair and replacement materials for approval of color and texture match. No masonry restoration work shall proceed until all samples are approved. Once a matching mortar color is achieved, placement of on-site mock-ups may begin.

Cured pointing mortar for stone masonry. See Section 04100 – Historic Mortar.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor performing the work in this section shall have a minimum of ten (10) years experience in historic masonry restoration and shall have successfully completed at least three projects of similar scope within the previous five years. He/she shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*.
- B. The Contractor shall not change sources or manufacturers of mortar or stone materials during the course of the work unless approved by the Architect.
- C. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.07 MOCK-UPS

- A. After completion of the masonry cleaning mock-ups specified in Section-04510, the Contractor, at locations designated by the Architect, shall prepare test panels of the following work:
 - 1. Stone Masonry Restoration:
 - a. All personnel proposed for work on the project shall prepare 3x3-foot samples demonstrating stone restoration techniques, including mortar removal, repointing, and stone replacement.
 - b. Mock-ups will be reviewed by the Architect after the mortar removal and again after completion of repointing.
 - c. Mock-ups shall display the full range of materials and workmanship required for completion of the project for approval by the Architect.
 - d. Color matching: Contractor shall match existing mortar color(s). The Contractor shall place the initial sample panel using the mix from the approved sample. The sample panel must be cured in the same manner as is expected for the work based on anticipated temperatures.
 - e. The Contractor shall prepare up to three additional mock-ups of each mortar, joint type, and mortar color with no further compensation if required to achieve approval. Approved test panel(s) shall become part of the work and shall serve as the quality standard for all subsequent work.
 - 2. Stone Pinning:
 - a. The Contractor shall prepare one mock-up for pinning of broken masonry units. Unit to be repaired shall be designated by the Architect.
 - b. The Contractor shall prepare up to three additional mock-ups of stone pinning repair with no further compensation if required to achieve approval. Approved

mock-up shall become part of the work and shall serve as the quality standard for all subsequent work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six months shall not be used.
- B. Masonry materials shall be stored in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Architect.
- C. Liquids shall be stored at temperatures between 40 and 85 degrees. Liquids shall not be allowed to freeze.
- D. Masonry Units will be protected from the ground and weather, and kept free from exposure to contaminants such as mud, dust, or materials that could cause staining.

1.09 PROJECT / SITE CONDITIONS

- A. Normal conditions for the work of this Section shall be defined as when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are predicted to rise above or fall below this temperature range, the Contractor may proceed using approved hot and cold weather procedures as defined by the Masonry Institute of America. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in the Section. The Contractor shall:
 - 1. Minimize levels of dust during mortar removal and masonry repointing operations.
 - 2. Protect open copings, reglets, and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall not be left exposed overnight or when inclement weather is predicted.
 - 3. Temporarily remove and store metal downspouts during masonry restoration work. Install temporary drainage leaders if required. Reinstall immediately upon completion of work in the immediate area. Protect open boots at grade from accumulation of masonry debris.
 - 4. Protect existing gutters and gutter outlets from damage and accumulation of mortar debris during restoration of roof elements.

5. Protect window sashes and frames with plywood or other sturdy barrier during repointing and repair of masonry around window openings.
 6. Protect the existing roof surfaces from damage during the course of the masonry restoration work. Repair all damage to wood and metal roofing, gutters, flashing, etc., to the satisfaction of, and at no additional cost to, the Owner.
 7. Remove and store light fixtures, signage, security devices and miscellaneous appurtenances from masonry surfaces to be repointed. Provide temporary protection for exposed fixture boxes.
- C. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection. Nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- D. Stone, brick, mortar, waste material, packaging and other debris associated with the masonry work shall be disposed of in accordance with local, state, and federal environmental regulations. Remove debris from masonry restoration work from the site on a daily basis and at the completion of the work.
- E. The Contractor shall coordinate masonry repairs with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Mortar Materials
1. Lime: ASTM C-207, Type S
 2. Portland Cement: ASTM C-150, Type I, non-staining and without air entrainment. Gray and white portland cement may be combined as required to match existing mortar.
 3. Sand: ASTM-C-144, free of clay, silt, soluble salts, and organic matter, and shall match the color and texture of the original mortar sand.
 4. Water: Potable and free of deleterious amounts of oil, soluble salts, alkali, acids, organic impurities, or other substances that may impair the strength or bond of the finished mortar.
 5. Mortar colorant, if required to match the color of the existing mortar, shall be a standard, alkali-resistant, non-fading product manufactured by an approved manufacturer. Submit product and manufacturer information to the Architect for approval.

2.02 MIXES

- A. Mortar mixes shall be the appropriate the strength and hardness for the masonry units and existing mortar. The mix shall match the composition, color, and texture existing mortars. Refer to Section 04100 – Historic Mortar.

2.03 ACCESSORY MATERIALS

- A. Stainless-steel pins for stone repair shall be Type 316 stainless-steel all-thread rods, ¼ inch diameter. Length shall be as required by the size of the stone to be repaired.
- B. Epoxy adhesive for embedding pins shall be a high modulus epoxy resin conforming to ASTM C-881, Type I, II, IV, and V, Grade 3 epoxy resin adhesives.
- C. Replacement cramps and other embedments shall be Type 316 stainless steel.
- D. Joint reinforcement for rebuilding masonry shall be Type 316 stainless-steel all-thread rods, ¼ inch diameter. Verify number and spacing of rods with the Architect.

PART 3 - EXECUTION

3.01 GENERAL

- A. Masonry cleaning shall be completed prior to beginning masonry restoration or repointing.

3.02 PINNED REPAIRS FOR BROKEN STONES

- A. Remove loose flakes of stone, dirt, and debris from both the fragments to be reattached. Dry fit to verify placement, using register marks to align and mask edges to protect surface from excess adhesive.
- B. Drill holes for new stainless steel rods parallel to the long dimension of the stone and centered in the thickness of the stone. Use register marks to ensure that holes in mating surfaces align perfectly and shall remove debris and dust after drilling with pressurized water or air (40 to 60 psi).
- C. Mix adhesive according to manufacturer's instructions. Fill anchor holes for reinforcing rods full with epoxy to ensure full adhesion and apply epoxy adhesive to both mating surfaces in a uniform layer, working product well into surface.
- D. Install rods and work stone fragment back into place, ensuring full contact with the adhesive. Immediately remove any excess adhesive from joint edges. Immobilize fragment until epoxy adhesive has cured.

3.03 RE-ANCHORING INDIVIDUAL BUILDING STONES

- A. The Contractor shall complete any required pinning, patching or other repair to individual stones prior to reinstallation.
- B. Remove damaged material from the area to be repaired and clean masonry backup and adjoining stones of mortar. Vacuum or rinse area free of dust and loose debris.

- C. Install stainless steel pins as required to secure the unit to the existing substrate. Allow for 1 pin per 20 square inches of surface area to be patched. Pins shall penetrate a minimum of one third the thickness of the stone to be installed but under no circumstance be allowed to penetrate beyond half the depth of the stone.
- D. The diameter of the holes for stainless steel anchor pins shall be drilled $\frac{1}{8}$ inch greater than the diameter of the pins. The Contractor shall anchor pins in specified setting adhesive. The use of hammer drills is NOT permitted.
- E. Use lead, slate, or plastic shims of the thickness required to maintain the required joint width. The use of wood shims is NOT permitted. Where the repair extends to the edge of the masonry unit, maintain the existing joint thickness. Joints occurring in the field of the masonry unit shall be hairline joints and shall not be pointed out. The Contractor shall dry fit the stone to assess the snugness of the fit and adjust as required.
- F. Set stone straight, plumb, and true to line and level in full mortar bed. Ensure head joint and vertical joints, if required, are packed full with mortar. Tool joints flush to existing stone surface profile.

3.04 MASONRY DISASSEMBLY AND RECONSTRUCTION

- A. The Contractor shall carefully dismantle selected areas of masonry. Dismantle adjacent assemblies as required for access to the designated masonry, salvaging components for reuse to the greatest extent possible.
- B. Rake or grind mortar from joints to the greatest extent possible before attempted removal of the stones. Avoid excessive prying against the arrises of the selected masonry units to avoid spalling and chipping. Label each unit on a concealed side with non-removable marking. Numbers shall be keyed to a drawing to ensure reinstallation in the original location.
- C. Clean old mortar and sealants from masonry units to be reassembled.
- D. Reset masonry units to proper position, straight, plumb, and true to line and level, with full mortar bed. The Contractor shall embed reinforcing rods in mortar bed, ensuring full coverage, and ensure that vertical head joints are completely filled with mortar. Rake and point as described above except at coping head joints, which shall be pointed with flexible sealant.
- E. Reinstall adjacent materials or patch in kind as required to complete the installation.

3.05 FINAL REPORT

The Contractor shall:

- A. Revisit the site with the Architect and compare the finish and color of the repair to determine if the desired affect has been achieved after the stone masonry repairs have been executed and new mortar has cured at least 30 days.
- B. Document the work and finished product with photographs.

- C. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not addressed in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Stone masonry repair through mortar and dutchman patching
- B. Repair of vertical cracks
- C. Stone masonry stone repair through consolidation

1.03 RELATED SECTIONS

- A. Section 04100 – Historic Mortar
- B. Section 04400 – Stone
- C. Section 04500 – Masonry Restoration
- D. Section 04510 – Masonry Cleaning
- E. 07900 – Joint Sealers

1.04 REFERENCES

- A. Masonry work shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.

- B. As applicable, techniques employed for masonry shall be as outlined in *Preservation Brief No. 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings* available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief01.htm>>.
- C. As applicable, techniques employed for masonry shall be as outlined in *Preservation Brief No. 2: Repointing Mortar Joints in Historic Masonry Buildings* available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief02.htm>>.
- D. See General Services Administration, Historic Preservation Technical Procedures Standards at <<http://w3.gsa.gov/web/p/hhttp.nsf/Repair%20Procedures?OpenView&Start=1&Count=30&Expand=3#3>>.
- E. Masonry restoration work shall comply with ACI / ASCE 530.1-88. Contractor shall maintain at least one copy of ACI / ASCE 530.1-88 on site.
- F. ASTM C 109/C 109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
- G. ASTM C 150 Standard Specification for Portland Cement.
- H. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes.
- I. ASTM C 881/C 881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- J. ASTM C 1324 Standard Test Method for Examination and Analysis of Hardened Masonry Mortar.
- K. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- L. *Conservation of Historic Stone Buildings and Monuments: Report of the Committee on Conservation of Historic Stone Buildings and Monuments*. National Material Advisory Board, Commission on Engineering and Technical Systems, National Research Council. Washington, D.C.: National Academy Press, 1982.

1.05 SUBMITTALS

The Contractor shall submit to the Architect:

- A. A detailed schedule of the areas for repair, including and assessment of the problem areas, historic mortar analysis, and detailed procedures for masonry repair for approval.
- B. Product data for all manufactured masonry consolidation, grouting, and patching materials. Manufacturer's product data shall include certification of compliance with specified standards and instructions for handling, storage, and installation of the material, and Material Safety Data Sheets for each material.

- C. Samples of the following masonry repair and replacement materials for approval of color and texture match. No masonry restoration work shall proceed until all samples are approved. Once a matching mortar color is achieved, placement of on-site mock-ups may begin.
 - 1. Cured pointing mortar for stone masonry
 - 2. Cured stone patching mortar
 - 3. Pointing mortar: Prepare portable samples using drywall channel or similar material the approximate width of a mortar joint.
 - 4. Patching mortar: Prepared samples shall be a minimum size of 3x3 inches by ½ inch or 3 inches diameter by ½-inch thickness.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience historic masonry restoration and shall have successfully completed at least three projects of similar scope within the previous five years. He/she shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*.
- B. The Contractor shall not change sources or manufacturers of mortar or consolidant materials during the course of the work.
- C. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.07 MOCK-UPS

- A. The Contractor shall provide samples of stone and mortar matches for approval by the Architect of color and texture. After approval the Contractor shall prepare test panels of the following work:
 - 1. Stone Masonry Restoration:
 - a. All personnel proposed for work on the project shall prepare 3x3-foot samples demonstrating stone restoration techniques, including mortar removal, repointing, dutchman and/or mortar patching and/or grouting.
 - b. Mock-ups will be reviewed after the mortar removal and patch preparation, and again after completion of repointing and patching work.
 - c. Mock-ups shall display the full range of materials and workmanship required for completion of the project for approval by the Architect.
 - d. Color matching: The Contractor shall match existing mortar color(s) for masonry pointing sample. The Contractor shall place the initial sample panel

using the mix from the approved sample. The sample panel must be cured in the same manner as is expected for the work based on anticipated temperatures.

- e. Color Matching: Contractor shall match existing mortar color(s) for stone patching sample(s). The Contractor shall place the initial sample panel(s) using the mix from the approved sample(s). The sample panel(s) must be cured in the same manner as is expected for the work based on anticipated temperatures.
 - f. Consolidant: Prepare a 3x3-foot test panel of consolidant application or as directed by the Architect. Apply consolidant in accordance with manufacturer's instructions and recommendations. Allow to cure for approximately one week prior to review of test panel to allow accurate assessment of surface appearance.
- B. The Contractor shall prepare up to three additional mock-ups of each mortar color, joint type, and patching color with no further compensation. Approved test panel(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six months shall not be used.
- B. Masonry materials shall be stored in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Architect.
- C. Store liquids at temperatures between 40 and 85 degrees. Do NOT allow liquids to freeze.

1.09 PROJECT / SITE CONDITIONS

- A. Normal conditions for the work of this Section shall be defined as when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling or as directed by manufacturer of restoration materials. When temperatures are predicted to rise above or fall below this temperature range, the Contractor may proceed using approved hot and cold weather procedures as defined by the Masonry Institute of America unless directed otherwise by material manufacturer(s). Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work. Provide all necessary protection and work procedures to avoid damage to existing material assemblies not a part of the work in this Section. The Contractor shall:
 - 1. Minimize levels of dust during mortar removal and masonry repointing operations.

2. Protect open copings, reglets, and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall be left exposed overnight or when inclement weather is predicted.
 3. Temporarily remove and store metal downspouts during masonry restoration work. Install temporary drainage leaders if required. Reinstall immediately upon completion of work in the immediate area. Protect open boots at grade from accumulation of masonry debris.
 4. Protect existing gutters and gutter outlets from damage and accumulation of mortar debris during restoration of roof elements.
 5. Protect window sashes and frames with plywood or other sturdy barrier during repointing and repair of masonry around window openings.
 6. Protect the existing roof surfaces from damage during the course of the masonry restoration work. Repair all damage to wood and metal roofing, gutters, flashing, etc., to the satisfaction of, and at no additional cost to, the Owner.
 7. Remove and store light fixtures, signage, security devices and miscellaneous appurtenances from masonry surfaces to be repointed. Provide temporary protection for exposed fixture boxes.
- C. The Contractor shall provide visible barriers and/or warning tape around the perimeter of the work area for visitor protection. Nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- D. Stone, brick, mortar, waste material, packaging, and other debris associated with the masonry work shall be disposed of in accordance with local, state, and federal environmental regulations. The Contractor shall remove debris from masonry restoration work from the site on a daily basis and at the completion of the work.
- E. Contractor shall coordinate masonry repairs with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Pointing and Patching Materials – Job-Mixed
1. Lime: ASTM C-207, Type S
 2. Portland Cement: ASTM C-150, Type I, non-staining and without air entrainment. Gray and white portland cement may be combined as required to match existing mortar.
 3. Sand: ASTM-C-144, free of clay, silt, soluble salts and organic matter and shall match the color and texture of the original mortar sand.

4. Water shall be potable and free of deleterious amounts of oil, soluble salts, alkali, acids, organic impurities, or other substances that may impair the strength or bond of the finished mortar.
 5. Mortar colorant, if required, shall match the color of the existing mortar. Mortar colorant shall be a standard product by a recognized manufacturer of this type of product. Colorant products and manufactures selected shall be approved by the Architect.
- B. Pointing and Patching Materials – Factory-Mixed: The Contractor shall have the option of providing factory-mixed pointing and patching mortars subject to approval of required technical data, samples, and mock-ups by the Architect.
- C. Manufacturers: Obtain masonry materials and units from an established plant having the capacity and facilities for producing material of specified quality and finish, and in sufficient quantity so as not to delay progress of the work. Plant shall be that of a producer recognized by the industry as a supplier and/or manufacturer of this type of material, who can show successful completion of work of comparable quality and scope.
- D. Dutchman materials
1. ASTM C568, Category II (medium density) Specification for Limestone
 2. ASTM C503 Specification for Marble Dimension Stone, Classification 1 Calcite
 3. ASTM C615 Specification for Granite Dimension Stone
 4. ASTM C616 Specification for Quartz-Based Dimension Stone
 5. ASTM C629 Specification for Slate Dimension Stone
 6. Obtain stone consistent with the color and texture range of the existing material. Stones shall be sound and free from cracks, chips, and other defects that may affect strength or appearance.

2.02 MIXES

- A. Mortar mixes shall be of the appropriate strength and hardness for the masonry units and existing mortar. The mix shall match the composition, color, and texture of existing mortars. Refer to Section 04100 – Historic Mortar.

2.03 STONE CONSOLIDANT

- A. The selection of a stone consolidant is highly dependent on the type of stone to be consolidated and the extent of its deterioration. Local VOC laws will significantly affect the availability and use of consolidant products for each project.
- B. The Contractor shall provide information on industry recognized manufacturers that provide products that may be suitable for consolidation of fragile masonry surfaces. Specific guidance should be sought from the manufacturer regarding the product

availability and use in the project locale. Manufacturers and products selected must be approved by the Architect.

2.04 ACCESSORY MATERIALS

- A. Stainless steel pins for anchoring patches shall be Type 304 or 316 stainless-steel all-thread rods, ¼ inch diameter. Length shall be as required by the depth of the patch. All other embedments such as eye bolts to be used for anchoring reinforcing pins and wire shall be stainless steel.
- B. Stainless-steel rods for stitching vertical cracks shall be Type 304 or 316 stainless-steel all-thread rods, ¼ inch diameter. Length shall be approximately 24 inches or as required to span crack 12 inches on either side.
- C. Epoxy adhesive for embedding anchors and pins shall be a high modulus epoxy resin conforming to ASTM C-881, Type I, II, IV, and V, Grade 3 epoxy resin adhesives.

2.05 MIXING PROCEDURES

- A. Job-Mixed Mortar:
 - 1. Mix mortar in accordance with ASTM C-270.
 - 2. Measure materials by volume or equivalent weight as indicated. Do not measure by shovel.
 - 3. Mix ingredients in a clean mechanical batch mixer for 3 to 5 minutes.
 - 4. Mortar shall stand for 20 minutes prior to use to allow for initial shrinkage. Place mortar in final position within two hours of mixing. Do NOT retemper or use partially hardened mortar.
- B. Proprietary Mortars: Mix in accordance with manufacturers printed instructions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Complete masonry cleaning prior to masonry repair and repointing. The Contractor shall match new patching materials and mortars to the color of the cleaned stone.
- B. The Contractor shall examine areas and conditions under which masonry restoration is to be performed and notify the Architect of any conditions detrimental to the proper and timely completion of the work. Work shall NOT commence until all unsatisfactory conditions have been adequately corrected.

3.02 MASONRY REPOINTING

- A. Refer to Section 04100.01 – Removal of Mortar Joints and Repointing.

3.03 REMOVAL OF EXISTING PATCHES AND PREPARATION OF SUBSTRATE

- A. Existing patches showing visible signs of failure such as cracking or delamination shall be removed and replaced as noted on the Drawings. Where a single small stone requires extensive patchwork, the entire stone shall be removed back to sound material and a dutchman patch installed.
- B. The Contractor shall remove existing patches by manual chiseling or using a low pressure (<40 psi) pneumatic chisel. Grinding with a carborundum blade will be permitted only after review and approval of the grinding technique by the Architect. Final chipping of the corners of the area to be patched shall be done by hand.
- C. The Contractor shall chip damaged areas back to sound material, ensuring a uniform minimum depth of $\frac{3}{4}$ inch. Remove additional stone only as required to provide for a neat square patch. Back bevel the top and sides of the patch area to provide a mechanical key for the new patching material.
- D. Wash area to be patched clean of dust, grit, and other debris.
- E. Where stone patches exceed 20 square inches in area or 3 inches in depth, the Contractor shall install stainless-steel pins as required to secure the patch or dutchman unit to the existing substrate. The Contractor shall allow for 1 pin per 20 square inches of surface area to be patched. Pins shall penetrate a minimum of one third the thickness of the patch/dutchman to be installed but under no circumstance be allowed less than 2 inches mortar cover.
- F. The diameter of the holes for stainless steel anchor pins shall be drilled $\frac{1}{8}$ inch greater than the diameter of the pins. The use of hammer drills is not permitted. The Contractor shall anchor pins in specified setting adhesive.

3.04 MORTAR PATCHING

- A. Thoroughly wet area to be patched to prevent suction of moisture from the patching material. Apply a slurry coat of approved mortar to the substrate.
- B. Install mortar patching material in lifts to build the required depth of patch in accordance with the manufacturer's published instructions. The surface shall be tooled to match the adjacent stone texture.
- C. Keep the mortar patches damp for 24 hours using damp burlap, plastic sheeting or other membrane as required.

3.05 DUTCHMAN PATCHING

- A. Remove damaged material from the area to be patched. Where possible, back-bevel edges of opening and bevel edges of dutchman to improve mechanical key. The Contractor shall clean masonry backup and adjoining stones of mortar, and vacuum or rinse area free of dust and loose debris.

- B. Where stones exceed 20 square inches in area, install stainless-steel pins as required to secure the unit to the existing substrate. The Contractor shall allow for 1 pin per 20 square inches of surface area to be patched. Pins shall penetrate a minimum of one third the thickness of the stone to be installed but under no circumstance be allowed to penetrate beyond half the depth of the stone.
- C. The diameter of the holes for stainless-steel anchor pins shall be drilled $\frac{1}{8}$ inch greater than the diameter of the pins. The use of hammer drills is not permitted. The Contractor shall anchor pins in specified setting adhesive.
- D. Use lead, slate, or plastic shims of the thickness required to maintain the required joint width. The use of wood shims is not permitted. Where the patch extends to the edge of the masonry unit, maintain the existing joint thickness. Joints occurring in the field of the masonry unit shall be hairline joints and shall not be pointed out. The Contractor shall dry fit the dutchman to assess the snugness of the fit and adjust as required.
- E. Set dutchman straight, plumb, and true to line and level in full mortar bed. The Contractor shall ensure head joint and vertical joints, if required, are packed full with mortar. Tool joints flush to existing stone surface profile. Surfaces mating with the existing stone shall be coated with adhesive and fitted tightly together.

3.06 VERTICAL CRACK REPAIR

- A. The Contractor shall rake horizontal masonry joints to approximately 12 inches on either side of the crack to be repaired and a minimum depth of 2 inches or to sound mortar. Rake entire crack down to sound mortar (where applicable). See Section 04100.01 Removal of Mortar Joints and Repointing.
- B. Where cracks extend through individual stones, the Contractor shall remove and replace cracked stones with sound material toothed into the adjacent masonry.
- C. Repoint all joints full depth, embedding stainless-steel reinforcing rods at least $1\frac{1}{2}$ inches behind the finish joint surface to a minimum distance of 12 inches on either side of the crack. Space rods approximately 12 inches o.c. vertically. Ensure rods are set in a full mortar bed. Finish joints to match existing.

3.07 STONE REPAIR BY CONSOLIDATION

- A. Consolidant should only be applied to those units most consumed by disaggregation. Face-bedded units exhibiting deep losses as a result of sloughing of parallel layers shall not be consolidated. The Contractor shall review the extent of the work with the Architect, marking each individual stone to be consolidated with chalk or other removable medium. All areas shall be photographed after marking is complete.
- B. To ensure better penetration of the stone, the Contractor shall rake surrounding joints prior to application of consolidant.
- C. Application to mortar joints is unnecessary and should be avoided.

- D. The Contractor shall apply consolidant according to manufacturer's instructions and approved test panel.

3.08 FINAL REPORT

The Contractor shall:

- A. Revisit the site with the Architect to compare the finish and color of the repair to see if the desired affect has been achieved after the repairs have been executed and new mortar has cured at least 30 days.
- B. Document the work and finished product with photographs.
- C. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not addressed in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Assessment of deteriorated units and criteria for replacement
- B. Stone masonry replacement procedure including selection, fabrication, and installation.

1.03 RELATED SECTIONS

- A. Section 04100 – Historic Mortar
- B. Section 04400 – Stone
- C. Section 04500 – Masonry Restoration
- D. Section 04510 – Masonry Cleaning
- E. Section 07900 – Joint Sealers

1.04 REFERENCES

- A. Masonry work shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings* available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. As applicable, techniques employed for masonry shall be as outlined in *Preservation Brief No. 2: Repointing Mortar Joints in Historic Masonry Buildings*. Available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief02.htm>>.

- C. See General Services Administration, Historic Preservation Technical Procedures, Standards for Masonry at
<<http://w3.gsa.gov/web/p/hhttp.nsf/Repair%20Procedures?OpenView&Start=1&Count=30&Expand=3#3>>.
- D. Masonry restoration work shall comply with ACI / ASCE 530.1-88. Contractor shall maintain at least one copy of ACI / ASCE 530.1-88 on site.
- E. American Society for Testing and Materials:
 - 1. ASTM C 109/C 109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 2. ASTM C 150 Standard Specification for Portland Cement.
 - 3. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes.
 - 4. ASTM C 881/C 881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - 5. ASTM C 1324 Standard Test Method for Examination and Analysis of Hardened Masonry Mortar.
 - 6. ASTM C503 Specification for Marble Dimension Stone
 - 7. ASTM C568 Specification for Limestone Dimension Stone
 - 8. ASTM C615 Specification for Granite Dimension Stone
 - 9. ASTM C616 Specification for Quartz-Based Dimension Stone
 - 10. ASTM C629 Specification for Slate Dimension Stone
- F. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- G. *Conservation of Historic Stone Buildings and Monuments: Report of the Committee on Conservation of Historic Stone Buildings and Monuments*. National Material Advisory Board, Commission on Engineering and Technical Systems, National Research Council. Washington, D.C.: National Academy Press, 1982.

1.05 SUBMITTALS

The Contractor shall submit to the Architect:

- A. A detailed schedule of the areas for repair, including an assessment of the problem areas, historic mortar analysis, and stone identification, and a detailed procedure for masonry repair for approval.
- B. Product data for all manufactured masonry restoration materials, including stone materials, adhesives, and mortar components. Manufacturer's product data shall include certification

of compliance with specified standards and instructions for handling, storage, and installation of the material. The Contractor shall also submit Material Safety Data Sheets for each material if available.

- C. Fabricator's shop drawings for new fabricated-stone-masonry units to be provided. Shop drawings shall include all dimensions, piece, marks, anchoring, and installation details. Indicate surface finish and special tooling required.
- D. Samples of the following masonry repair and replacement materials for approval of color and texture match. No masonry restoration work shall proceed until all samples are approved.
 - 1. Cured pointing mortar for stone masonry: the Contractor shall prepare portable samples using drywall channel or similar material of the approximate width of a mortar joint. Once a matching mortar color is achieved, placement of on-site mock-ups may begin.
 - 2. Replacement stone materials: The Contractor shall provide at least three samples (minimum size 6x6 inches) of each type of replacement stone required for the project. Samples shall illustrate the full range of color variation and figuring to be expected. If stone units required for the project are larger than 12x12 inches, the Contractor shall provide larger samples to illustrate true appearance of the fabricated units.

1.06 QUALITY ASSURANCE

- A. Work Experience: The Contractor to perform the work in this section shall have a minimum of ten (10) years experience in historic masonry restoration and shall have successfully completed at least three projects of similar scope within the previous five years. He/she shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*.
- B. The Contractor shall not change sources or manufacturers of stone or mortar materials during the course of the work without prior Architect approval.
- C. Warranty: The Contractor shall provide a warranty in writing against defects in material and installation for a period of five (5) years.

1.07 MOCK-UPS

- A. The Contractor shall provide samples of stone and mortar matches for stone masonry restoration for approval by the Architect of color and texture. After approval the Contractor shall prepare test panels:
 - 1. Stone Masonry Restoration: All personnel proposed for work on the project shall prepare 3x3-foot samples demonstrating stone restoration techniques, including mortar removal, repointing, and stone replacement. Personnel whose mock-up panels are rejected shall not be utilized for masonry restoration work.

2. Mock-ups will be reviewed after the mortar removal and again after completion of repointing.
 3. Mock-ups shall display the full range of materials and workmanship required for completion of the project for approval by the Architect.
 4. Color matching: Contractor shall match existing mortar color(s). The Contractor shall place the initial sample panel using the mix from the approved sample. The sample panel must be cured in the same manner as is expected for the work based on anticipated temperatures.
- B. The Contractor shall prepare up to three additional mock-ups of each mortar, joint type, and mortar color without further compensation. Approved test panel(s) shall become part of the work and shall serve as the quality standard for all subsequent work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original packaging, unopened, with manufacturer's name and product identification thereon. Cementitious materials shall be protected from contamination by foreign matter and deterioration by moisture or temperature. Contaminated or deteriorated material shall not be used. Products stored longer than six months shall not be used.
- B. Masonry materials shall be stored in such a manner as not to interfere with the operation and daily maintenance of the facility. Proposed storage locations shall be approved by the Architect.
- C. The Contractor shall store liquids at temperatures between 40 and 85 degrees. Do not allow liquids to freeze.
- D. Masonry units shall be stored off the ground, protected from the weather, and kept free from exposure to contaminants such as mud, dust, or materials that could cause staining.
- E. Transport and handle masonry stone units in such a manner as to prevent chipping and breakage. Locate storage piles, stacks, or bins to avoid and protect material from heavy and unnecessary traffic. The Contractor shall store stone slabs on pallets on edge.
- F. The Contractor shall coordinate stone deliveries with the construction schedule and sequence. Stone materials shall be delivered in an order consistent with the order of installation at the project site to avoid unnecessary handling of materials.

1.09 PROJECT / SITE CONDITIONS

- A. Normal conditions for the work of this Section shall be defined as when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. When temperatures are predicted to rise above or fall below this temperature range, the Contractor may proceed using approved hot and cold weather procedures as defined by the Masonry Institute of America. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.

- B. The Contractor is responsible for protecting existing adjacent materials and surfaces during the execution of the work, and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work in this Section. The Contractor shall:
1. Minimize levels of dust during mortar removal and masonry repointing operations.
 2. Protect open copings, reglets, and other vulnerable areas from water penetration to prevent leakage during the course of the work. Open areas shall not be left exposed overnight or when inclement weather is predicted.
 3. Temporarily remove and store metal downspouts during masonry restoration work. Install temporary drainage leaders if required. Reinstall immediately upon completion of work in the immediate area. Protect open boots at grade from accumulation of masonry debris.
 4. Protect existing gutters and gutter outlets from damage and accumulation of mortar debris during restoration of roof elements.
 5. Protect window sashes and frames with plywood or other sturdy barrier during repointing and repair of masonry around window openings.
 6. Protect the existing roof surfaces from damage during the course of the masonry restoration work. Repair all damage to wood and metal roofing, gutters, flashings, etc., to the satisfaction of, and at no additional cost to, the Owner.
 7. Remove and store light fixtures, signage, security devices and miscellaneous appurtenances from masonry surfaces to be repointed. Provide temporary protection for exposed fixture boxes.
- C. The Contractor shall provide visible barriers and / or warning tape around the perimeter of the work area for visitor protection. Nearby vehicles and adjacent structures shall be protected from damage during the course of the work.
- D. Stone, brick, mortar, waste material, packaging, and other debris associated with the masonry work shall be disposed of in accordance with local, state, and federal environmental regulations. The Contractor shall remove debris from masonry restoration work from the site on a daily basis and at the completion of the work.
- E. The Contractor shall coordinate masonry repairs with the other trades involved in exterior and interior restoration work, including but not limited to masonry cleaning, sealing, and painting.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Pointing Materials
1. Lime: ASTM C-207, Type S

2. Portland cement: ASTM C-150, Type I, non-staining and without air entrainment. Gray and white portland cement may be combined as required to match existing mortar.
3. Sand: ASTM-C-144, free of clay, silt, soluble salts and organic matter and shall match the color and texture of the original mortar sand.
4. Water: Potable and free of deleterious amounts of oil, soluble salts, alkali, acids, organic impurities, or other substances that may impair the strength or bond of the finished mortar.
5. Mortar colorant, if required to match the color of the existing mortar, shall be a standard product manufacture by Solomon Grind-Chem Service, Medusa, or other approved manufacturer.

2.02 MIXES

- A. Mortar mixes shall be appropriate the strength and hardness for the masonry units and existing mortar. The mix shall match the composition, color, and texture existing mortars. Refer to Section 04100 – Historic Mortar.

2.03 IN-KIND STONE REPLACEMENT

- A. Architectural stone: New stone must be compatible with the existing stone and match in color and texture. Any chosen product must be justified accordingly and approved by Architect.
 1. Granite: ASTM C615
 2. Marble: ASTM C503
 3. Sandstone: ASTM C616
 4. Limestone: ASTM C568
 5. Slate: ASTM C629
 6. Other varieties of material, such as fieldstone, that are not subject to referenced standards shall be selected for their soundness, color, and texture match to the original masonry.
- B. One supplier for approved stone shall be used for completion of the work.
- C. Fabrication:
 1. New ashlar stone units shall be fabricated in accordance with approved shop drawings. Fabricated units shall match all dimensions indicated on the approved shop drawings within a tolerance of +/- 1/8 inch in 12 inches.
 2. The Contractor shall cut masonry units with a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

3. Exposed surfaces shall be tooled by hand or machine as required to match the original stone.
4. The Contractor shall provide slots or holes for anchors as indicated on the shop drawings.

2.04 ACCESSORY MATERIALS

- A. Stainless-steel pins for anchoring patches shall be Type 304 or 316 stainless-steel all-thread rods, ¼ inch diameter. Length shall be as required by the depth of the patch. All other embedments such as eye bolts to be used for anchoring reinforcing pins and wire shall be stainless steel.
- B. Stainless-steel rods for stitching vertical cracks shall be Type 304 or 316 stainless-steel all-thread rods, ¼ inch diameter. Length shall be approximately 24 inches or as required to span crack 12 inches on either side.
- C. Epoxy adhesive for embedding anchors and pins shall be a high modulus epoxy resin conforming to ASTM C-881, Type I, II, IV, and V, Grade 3 epoxy resin adhesives.

PART 3 - EXECUTION

3.01 GENERAL

- A. Masonry cleaning shall be completed prior to masonry repair and repointing. New replacement materials and mortars shall be matched to the color of the cleaned stone.
- B. The Contractor shall examine areas and conditions under which masonry restoration is to be performed and notify the Architect of any conditions detrimental to the proper and timely completion of the work. Do not commence work until all unsatisfactory conditions have been adequately corrected.
- C. Masonry repairs shall be completed prior to beginning masonry repointing.

3.02 IN-KIND REPLACEMENT OF HISTORIC STONE

- A. Carefully dismantle selected areas of masonry where designated on the Drawings, and dismantle adjacent assemblies as required for access to the designated masonry, salvaging components for reuse to the greatest extent possible. The Contractor shall permanently label individual masonry units to remain on a concealed face to allow reassembly in original locations.
- B. Rake or grind mortar from joints to the greatest extent possible before attempted removal of the building stones. Avoid excessive prying against the arrises of the masonry units to remain to avoid spalling and chipping. Deteriorated masonry units to be replaced may be broken out using pneumatic chisels or grinders.
- C. Clean old mortar and sealants from masonry units to be reused.

- D. Install new masonry units where indicated to match the depth of the surrounding walls. Patch in kind and/or reinstall to match adjacent materials as required to complete the installation. The Contractor shall:
1. Cut units as required to provide bonding pattern to match the existing masonry and to fit adjoining work neatly. Use full units without cutting wherever possible.
 2. Lay masonry units straight, plumb, and true to line and level in full mortar bed with full coverage for horizontal bed and vertical head joints. Rake back all mortar joints ½ inch for installation of pointing mortar.
 3. Install stainless-steel pins or anchors as indicated on the approved shop drawings to secure stone units to the existing substrate. Pins shall penetrate a minimum of one third the thickness of the stone to be installed but under no circumstance be allowed to penetrate beyond half the depth of the stone.
 4. The diameter of the holes for stainless steel anchor pins shall be drilled ⅛ inch greater than the diameter of the pins. The use of hammer drills is NOT permitted. Anchor pins in specified setting adhesive.
 5. Use lead, slate, or plastic shims of the thickness required to maintain the required joint width. The use of wood shims is NOT permitted.
- E. Brush, vacuum, or flush joints to remove all dirt and loose debris. Dampen joints prior to pointing to prevent suction of moisture from the pointing mortar.
- F. Where finish mortar joints are indicated, install pointing mortar in ¼-inch-thick layers, allowing each layer to reach thumbprint hardness before applying the succeeding layer. When the final layer of mortar is thumbprint hard, tool joint to match existing profile.
- G. The Contractor shall keep joints damp for 48 hours after pointing.

3.03 FINAL REPORT

The Contractor shall:

- A. Revisit the site with the Architect and compare the finish and color of the repair to see if the desired affect has been achieved after the brick repairs have been executed and new mortar has cured at least 30 days.
- B. Document the work and finished product with photographs.
- C. Provide a written summary of the project and results upon final inspection and approval. The summary shall outline steps taken or new findings not addressed in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Masonry cleaning of soiling.
- B. Masonry cleaning of staining and graffiti.
- C. Masonry cleaning of biological growth and bird droppings

1.03 RELATED SECTIONS

- A. Section 03710.01 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Staining, and Biogrowth on Concrete.
- B. Section 04100.01 – Removal of Mortar Joints and Repointing
- C. Section 04110.02 – Repair and Replacement of Historic Stucco
- D. Section 04211 – Historic Brick
- E. Section 04214 – Terra-cotta and Ceramics
- F. Section 04510.02 – Appropriate Use of Wet and Dry Abrasive Cleaning Systems
- G. Section 04510.03 – Poulting and Salt Removal
- H. Section 04510.04 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Stains, and Biogrowth on Fabricated Masonry Units.

1.04 REFERENCES

- A. Masonry cleaning shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*. Available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. Techniques employed for cleaning masonry shall be as outlined in *Preservation Brief No. 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings*. Available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief01.htm>>.
- C. Techniques employed for cleaning graffiti shall be as outlined in *Preservation Brief No. 38: Removing Graffiti from Historic Masonry*. Available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief38.htm>>.
- D. *Preservation Brief No. 6: Dangers of Abrasive Cleaning to Historic Buildings*. Available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief06.htm>>; offers valuable information on cleaning historic buildings.
- E. See General Services Administration, Historic Preservation Technical Procedures Standards at <<http://w3.gsa.gov/web/p/hhttp.nsf/Repair%20Procedures?OpenView&Start=1&Count=30&Expand=3.13#3.13>>.
- F. *Cleaning Techniques in Conservation Practice*. Edited by Kyle C Normandin and Deborah Slaton, Consultant Norman R Weiss, Managing Editor Jill Pearce. A special issue of the *Journal of Architectural Conservation*. Vol. 11 No. 3. November 2005.
- G. *Conservation of Historic Stone Buildings and Monuments: Report of the Committee on Conservation of Historic Stone Buildings and Monuments*. National Material Advisory Board, Commission on Engineering and Technical Systems, National Research Council. Washington, D.C.: National Academy Press, 1982.
- H. Grimmer, Anne E. *Keeping it Clean: Removing Exterior Dirt, Paint, Stains and Graffiti from Historic Masonry Buildings*. Darby, Pennsylvania: Diane Publishing Co., 1992.
- I. Staehli Alfred M. Appropriate Water Pressures for Masonry Cleaning: What Do the Numbers Mean? *APT Bulletin*, Vol. 18, No. 4 (1986), pp. 10-17. Published by: Association for Preservation Technology International (APT).
- J. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- K. Weiss, Norman R. *Exterior Cleaning of Historic Masonry Buildings*. Washington, D.C.: National Park Service, February 1977.

1.05 SUBMITTALS

The Contractor shall submit to the Architect:

- A. A detailed schedule of the areas to be cleaned, including an assessment of the problem surfaces, and proposed masonry procedures, application methods, dwell times, etc., for approval once cleaning test panels are completed and approved.
- B. Submit manufacturer's product literature for all proprietary cleaning products. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling, and use.

1.06 QUALITY ASSURANCE

- A. The Contractor to perform the work of this Section shall have a minimum of ten (10) years experience in masonry cleaning and restoration and shall have successfully completed at least three projects of similar scope within the previous five years. He/she shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*.

1.07 MOCK-UPS

- A. The Contractor, at locations designated by the Architect, shall prepare test panels not to exceed 100 square feet per sample demonstrating the cleaning product on inconspicuous areas, preferably conducted by the operator undertaking the final work.
 - 1. Water Soak Cleaning – Approximately 100 square feet.
 - 2. Chemical Cleaners – Approximately 50 square feet for each specified product.
- B. Preparation of the cleaning sample panels shall be used to determine the appropriate concentrations and dwell times for the remainder of the cleaning work. Following approval of the cleaning test panels, the Contractor shall submit the approved procedures in writing to the Architect as specified in Paragraph 1.04.A.:

Preparation of test panels shall begin with the lowest concentration of cleaner and the shortest dwell recommended by the manufacturer. Concentration and/or dwell time shall be increased as required up to the maximum recommended by the product manufacturer.

- C. More than one test panel may be required to be acceptable for approval. The Contractor shall prepare at least four (4) test panels of each type, if necessary, without further compensation. Approved test panels shall become part of the work and shall serve as the quality standard for all similar work.

1.08 DELIVERY, STORAGE, AND HANDLING (as applied to products and materials)

The Contractor shall:

- A. Deliver restoration cleaning and testing materials and proprietary products to the project site in manufacturer's or distributor's packaging, undamaged, complete with application instructions and Material Safety Data Sheets
- B. Store and transport cleaning agents, chemicals, and solvents within the temperature range recommended by the manufacturer and away from direct sunlight. Handle all materials following manufacturer's instructions.
- C. Collect and dispose of waste material, packaging, debris, and effluent associated with the masonry cleaning work in accordance with local, state, and federal environmental regulations.

1.09 PROJECT / SITE CONDITIONS

- A. The work of this Section shall be executed only when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. Minimum temperature for masonry cleaning shall be 50 degrees F and above for at least 2 hours after completion and above freezing for at least 24 hours after completion. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor is responsible for protecting existing adjacent materials during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work of this Section. At a minimum, the Contractor shall:
 - 1. Protect woodwork, glass, and metal adjacent to masonry areas to be cleaned from overspray and possible chemical or water damage from cleaning operations. Cover all window openings with waterproof plastic to prevent leakage to the building interior.
 - 2. Protect surrounding lawns and vegetation from runoff during cleaning operations.
 - 3. Access work areas from the exterior only. Under no circumstances are hoses to be run or equipment transported through the building during cleaning operations.
 - 4. Add additional site conditions here.
- C. The Contractor shall erect waterproof enclosures around areas where cleaning operations are in progress to protect nearby property and passers-by from overspray of cleaning chemicals or rinse water.
- D. The Contractor shall coordinate masonry cleaning operations with the other trades involved in exterior and interior restoration work, including but not limited to masonry restoration, sealing, and painting. Masonry cleaning is to be completed prior to restoration of windows, doors, and metalwork, and prior to any exterior painting in the affected areas.

- E. Contractor personnel performing masonry cleaning operations shall be provided with gloves, respirators, and protective clothing as recommended by the manufacturer of the masonry cleaning products.
- F. Complete installation of temporary sealants at window and door perimeters prior to starting cleaning operations where required to prevent leakage to interior.

PART 2 - PRODUCTS

2.01 CLEANING OF ATMOSPHERIC SOILING

- A. Investigations and method selection: Types of materials, surface and substrate conditions, previous treatments, and the nature, cause and pattern of the stain type for each area shall be determined. The method of cleaning and the level of cleaning shall be approved by the Architect. The Contractor shall protect adjacent materials, installed non-masonry materials, and openings.
- B. Cleaning methods: Cleaning shall be undertaken through the mildest, least abrasive method.
 - 1. Water Washing: Washing the surface with low to medium-high jet pressure, not to exceed 1,000 psi at 4-6 gpm, using a 45-degree fan-type nozzle for water soluble dirt and chemical compounds. Optimal water pressure to be determined during preparation of cleaning samples. Begin with lowest possible pressure and increase as necessary to achieve the desired results.
 - 2. Nebulous Sprays: Application of intermittent mist spray under low pressure to dampen surface. Dirt is removed through scrubbing and agitation.
 - 3. Detergents: Formulations made with dilutions of detergents, surfactants, and chelating agents in water. Neutral or non-ionic detergents or surfactants are added to water for use on hydrophobic stains.
 - 4. Masonry Cleaners: Proprietary cleaning solutions containing detergents, acidic or alkaline compounds. If this type of product is proposed, great care must be exercised in product selection and preparation of test panels to identify potentially detrimental effects on the masonry. This type of product is not recommended for polished stones or extremely fragile or deteriorated masonry. The use of raw acids and/or alkalis for masonry cleaning is not permitted at any time.
- C. Water used for cleaning of historic masonry cleaning shall be potable, free of injurious amounts of oil, soluble salts, alkali, acids, and other impurities that might stain or otherwise damage masonry.
- D. Equipment for masonry cleaning:
 - 1. Pipes and hoses used for water cleaning shall be plastic or other similar material that is not subject to corrosion, which can cause discoloration and staining of surfaces being cleaned.

2. Natural bristle brushes shall be used for scrubbing (metal bristle brushes are NOT to be used).
 3. Hoses, fittings, and equipment to be used for application of proprietary cleaning compounds shall be solvent, acid, or alkali-resistant as recommended by the manufacturer of the cleaning products.
 4. Buckets, trowels, scrapers, and other tools to be used for mixing and application of poultices shall be solvent-resistant plastic. Wood scrapers and trowels are also permitted. No metal tools are to be used.
- E. Water/rinsing method: Surfaces shall be rinsed with water after cleaning. Rinse water will be collected and disposed of as stipulated in 2.01 B above. Rates of water pressure shall be no greater than 200-300 psi at 3-6 gpm with minimal saturation.

2.02 CLEANING OF STAINS

- A. Investigations and method selection: Types of materials, surface and substrate conditions, previous treatments, and the nature, cause and pattern of the stain, corrosion, or deposits for each area shall be determined. The method of cleaning and the level of clean shall be approved by the Architect.
- B. Cleaning Methods:
1. Poultices (see Section 04510.03)
 2. Reducing Compounds: Iron stain/rust reducing with bleaching compounds or potassium hexacyanoferrate. (See also Poultices, Section 04510.03)
 3. Acids: Rust removal with colorless soluble formulations made with hydrofluoric, formic, oxalic, or phosphoric acids at 5-10% concentrations.
- C. Equipment for Application (see Atmospheric Soiling above)
- D. Water/rinsing method (see Atmospheric Soiling above)

2.03 CLEANING OF GRAFFITI.

- A. Investigations and method selection: Types of materials, surface and substrate conditions, previous treatments, and the materials used to create the graffiti for each area shall be determined. The method of cleaning and the level of cleaning shall be approved by the Architect.
1. Incised graffiti cannot be addressed by cleaning, and is, therefore, not covered under this section. If the damage is deep, removal may be addressed in Sections 04500.02 and 04500.03.
 2. Staining and graffiti should be addressed after atmospheric soiling and biogrowth are removed.

3. Graffiti is most easily removed when it has been freshly applied. Therefore, timely removal of graffiti is important.

B. Cleaning Methods:

1. Water and Detergent: Washing the surface with water at low to medium jet pressure, not to exceed 300 psi at 4-6 gpm. Neutral or non-ionic detergents or ammonia may be introduced. Use the lowest possible pressure to achieve the desired results.
2. Poultices: A paste or slurry made with absorbent material or powder-inert clay, such as kaolin or sepiolite, diatomaceous earth (fuller's earth); or Cellulose products such as pulp cellulose or shredded paper that is mixed with a cleaning solution (a liquid reagent such as water, organic solvent, paint stripper, or bleach).
3. Organic Solvents and Paint Removers: Proprietary graffiti-removal products and/or commercial paint strippers containing organic solvents used in conjunction with a poultice (see 2.03 B 2 above), gel or paste removers, or paper or cloth-backed removers. Do not use "off-the-shelf" aerosol graffiti removers as these can cause additional staining and redistribution of pigments to clean areas.
4. Laser Cleaning: A unique source of light with an intense monochromatic, well-collimated beam such as pulsed laser beams and xenon flash lamps. Cleaning is conducted at a low fluence (<1 J/cm²).

C. Equipment for Application: See Atmospheric Soiling above

D. Water/rinsing method: See Atmospheric Soiling above

2.04 CLEANING BIOGROWTH AND BIRD DROPPINGS

A. Investigations and method selection: Types of materials, surface and substrate conditions and the nature, cause and pattern of biomaterials for each area shall be determined. The method of cleaning shall be approved by the Architect.

B. Cleaning Methods:

1. Water Washing: Cold water applied by low to medium jet pressure, not to exceed 300 psi. Ammonia may be introduced for treatment of algae, fungi, molds, and mildew. Use lowest possible pressure to achieve desired results.
2. Acidic Cleaners: Formulations of acids, surfactants, and chelating agents.
3. Poultices: See Section 04510.03.
4. Herbicides: Quaternary ammonium treatment.

C. Equipment for Application: See Atmospheric Soiling above

D. Water/rinsing method: See Atmospheric Soiling above

2.05 STONE PROPERTIES AFFECTING CLEANING

- A. Calcitic Stone (Limestone, Marble and some Sandstones): Marble, limestone and some sandstones are acid sensitive. Acids can cause etching and dissolution of the stones and should not be used for their cleaning.
- B. Silicate Stone (most types of Sandstone): There are many kinds of sandstone, each with a different geological composition. For example, sandstones that contain water-soluble minerals can be eroded by water cleaning. Some sandstone can be cleaned with acids; others are acid-sensitive and can be severely etched or dissolved by an acid cleaner.
- C. Granite: This extremely hard, dense stone is generally not adversely affected by chemical cleaning. However, the use of strongly acidic cleaners may cause selective etching and/or bleaching of the constituent minerals, resulting in a change in appearance, particularly for polished stones. In addition, some granites and gneisses contain impurities that may be eroded or chemically converted by inappropriately strong or improperly applied acidic cleaners, resulting in a weakened surface that may deteriorate at an accelerated rate in the future. Where possible, petrographic analysis should be sought when planning a large granite masonry cleaning project if chemical cleaning is proposed.
- D. Schist and Gneiss: These are metamorphic rocks derived from clays and silts (schist) or igneous rocks (gneiss) and containing a proportion of platy minerals such as mica and hornblende, often combined with quartz and feldspar. Schists are generally highly micaceous and are distinguished by their flaky texture and easily split along their micaceous layers. Gneisses are formed under higher temperatures, forming distinct mineral bands. They also contain a small proportion of micaceous minerals. The strength and chemical resistance of schists and gneisses varies widely and is best assessed by preparation of cleaning test panels.
- E. Shale and Slate: Shale is a fine-grained sedimentary rock composed primarily of quartz and feldspar minerals derived from settled clay and silt particles. Slate is a fine-grained layered rock derived from the metamorphosis of shale under low to moderate heat and pressure. Slate is relatively common as a finish material for floors, walls, and roofs because of its low permeability. As it is composed primarily of quartz and feldspar, slate is relatively unaffected by mild acids.

PART 3 - EXECUTION

3.01 GENERAL

- A. The extent of the cleaning (clean level) and areas to be cleaned shall be reviewed by the Architect on site prior to beginning operations. Contractor shall submit testing schedule and a cleaning schedule, including the methods and materials to be used.
- B. The Contractor shall protect all adjacent materials from spray and chemicals.
- C. The cleaning runoff will be collected in plywood troughs lined with polyethylene sheeting. Polluted liquid gathered shall be pumped into tanker trucks or drums for properly controlled disposal. Acidic runoff shall be neutralized with lime or soda ash prior to release.

- D. Masonry cleaning shall be completed prior to masonry repointing and repairs. The Contractor shall remove and store light fixtures, downspouts, and other appurtenances to ensure full access to wall surfaces, unless otherwise noted by the Architect. Anchor holes and penetrations from appurtenances must be temporarily filled with removable sealant or protected with cover plates.
- E. The Contractor shall remove all live vegetation and plant debris prior to cleaning. With the approval of the Architect, invasive vines shall be cut close to the ground and allowed to wither and dry. The dry vines shall be carefully removed and the façade surface cleaned with a natural bristle brush prior to other treatments.

3.02 MASONRY CLEANING

A. Surface Preparation for Cleaning

- 1. Examine the surfaces to be cleaned prior to commencing cleaning operations. Large cracks ($\frac{1}{8}$ inch or larger) and open joints discovered shall be temporarily filled with removable sealant to prevent penetration of cleaning solutions into the core of the wall.
- 2. Window and door openings shall be protected from leakage and damage from cleaning solutions by plastic sheeting or other waterproof membrane. Open joints around window frames and door frames shall be filled with temporary sealant to prevent leakage.

B. Water Mist Cleaning

- 1. Using $\frac{1}{2}$ -inch PVC pipe and fittings as required, construct a sprinkler assembly with mist-type spray heads located approximately 2 feet apart. Assembly to be connected to a continuous water source with a timed shutoff valve for on/off cycling. Assembly to be suspended beneath the overhanging surfaces to be cleaned.
- 2. Starting from the top and working downward in sections, saturate the stone surface in cycles of 4 hours on / 4 hours off for a period of 24 hours to soften soiling prior to final washing. Water flow to be approximately 20 to 25 gallons per hour. Do not point nozzles directly at joints in the masonry.
- 3. After water misting is complete for a section of masonry, manually agitate heavily soiled areas and areas of high relief decoration with masonry brushes to loosen deposits. Final washing of each section shall consist of a medium to high pressure wash, not to exceed 1,000 psi. Rinse surfaces from top to bottom using a 45° fan-tip nozzle and a flow of approximately 4 gallons per minute. Maintain a minimum distance of 18 inches between the nozzle tip and the masonry surface. Use lowest possible pressure to achieve desired results.

C. Chemical Cleaning

- 1. Masonry surfaces shall be saturated with water prior to application of chemical cleaning products to prevent undesirable absorption of cleaning chemicals.

2. Cleaning of masonry walls shall proceed from the bottom of the wall upward to minimize streaking.
 3. Apply the masonry cleaning product in accordance with manufacturer's instructions and approved cleaning procedure submittal. The Contractor shall use tampico fiber brushes, rollers or very low-pressure spray (not to exceed 50 psi) for application. The Contractor shall NOT use high-pressure spray equipment to apply cleaning product.
 4. After completion of the appropriate dwell time, loosened soiling shall be removed using a moderate-pressure water rinse. Do NOT allow the cleaning products to dry on masonry surfaces. Rinse surfaces from top to bottom using a 45° fan-tip nozzle with a nozzle pressure not to exceed 800 psi and a flow of approximately 4 gpm. A minimum distance of 18 inches between the nozzle tip and the masonry surface shall be maintained.
 5. After cleaning is completed, the Contractor shall remove protective coverings from adjacent surfaces and repair any damage or staining caused by the cleaning operation to adjacent surfaces.
- D. Removal of Metallic Stains
1. See Section 04510.03, Poulticing and Salt Removal
- E. Removal of Salts
1. See Section 04510.03, Poulticing and Salt Removal
- F. Cleaning Graffiti
1. Apply the specified paint stripper using a brush, roller or low pressure spray apparatus equipped with a nozzle 0.019 inch or larger. Spray equipment must be equipped with chemical resistant packing and hoses. Apply to a minimum thickness of 10 mils.
 2. Allow stripper to remain on the surface in accordance with the dwell time determined during preparation of the approved test panel. Dwell time will increase as temperatures decrease.
 3. After dwell time is completed, the Contractor shall remove lifted layers using a squeegee, plastic scraper, or wet vacuum device as required. Collect paint and stripper residue, and dispose of in accordance with local, state and federal regulations.
 4. Thoroughly rinse surface with clean water. Re-apply stripper as required to remove all existing paint layers.
- G. Removal of Algal Growth, Moss, and Bird Droppings (Biological Staining)
1. The Contractor shall remove colonies of moss, loose growth, and accumulations of bird droppings from masonry surfaces to be cleaned using wooden scrapers.

2. The Contractor shall apply selected cleaning agent in accordance with manufacturers' instructions and approved test panel. Allow product to dwell on soiled surfaces to achieve optimal cleaning.
3. After completion of required dwell time, agitate with a bristle brush to lift and remove embedded growth. The contractor shall flush surfaces with low to medium-high pressure (not to exceed 1,000 psi) water rinse as required to remove staining. Repeat applications as required to remove stains.
4. Spot clean for heavily soiled areas (biological growth):
 - a. Spot cleaning shall be performed only after general cleaning has been completed for approximately two weeks.
 - b. Thoroughly wet surfaces to be treated with spot cleaner. Apply product using a synthetic brush, roller or low-pressure spray and allow it to dwell on the surface. Dwell time to be in accordance with the approved test panel.
 - c. After dwell time has elapsed, thoroughly rinse the surface with clean water at moderate pressure (200 to 600 psi), working from the bottom up.
 - d. Apply neutralizing rinse (if required) and allow to dwell on the cleaned surface 3 to 5 minutes. After completion of the required dwell time, rinse the surface again with clean water at moderate pressure (200-600 psi) working from the bottom up.

3.05 FINAL REPORT

The Contractor shall:

- A. Provide a final report of complete work, including all approved submittals and photographs of the areas cleaned taken before, during, and after the work.
- B. Provide a written summary of the project and results upon final inspection and approval. The summary shall include a discussion of steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Appropriate use of wet abrasive cleaning systems for masonry.
- B. Appropriate use of abrasive cleaning systems for masonry.

1.03 RELATED SECTIONS

- A. Section 03710.01 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Staining, and Biogrowth on Concrete.
- B. Section 04100.01 – Removal of Mortar Joints and Repointing
- C. Section 04110.02 – Repair and Replacement of Historic Stucco
- D. Section 04211 – Historic Brick
- E. Section 04214 – Terra-cotta and Ceramics
- F. Section 04400 – Stone
- G. Section 04510.01 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Stains, and Biogrowth
- H. Section 04510.03 – Poulting and Salt Removal

1.04 REFERENCES

- A. Masonry cleaning shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*. Available at the National Park Service (NPS) website at <http://www.nps.gov/history/hps/tps/standards_guidelines.htm>.
- B. Techniques employed for cleaning masonry shall be as outlined in *Preservation Brief No. 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings*. Available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief01.htm>>.
- C. *Preservation Brief No. 6: Dangers of Abrasive Cleaning to Historic Buildings* available online at the NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief06.htm>>, offers valuable information on cleaning historic buildings.
- D. Techniques employed for cleaning graffiti shall be as outlined in *Preservation Brief No. 38: Removing Graffiti from Historic Masonry* available online at NPS website at <<http://www.nps.gov/history/hps/tps/briefs/brief38.htm>>.
- E. See General Services Administration, Historic Preservation Technical Procedures Standards at <<http://w3.gsa.gov/web/p/hptp.nsf/Repair%20Procedures?OpenView&Start=1&Count=30&Expand=3.13#3.13>>.
- F. *Cleaning Techniques in Conservation Practice*. Edited by Kyle C Normandin and Deborah Slaton, Consultant Norman R Weiss, Managing Editor Jill Pearce. A special issue of the *Journal of Architectural Conservation*. Vol. 11 No. 3. November 2005.
- G. *Conservation of Historic Stone Buildings and Monuments*. Report of the Committee on Conservation of Historic Stone Buildings and Monuments. National Material Advisory Board, Commission on Engineering and Technical Systems, National Research Council. Washington, D.C.: National Academy Press, 1982.
- H. Grimmer, Anne E. *Keeping it Clean: Removing Exterior Dirt, Paint, Stains and Graffiti from Historic Masonry Buildings*. Darby, Pennsylvania: Diane Publishing Co., 1992.
- I. Staehli Alfred M. Appropriate Water Pressures for Masonry Cleaning: What Do the Numbers Mean? *APT Bulletin*, Vol. 18, No. 4 (1986), pp. 10-17. Association for Preservation Technology International (APT).
- J. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- K. Weiss, Norman R. *Exterior Cleaning of Historic Masonry Buildings*. Washington, D.C.: National Park Service, February 1977.

1.05 SUBMITTALS

The Contractor shall submit to the Architect for approval:

- A. A detailed schedule of the areas to be cleaned, including an assessment of the problem surfaces, and proposed masonry procedures, application methods, sequence of operations, etc., once cleaning test panels are completed and approved.
- B. Manufacturer's product literature for all proprietary cleaning products and processes. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling and use.

1.06 QUALITY ASSURANCE

- A. The Contractor performing the work of this Section shall have a minimum of ten (10) years experience in masonry cleaning and restoration and shall have successfully completed at least three projects of similar scope within the previous five years. He/she shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*.

1.07 MOCK-UPS

- A. The Contractor, at locations designated by the Architect, shall prepare test panels, not to exceed 100 square feet per sample, demonstrating the cleaning product on inconspicuous areas, preferably conducted by the operator undertaking the final work. Test panels shall be prepared in the presence of the Architect.
- B. Preparation of the cleaning sample panels shall be used to determine the appropriate materials and methods for the remainder of the cleaning work. Following approval of the cleaning test panels, the Contractor shall submit the approved procedures in writing to the Architect as specified in Paragraph 1.04.A.

Preparation of test panels shall begin with the lowest pressure recommended by the equipment manufacturer. Increase pressure as required up to the maximum recommended by the product manufacturer or until directed otherwise by Architect. Increase nozzle distance from the substrate as pressure is increased unless otherwise indicated by the requirements of a proprietary cleaning process.

- C. More than one test panel may be required to be acceptable for approval. The Contractor shall prepare at least four (4) test panels of each type, if necessary, without further compensation. Approved test panels shall become part of the work and shall serve as the quality standard for all similar work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Masonry cleaning materials and proprietary products shall be delivered to the project site in manufacturer's or distributor's packaging, undamaged, complete with application instructions and Material Safety Data Sheets.
- B. The Contractor shall store and transport cleaning agents, abrasives, and solvents within the temperature range recommended by the manufacturer and away from direct sunlight. The Contractor shall handle all materials following manufacturer's instructions.

- C. Waste material, packaging, debris, and effluent associated with the masonry cleaning work shall be collected and disposed of in accordance with local, state, and federal environmental regulations.

1.09 PROJECT / SITE CONDITIONS

- A. The work of this Section shall be executed only when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. Minimum temperature for masonry cleaning shall be 50 degrees F and above for at least 2 hours after completion and above freezing for at least 24 hours after completion. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost, and ice.
- B. The Contractor is responsible for protecting existing adjacent materials during the execution of the work. The Contractor shall provide all necessary protection and work procedures to avoid damage to existing material assemblies not a part of the work of this Section. At a minimum, the Contractor shall:
 - 1. Protect woodwork, glass, and metal adjacent to masonry areas to be cleaned from overspray and possible chemical or water damage from cleaning operations. Cover all window openings with waterproof plastic to prevent leakage to the building interior.
 - 2. Protect surrounding lawns and vegetation from runoff during cleaning operations.
 - 3. Access work areas from the exterior only. Under no circumstances are hoses to be run or equipment transported through the building during cleaning operations.
 - 4. Protect mechanical and plumbing vents and air intakes from masonry cleaning overspray or airborne dust. Coordinate cleaning operations with building maintenance staff to close off required vent openings and intakes.
 - 5. Coordinate abrasive cleaning operations with owners of surrounding properties that may be affected by the work.
- C. The Contractor shall erect waterproof enclosures and/or barriers around areas where cleaning operations are in progress to protect nearby property and passers-by from overspray of cleaning materials or rinse water.
- D. The Contractor shall coordinate masonry cleaning operations with the other trades involved in exterior and interior restoration work, including but not limited to masonry restoration, sealing, and painting. Masonry cleaning shall be completed prior to restoration of windows, doors, and metalwork, and prior to any exterior painting in the affected areas.
- E. Contractor personnel performing masonry cleaning operations shall be provided with gloves, respirators, and protective clothing as recommended by the manufacturer of the masonry cleaning products.
- F. The Contractor shall complete installation of temporary sealants at window and door perimeters prior to starting cleaning operations where required to prevent leakage to the interior.

PART 2 - PRODUCTS

2.01 WET ABRASIVE CLEANING SYSTEM

A. Equipment for Wet Abrasive Masonry Cleaning

1. Pipes and hoses used for water cleaning shall be plastic, rubber, or other similar material that is not subject to corrosion, which can cause discoloration and staining of surfaces being cleaned.
2. Natural or plastic bristle brushes shall be used for scrubbing. Do NOT use metallic wire brushes or pads.
3. Hoses, fittings, and equipment to be used for application of proprietary cleaning compounds shall be solvent, acid-, or alkali-resistant as recommended by the manufacturer of the cleaning products.
4. Pressurizing equipment for masonry cleaning shall be fitted with pressure gauges located at or near the nozzle so as to be easily visible to the operator. Equipment shall provide for continuous adjustment in nozzle pressure and flow by the operator.

B. Abrasives for wet masonry cleaning may include, but are not limited to, the following:

1. Crushed walnut or almond shells
2. Corncobs
3. Rice husks
4. Glass beads or micro-balloons
5. Plastic beads or micro-balloons
6. Baking soda
7. Silica flour
8. Moderate to high pressure water (600 psi and above) may be considered an abrasive.
9. Appropriate abrasives for testing shall be determined by the surfaces to be cleaned and the type of soiling to be removed. Final determination shall be based on preparation of test panels.

C. Water: Cleaning and rinsing water shall be potable and free of injurious amounts of oil, soluble salts, alkali, acids, and other impurities that might stain or otherwise damage masonry.

2.02 DRY ABRASIVE CLEANING SYSTEM

A. Equipment for Dry Abrasive Masonry Blasting

1. Pipes and hoses used for dry cleaning shall be plastic or other similar material that is not subject to corrosion, which can cause discoloration and staining of surfaces being cleaned.
 2. Hoses, fittings, and equipment to be used for application of abrasives shall be as recommended by the manufacturer of the cleaning products.
- B. Other equipment used for dry abrasive masonry cleaning includes:
1. Grinders
 2. Belt sanders
 3. Wire brushes
- C. Abrasive materials for dry masonry cleaning may include, but are not limited to, the following:
1. Sand: Shall NOT be used on historic buildings.
 2. Crushed walnut or almond shells
 3. Corncobs
 4. Rice husks
 5. Glass beads or micro-balloons
 6. Plastic beads or micro-balloons
 7. Baking soda: Not appropriate for all types of masonry
 8. Silica flour
 9. Ice Particles, or palletized dry ice (carbon dioxide [CO₂]): Generally not appropriate for use on historic masonry.
- D. Rinse water: Water shall be potable, free of injurious amounts of oil, soluble salts, alkali, acids, and other impurities that might stain or otherwise damage masonry.

PART 3 - EXECUTION

3.01 GENERAL

- A. The extent of the cleaning (acceptable level of cleaning) and areas to be cleaned shall be reviewed by the Architect on site prior to beginning operations. Contractor shall submit testing schedule and a cleaning schedule, including the methods and materials to be used.
- B. The Contractor shall protect all adjacent materials from spray and cleaning materials or dust.

- C. The cleaning and rinse runoff for both wet and dry cleaning will be collected in plywood troughs lined with polyethylene sheeting. Polluted liquid gathered shall be pumped into tanker trucks or drums for properly controlled disposal. Acidic runoff shall be neutralized with lime or soda ash prior to release.
- D. Where dry abrasive blasting is to be used, contain and collect all spent abrasive and dispose of in accordance with local, state, and federal regulations.
- E. Masonry cleaning is to be completed prior to masonry repointing and repairs. Remove and store light fixtures, shutters, awnings, downspouts, and other appurtenances to ensure full access to wall surfaces, unless otherwise noted by the Architect. Anchor holes and penetrations from appurtenances must be temporarily filled with removable sealant or protected with cover plates.
- F. Remove all live vegetation and plant debris prior to cleaning. With the approval of the Architect, invasive vines shall be cut close to the ground and allowed to wither and dry. The dry vines shall be carefully removed and the façade surface cleaned with a natural bristle brush prior to other treatments.

3.02 PROBLEMS/USES OF ABRASIVE CLEANING METHODS

- A. Problems of Abrasive Cleaning Methods. Most abrasive cleaning methods are very difficult to monitor and control and are NOT considered appropriate for cleaning historic buildings as they often permanently harm building surfaces. Abrasive cleaning methods can harm building surfaces by:
 - 1. Removing the dense fired surface (also called the “fire-skin”) from brick and terra-cotta, which causes physical and aesthetic damage to exposed surfaces.
 - 2. Removing patina and causing micro-fractures in exposed surfaces of natural stones, causing aesthetic damage and possibly accelerating surface deterioration.
 - 3. Increasing water permeability of brick and some types of stone.
 - 4. Creating rough surfaces that may attract more dirt and contaminants.
 - 5. Diminishing or destroying decorative detail.
 - 6. Eroding mortar joints.
 - 7. Introducing airborne dust and pollutants.
 - 8. Damaging adjacent surfaces.
 - 9. With high pressure wet cleaning, forcing moisture into the building envelope, damaging interior features.
- B. Variables to be Considered:
 - 1. Type and condition of the material being cleaned. Fired masonry units such as brick and terra-cotta are subject to degradation by abrasive treatments that remove the

protective outer shell of the units. Stucco and other soft masonry can literally be washed away by abrasive cleaning.

2. Size, hardness, and sharpness of the grit particles. Polished surfaces are easily clouded or scratched by grit used in abrasive cleaning.
3. The pressure with which water and/or abrasive grit is applied to the building surface: The nozzle distance is a primary determinant in achieving the desired pressure.
4. Skill and care of the operator.
5. Constancy of the pressure on all surfaces during the cleaning process.

C. Appropriate Uses of Abrasive Cleaning

1. Remove stubborn stains and buildup from stone that is detrimental to the building.
2. Clean isolated hard-to-reach areas of carved, molded, or cut ornament.

D. Inappropriate Use of Abrasive Cleaning

1. Abrasive cleaning is almost never appropriate for polished surfaces.
2. Abrasive cleaning is almost never appropriate for cleaning stucco.
3. Abrasive cleaning is almost never appropriate for interior plaster or other finish surfaces.

3.03 WET ABRASIVE CLEANING SYSTEM

A. Types of Wet Abrasive Cleaning

1. Moderate to High Pressure Wash: not to exceed 1,800 psi.
2. Micro-Abrasive Grit Wash: Small amounts of abrasive grit material used in conjunction with low pressure wash, not to exceed 100 psi.

B. Surface Preparation for Cleaning

1. The Contractor shall examine the surfaces to be cleaned prior to commencing cleaning operations. Large cracks ($\frac{1}{8}$ inch or larger) and open joints discovered shall be temporarily filled with removable sealant to prevent penetration of cleaning solutions into the core of the wall.
2. Window and door openings shall be protected from leakage and damage from cleaning solutions by plastic sheeting or other waterproof membrane. Open joints around window frames and door frames shall be filled with temporary sealant to prevent leakage

C. High Pressure Wash: General Procedure

1. Water (sometimes with chemical additives) is applied at approximately 1,500 psi (should not exceed 1,800 psi).
2. Starting from the top and working downward in sections, direct spray at surface at a constant angle and minimum distance of 18 inches from the surface. Do not point nozzle directly at joints in the masonry.
3. After pressure washing is complete for a section of masonry, manually agitate heavily soiled areas and areas of high relief decoration with masonry brushes to loosen deposits. Rinse surfaces from top to bottom using a 45° fan-tip nozzle and a flow of approximately 4 gpm. Maintain a minimum distance of 18 inches between the nozzle tip and the masonry surface.

D. Wet Abrasive Grit Cleaning: Project-specific specifications are required for all wet abrasive cleaning work contained herein. As material and methods of construction vary greatly, each building must be evaluated and work scheduled accordingly. Procedures shall be based on those used in preparation of the approved test panel(s). The Contractor shall submit schedules, including methods and materials to be used. The following is a general procedure for wet abrasive cleaning work:

1. Using 00 or 0 mesh grit with a ¼-inch opening and fittings as required, set up spray assembly with controlled pressure of 20 to 100 psi. Assembly to be connected to a continuous water source.
2. Starting from the top and working downward in sections, direct spray at surface at a constant angle and distance from the surface. Nozzle distance to be as determined by approved test panels. Do not point nozzles directly at joints in the masonry.

E. Rinsing: After abrasive wash is complete for a section of masonry, wash the slurry from the surface and manually agitate heavily soiled areas and areas of high relief decoration with masonry brushes to loosen deposits. Final washing of each section shall consist of a low to moderate pressure wash. Rates of water pressure shall be 200-300 psi at 3-6 gpm with minimal saturation. Maintain a minimum distance of 18 inches between the nozzle tip and the masonry surface.

3.04 DRY ABRASIVE CLEANING SYSTEM

A. Types of Dry Abrasive Cleaning

1. Micro-Abrasive Grit: Small amounts of abrasive grit material consisting of very small particles directed at the surface in a stream of compressed air. This technique requires careful use and supervision and is generally not suitable for large-scale cleaning.
2. Mechanical Cleaning: Grinders and sanders are used to abrade the soiling away and with it, the building surface. This type of equipment shall NOT be used to clean building surfaces.

B. Surface Preparation for Cleaning

1. The Contractor shall examine the surfaces to be cleaned prior to commencing cleaning operations.
2. Window and door openings and mechanical intakes shall be protected from dust infiltration by plastic sheeting or other waterproof membrane. Open joints around window frames and door frames shall be filled with temporary sealant to prevent infiltration.

C. Dry Abrasive Grit Cleaning: Project-specific specifications are required for all dry abrasive cleaning work contained herein. As material and methods of construction vary greatly, each building must be evaluated and work scheduled accordingly. Procedures shall be based on those used in preparation of the approved test panel(s). The Contractor shall submit schedules including methods and materials to be used.

D. Rinsing: After abrasive cleaning is complete for a section of masonry, wash the dust from the surface and manually agitate heavily soiled areas with masonry brushes to loosen remaining deposits. Final washing of each section shall consist of a low to moderate pressure wash. Rates of water pressure shall be 200-300 psi at 3-6 gpm with minimal saturation. Maintain a minimum distance of 18 inches between the nozzle tip and the masonry surface.

3.05 FINAL REPORT

The Contractor shall:

- A. Provide a final report of complete work including all approved submittals and photographs of the areas cleaned taken before, during, and after the work.
- B. Provide a written summary of the project and results upon final inspection and approval. The summary shall include a discussion of steps taken or new findings not specified in the initial documentation.

END OF SECTION

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This specification has been developed for use on historic properties (defined as any district, site, building, structure, or object that is listed in or eligible for listing in the National Register of Historic Places) and provides an overview of accepted practices. Site-specific specifications, when appropriate, will be provided by the Architect.
- B. All work described herein and related work must conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- C. The Contractor shall provide all labor, materials, equipment, and operations required to complete the rehabilitation work indicated herein.
- D. All work described herein and related work must have the approval of a Cultural Resources Manager, Conservator, Historic Architect, or other professional who meets the standards outlined in the Secretary of the Interior's Standards – Professional Qualifications Standards pursuant to 36 CFR 61. Such person is referred to in this document as the *Architect*.

1.02 SECTION INCLUDES

- A. Masonry poulticing with paper and clay based poultices.
- B. Masonry removal of salts with surfactants and water based treatment.

1.03 RELATED SECTIONS

- A. Section 03710.01 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Staining, and Biogrowth on Concrete.
- B. Section 04100.01 – Removal of Mortar Joints and Repointing
- C. Section 04110 –Historic Stucco
- D. Section 04211 – Historic Brick
- E. Section 04214 – Terra-cotta and Ceramics
- F. Section 04400 -- Stone
- G. Section 04510.01 – Cleaning and Testing of Atmospheric Soiling, Graffiti, Stains, and Biogrowth
- H. Section 04510.02 – Appropriate use of Wet and Dry Abrasive Cleaning Systems

1.04 REFERENCES

- A. Masonry cleaning shall conform to *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring*

& *Reconstructing Historic Buildings*. Available at the National Park Service (NPS) website at http://www.nps.gov/history/hps/tps/standards_guidelines.htm.

- B. Techniques employed for cleaning masonry shall be as outlined in *Preservation Brief No. 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings*. Available online at the NPS website at <http://www.nps.gov/history/hps/tps/briefs/brief01.htm>.
- C. *Preservation Brief No. 6: Dangers of Abrasive Cleaning to Historic Buildings*. Available online at the NPS website at <http://www.nps.gov/history/hps/tps/briefs/brief06.htm>, offers valuable information on cleaning historic buildings.
- D. Techniques employed for cleaning graffiti shall be as outlined in *Preservation Brief No. 38: Removing Graffiti from Historic Masonry*. Available online at NPS website at <http://www.nps.gov/history/hps/tps/briefs/brief38.htm>.
- E. See General Services Administration, Historic Preservation Technical Procedures Standards at <http://w3.gsa.gov/web/p/hptp.nsf/Repair%20Procedures?OpenView&Start=1&Count=30&Expand=3.13#3.13>.
- F. *Cleaning Techniques in Conservation Practice*. Edited by Kyle C Normandin and Deborah Slaton, Consultant Norman R Weiss, Managing Editor Jill Pearce. A special issue of the *Journal of Architectural Conservation*. Vol. 11 No. 3. November 2005.
- G. *Conservation of Historic Stone Buildings and Monuments: Report of the Committee on Conservation of Historic Stone Buildings and Monuments*. National Material Advisory Board, Commission on Engineering and Technical Systems, National Research Council. Washington, D.C.: National Academy Press, 1982.
- H. Grimmer, Anne E. *Keeping it Clean: Removing Exterior Dirt, Paint, Stains and Graffiti from Historic Masonry Buildings*. Darby, Pennsylvania: Diane Publishing Co., 1992.
- I. Staehli Alfred M. Appropriate Water Pressures for Masonry Cleaning: What Do the Numbers Mean? *APT Bulletin*, Vol. 18, No. 4 (1986), pp. 10-17. Published by: Association for Preservation Technology International (APT).
- J. Weaver, Martin E. *Conserving Buildings: A Manual of Techniques and Materials*. Revised edition. New York: John Wiley & Sons and the Preservation Press, 1997.
- K. Weiss, Norman R. *Exterior Cleaning of Historic Masonry Buildings*. Washington, D.C.: National Park Service, February 1977.

1.05 SUBMITTALS

The Contractor shall submit to the Architect for approval:

- A. A detailed schedule of the areas to be cleaned, including an assessment of the problem surfaces, and proposed masonry procedures, application methods, dwell times, etc., once cleaning test panels are completed and approved.
- B. Manufacturer's product literature for all proprietary cleaning products. Product literature shall include specification data, Material Safety Data Sheets, and instructions for storage, handling, and use.

1.06 QUALITY ASSURANCE

- A. The Contractor to perform the work of this Section shall have a minimum of ten (10) years experience in historic masonry cleaning and shall have successfully completed at least three projects of similar scope within the previous five years. The Contractor shall demonstrate with project descriptions, photographs, and references successful experience in all specified cleaning techniques. Contractor experience shall include cleaning exterior masonry stains of similar type, complexity, and similar materials. He/she shall demonstrate a working knowledge of *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings*.

1.07 MOCK-UPS

- A. The Contractor, at locations designated by the Architect, shall prepare test panels, not to exceed 100 square feet per sample, demonstrating the cleaning product (s) on inconspicuous areas, preferably conducted by the operator undertaking the final work. The Contractor shall prepare test panels of each method utilized under this section:
 - 1. Poultice Cleaning for Desalination – a minimum of 1 square foot for each type of masonry unit and each product to be used.
 - 2. Poultice Cleaning for Iron and Copper Stains – 2 areas, a minimum of one square foot at each test panel for each type of masonry unit and each specified product.
 - 3. Poultice Cleaning for Paint Remover and Tar/Mastic Remover – approximately 10 square feet for each type of masonry/stone unit and each procedure to be performed.
 - 4. Poultice Cleaning for Oil and/or Grease Stains – a minimum of 1 square foot for each type of masonry unit and each product to be used.
- B. Preparation of the cleaning sample panels shall be used to determine the appropriate concentrations and dwell times for the remainder of the cleaning work. Following approval of the cleaning test panels, the Contractor shall submit the approved procedures in writing to the Architect as specified in Paragraph 1.04.A.
- C. Preparation of test panels shall begin with the lowest concentration of cleaner and the shortest dwell recommended by the manufacturer. Concentration and/or dwell time shall be increased as required up to the maximum recommended by the product manufacturer.
- D. More than one test panel may be required to be acceptable for approval. The Contractor shall prepare at least four (4) test panels of each type, if necessary, without further compensation. Approved test panels shall become part of the work and shall serve as the quality standard for all similar work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Restoration cleaning and testing materials and proprietary products shall be delivered to the project site in manufacturer's or distributor's original and unopened packaging, undamaged, bearing labels as to the type of material, brand name, and manufacturer's name, complete with application instructions and Material Safety Data Sheets. Materials delivered shall be identical to approved tested materials.

- B. The Contractor shall store and transport cleaning agents, chemicals, and solvents within the temperature range recommended by the manufacturer and away from direct sunlight. Handle all materials following manufacturer's instructions. The Contractor shall remove materials which are damaged or otherwise not suitable for use from the job site.
- C. Waste material, packaging, debris, and effluent associated with the masonry cleaning work shall be collected and disposed of in accordance with local, state, and federal environmental regulations.
- D. The Contractor shall follow manufacturer's instructions for the handling of all materials, and remove all solvents, soiled rags, applicators, and other flammable materials daily and dispose off-site according to local, state, and federal regulations.

1.09 PROJECT / SITE CONDITIONS

- A. The work of this Section shall be executed only when the air and surface temperatures are 40 degrees F and rising or less than 90 degrees F and falling. Minimum temperature for masonry cleaning shall be 50 degrees F and above for at least 2 hours after completion and above freezing for at least 24 hours after completion. Work shall not commence when rain, snow, or below-freezing temperatures are expected within the next 24 hours. All surfaces shall be free of standing water, frost and ice.
- B. The Contractor is responsible for protecting existing adjacent materials during the execution of the work and shall provide all necessary protection and follow all necessary work procedures to avoid damage to existing material assemblies not a part of the work of this Section. At a minimum, the Contractor shall:
 - 1. Protect woodwork, glass, and metal adjacent to masonry areas to be cleaned from possible chemical or water damage from cleaning operations. Cover all window openings with waterproof plastic to prevent leakage to the building interior.
 - 2. Protect surrounding lawns and vegetation from runoff during rinsing operations.
 - 3. Access work areas from the exterior only. Under no circumstances are hoses to be run or equipment to be transported through the building during cleaning operations.
 - 4. Add additional site conditions here.
- C. The Contractor shall erect enclosures around areas where poulticing operations are in progress to protect passers-by from contact with cleaning chemicals or rinse water.
- D. Contractor shall coordinate masonry cleaning operations with the other trades involved in exterior and interior restoration work, including but not limited to masonry restoration, sealing, and painting. Complete masonry cleaning prior to restoration of windows, doors and metalwork and prior to any exterior painting in the affected areas.
- E. Contractor personnel performing masonry cleaning operations shall be provided with gloves, respirators, and protective clothing as recommended by the manufacturer of the masonry cleaning products.
- F. Complete installation of temporary sealants at window and door perimeters prior to starting cleaning operations where required to prevent leakage to interior.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The type of stone to be cleaned must be identified. See section 04400.01, Identifying Masonry Types and Failures. This method of removal must be compatible with the stone type and type of soiling.
- B. Cleaning and rinse water shall be potable, and free of injurious amounts of oil, soluble salts, alkali, acids, and other impurities that might stain or otherwise damage masonry.

2.02 EQUIPMENT

- A. Clean pail or containers to prepare poultices
- B. Nonmetallic spatulas
- C. Wooden scrapers
- D. Trowels
- E. Natural and synthetic fiber bristle brushes
- F. Polyethylene sheeting
- G. Protective paper recommended by the manufacturer
- H. Japanese tissue or thin polyester geotextile, 200 g/sq m (for use on very porous or highly textured masonry surfaces)

2.03 MATERIALS AND MANUFACTURERS

- A. Cleaning materials including poultice clay; poultices for iron and copper staining; poultices for oil and grease removal; paint remover for paint and adhesives; and asphalt, sealant and tar removal; shall be products appropriate for the work in this section and manufactured by industry recognized sources. The Contractor shall submit all selected materials and manufacturers to the Architect for approval.

2.04 ACCESSORIES AND RELATED MATERIALS

- A. Temporary Sealant: Non-staining, removable sealant suitable for masonry substrates.
- B. Brushes for scrubbing masonry and stucco shall be stiff-bristle, nonmetallic brushes as recommended by the manufacturer of the masonry cleaning products. Metal bristle brushes shall NOT be used.

PART 3 - EXECUTION

3.01 GENERAL

- A. The extent of the cleaning (desired level of cleaning) and areas to be cleaned shall be reviewed by the Architect on site prior to beginning operations. Contractor shall submit testing schedule and a cleaning schedule, including the methods and materials to be used.
- B. Masonry cleaning is to be completed prior to masonry repointing and repairs. The Contractor shall remove and store light fixtures, downspouts, and other appurtenances to ensure full access to wall surfaces, unless otherwise noted by the Architect. Anchor holes and penetrations from appurtenances must be temporarily filled with removable sealant or protected with cover plates.
- C. The Contractor shall protect all adjacent materials from rinse water and poultice chemicals.
- D. The cleaning/rinsing runoff shall be collected by wet vacuum or in plywood troughs lined with polyethylene sheeting. Polluted liquid shall be gathered and stored in plastic containers for properly controlled disposal. Acidic runoff shall be neutralized with lime or soda ash prior to release.
- E. Masonry cleaning shall employ the gentlest means possible. When evidence of deterioration causes doubts about the ability of a stone or other masonry unit to withstand rinsing pressures and manual scrubbing or scraping, remove cleaning products as gently as possible and cease the cleaning procedure at that location. The Contractor shall notify Architect of the location and condition of masonry units involved.

3.02 SURFACE PREPARATION FOR CLEANING

- A. The Contractor shall examine the surfaces to be cleaned prior to commencing cleaning operations. Large cracks ($\frac{1}{8}$ inch or larger) and open joints discovered in the area to be cleaned shall be temporarily filled with removable sealant to prevent penetration of cleaning materials.
- B. Window and door opening shall be protected from leakage and damage from cleaning materials and spray by plastic sheeting or other waterproof membrane. Open joints around window frames and door frames shall be filled with temporary sealant to prevent leakage.
- C. The Contractor shall remove all live vegetation and plant debris prior to cleaning. With the approval of the Architect, invasive vines shall be cut close to the ground and allowed to wither and dry. The dry vines shall be carefully removed and the façade surface cleaned with a natural bristle brush prior to other treatments.

3.03 POULTICING WITH CLAY OR PAPER BASED POULTICES

- A. Dampen the surface area to be cleaned with clean water.
- B. In a plastic bucket or container, combine poultice ingredients in accordance with manufacturer's printed instructions. Stir continuously until the mixture forms a smooth, wet paste.

- C. Apply a layer of poultice paste, $\frac{1}{8}$ inch to $\frac{1}{4}$ inch in thickness, immediately to the stained surface. Surfaces to be cleaned should be free of surface dirt or dust.
- D. Leave poultice paste on the masonry surface until completely dry or for a maximum of 24 hours.
- E. During hot and/or windy conditions or to protect passers-by, the Contractor shall cover poultice with protective paper covering, sealing and taping the edges. Leave covered for 12-24 hours, adjusting dwell time for cases of extreme humidity. Remove covering, and if the poultice is still wet, allow it to dry completely.
- F. Once the poultice is completely dried, the Contractor shall scrape mixture from the surface using wood, plastic, or rubber spatulas.
- G. Rinse the treated area thoroughly with water and a soft brush to remove remaining residue.
- H. Reapply poultice for consecutive treatments if required.

3.04 SALT REMOVAL WITH SURFACTANTS AND WATER BASED TREATMENTS

- A. In a plastic bucket or container, combine poultice filler (paper fiber or clay) ingredients with water. Stir continuously until the mixture forms a smooth, wet paste.
- B. Apply a layer of poultice paste, $\frac{1}{8}$ inch to $\frac{1}{4}$ inch in thickness, immediately to the stained surface. Surfaces to be cleaned should be dry and free of surface dirt or dust.
- C. Leave poultice paste on the masonry surface until completely dry or for a maximum of 24 hours.
- D. Once the poultice is completely dried, scrape mixture from the surface using wood, plastic, or rubber spatulas.
- E. Rinse the treated area thoroughly with water and a soft brush to remove remaining residue.
- F. After each application, the Contractor shall test poultice material after it is removed to determine the salt concentration and the need for additional treatments. The Contractor shall reapply poultice for consecutive treatments, as needed. When cleaning limestone, the Contractor shall check between each application to ensure that the removal of the salts is not causing discoloration of the stone.

3.05 REMOVAL OF METALLIC STAINS

- A. In a plastic bucket or container, combine poultice ingredients in accordance with manufacturer's printed instructions. Stir continuously until the mixture forms a smooth, wet paste.
- B. Apply a layer of poultice paste, $\frac{1}{8}$ inch to $\frac{1}{4}$ inch in thickness, immediately to the stained surface. Surfaces to be cleaned should be dry and free of surface dirt and dust.
- C. Leave poultice paste on masonry until completely dry or for a maximum of 24 hours.

- D. Once the poultice is completely dried, the Contractor shall scrape mixture from the surface using wood, plastic, or rubber spatulas. Rinse the treated area thoroughly with water and a soft brush to remove remaining residue.

3.06 REMOVAL OF OIL AND GREASE

- A. Mix poultice ingredients thoroughly and apply a coat to completely cover the stained area, following manufacturer's instructions. Do Not pre-wet the surface.
- B. Allow poultice to dry for 5 to 8 hours overnight until completely dried. Fully developed cracking indicates that the poultice is completely dry.
- C. Protect poultice from pedestrian contact and rain while drying. Area may be tented with plastic. Do NOT use tightly-adhered covers.
- D. The Contractor shall remove residue powder and properly dispose of the residue. Pressure water rinsing can be used on textured finished to facilitate removal of the poultice residue.

3.07 PAINT REMOVAL

- A. Scrape loose material from surface to the greatest extent possible.
- B. Prepare poultice-solvent mixture in accordance with manufacturer's instruction.
- C. Apply the poultice to the stained area to a minimum thickness of ¼ inch.
- D. The poultice shall be covered with a plastic film to prevent drying. Press the film to the poultice, and tape and seal edges. Allow the poultice to dwell on the surface in accordance with the approved test panel.
- E. After dwell time, remove the plastic cover.
- F. Remove the poultice and softened residue by scraping with a nonmetallic spatula. Wash the surface thoroughly with fresh water. Scrub with a stiff bristle brush to loosen spots. Do not allow poultice material to dry on surface.
- G. The process shall be repeated as needed.

3.08 SEALANT, TAR AND MASTIC REMOVAL

- A. The Contractor shall clean bituminous material from surfaces of walls using wood scrapers to remove bulk of material prior to applying specified remover.
- B. Masonry shall be cleaned using specified cleaning agent in accordance with manufacturer's instructions. The Contractor shall:
 - 1. Pre-wet the surface with clean water.
 - 2. Thoroughly rinse the surface after cleaning and apply neutralizing agent if required by manufacturer.

3. Keep area below stained area wet and rinsed free of cleaning residues.
4. Remove protective coverings from adjacent surfaces and repair any damage or staining caused by the cleaning operation to adjacent surfaces.

3.09 MARBLE CLEANING

- A. In a container mix the ingredients according to manufacturer's instructions until a dry paste is formed. Gradually add water until troweling consistency is reached.
- B. Apply the poultice to the surface to provide an even covering of ¼ inch.
- C. Cover the poultice with protective sheets as recommended by manufacturer. Rub to remove air pockets and ensure smooth adhesion, then tape and seal edges.
- D. Leave the poultice covered for 12 to 24 hours; adjust dwell time in extreme humidity.
- E. Remove the film. If the film is still wet, allow the poultice to dry for an additional 2 to 4 hours.
- F. Remove the poultice and dissolved staining matter by inserting a non-metallic scraper, spatula, or other tool through the paste and lifting from the surface. Remove as much residue as possible.
- G. Wash the surface thoroughly with fresh water using a sponge, soft brush, or cloth, and allow surface dry thoroughly.
- H. Repeat the process as needed.

3.10 FINAL REPORT

The Contractor shall:

- A. Provide a final report of complete work including all approved submittals and photographs of the areas cleaned taken before, during, and after the work.
- B. Provide a written summary of the project and results upon final inspection and approval. The summary shall include a discussion of steps taken or new findings not specified in the initial documentation.

END OF SECTION

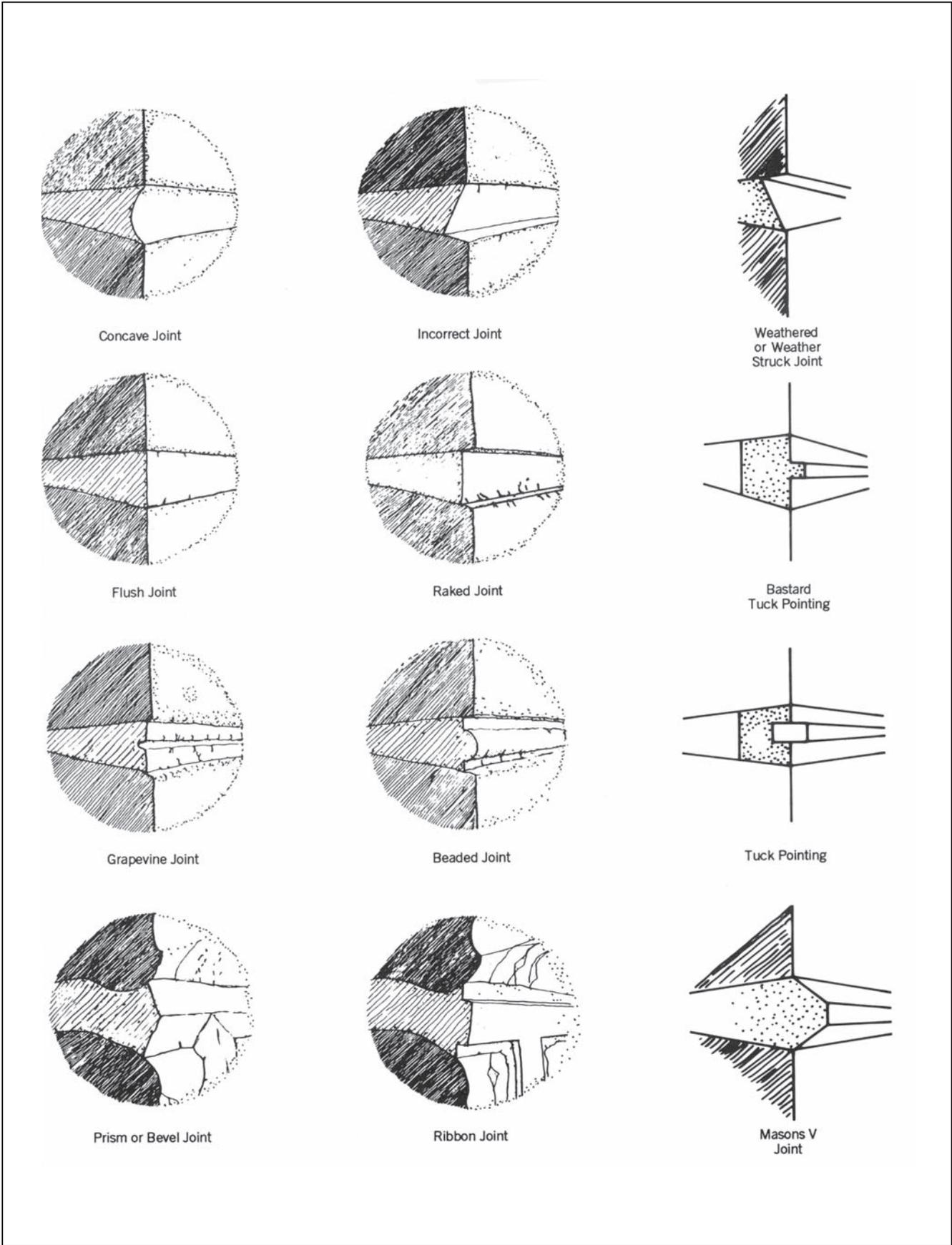


FIGURE 1: Examples of Mortar Joints

Source: Weaver 1997

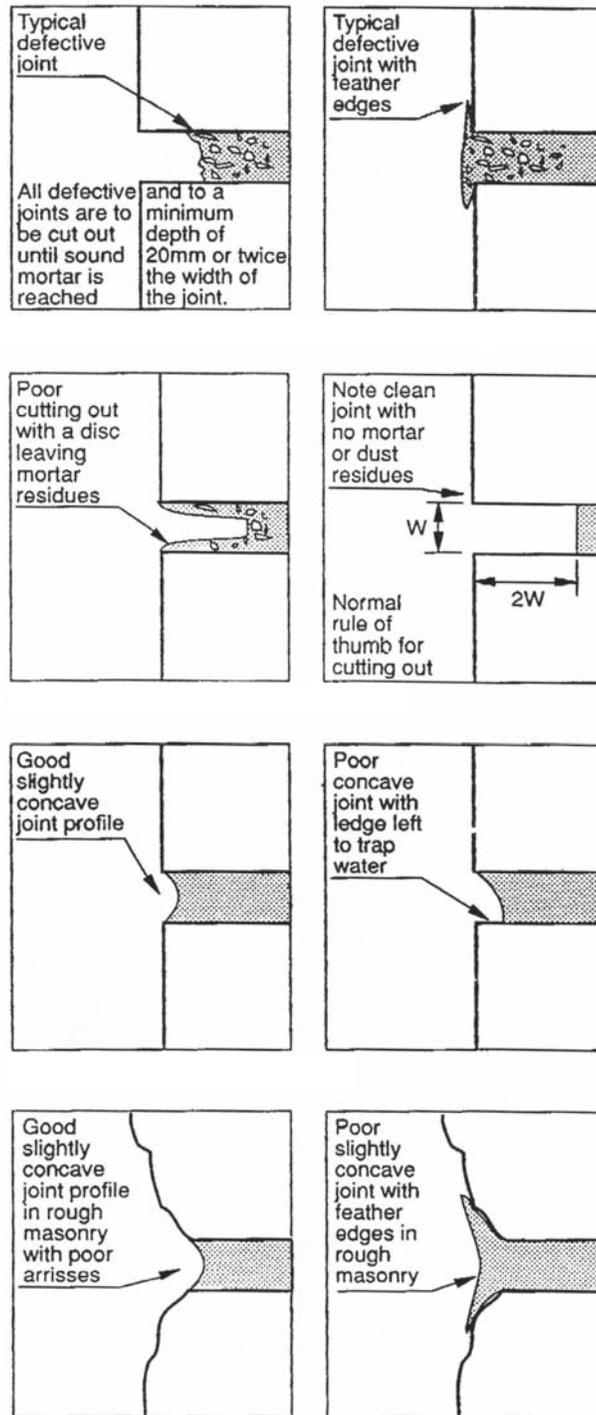


FIGURE 2: Examples of Appropriate Mortar Joint Applications

Source: Weaver 1997

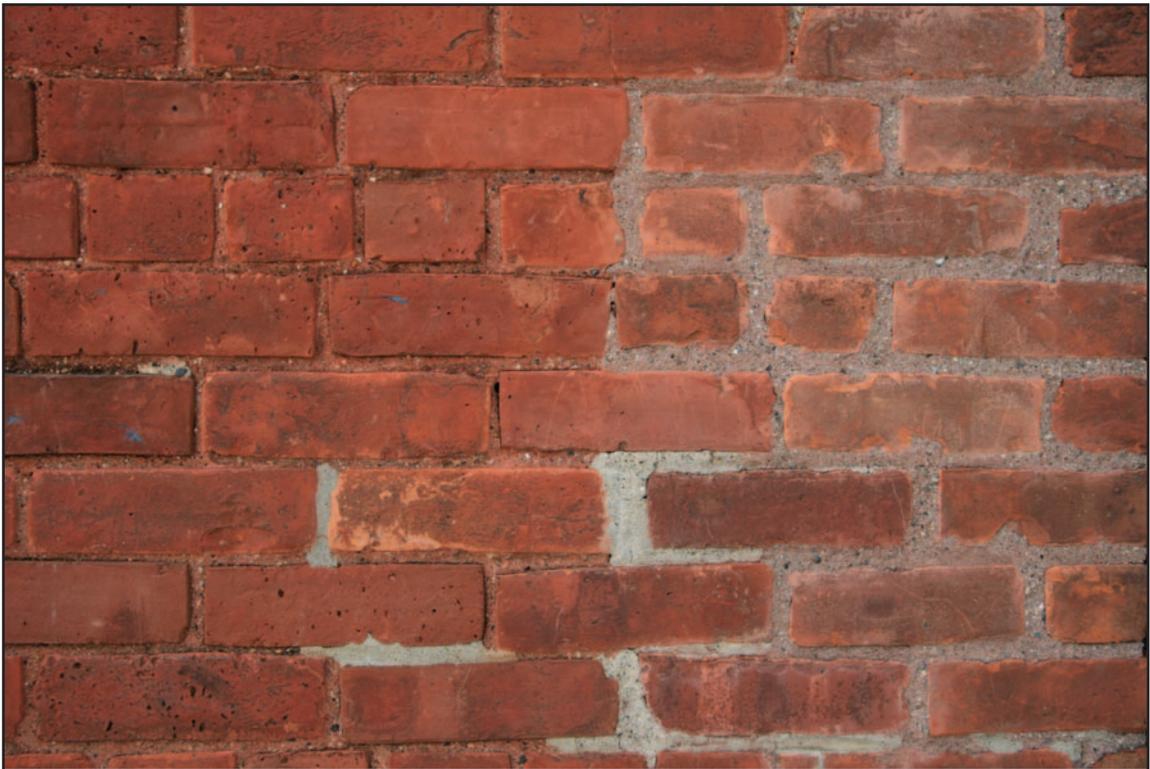


Example of Failed Paint Application on Stucco Exterior

FIGURE 3: Examples of Inappropriate Stucco Repair

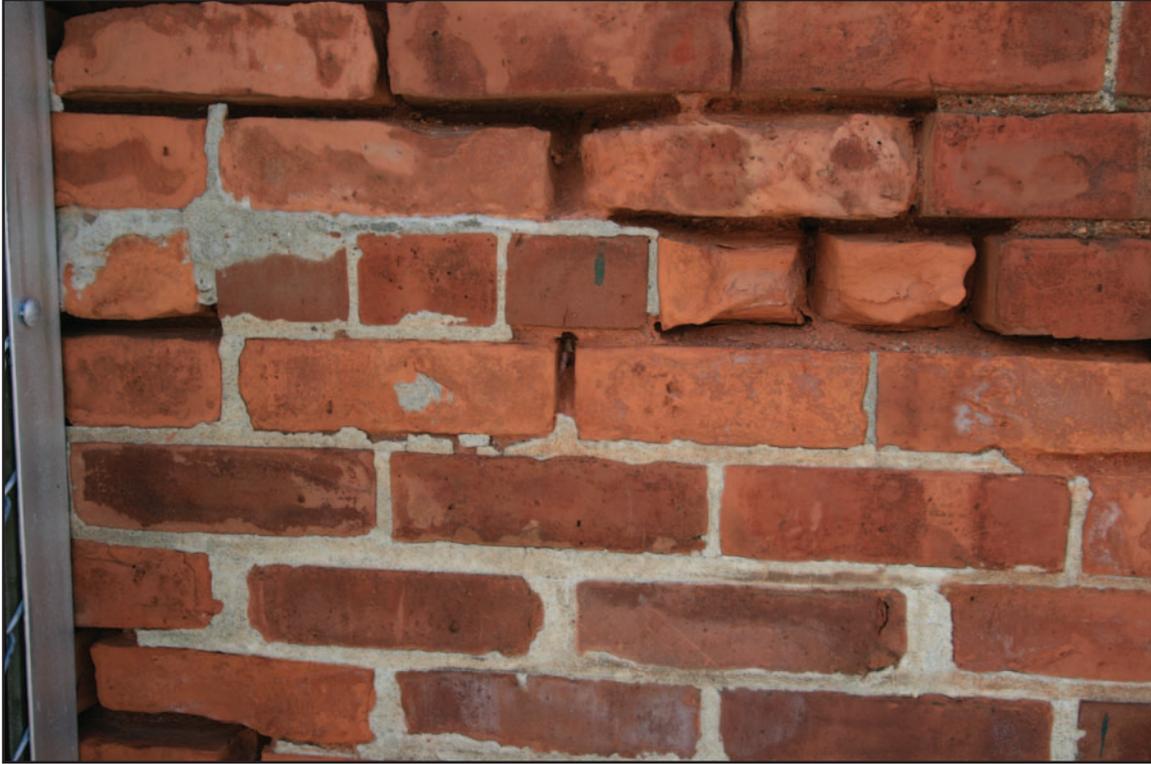


Example of Tinted Mortar

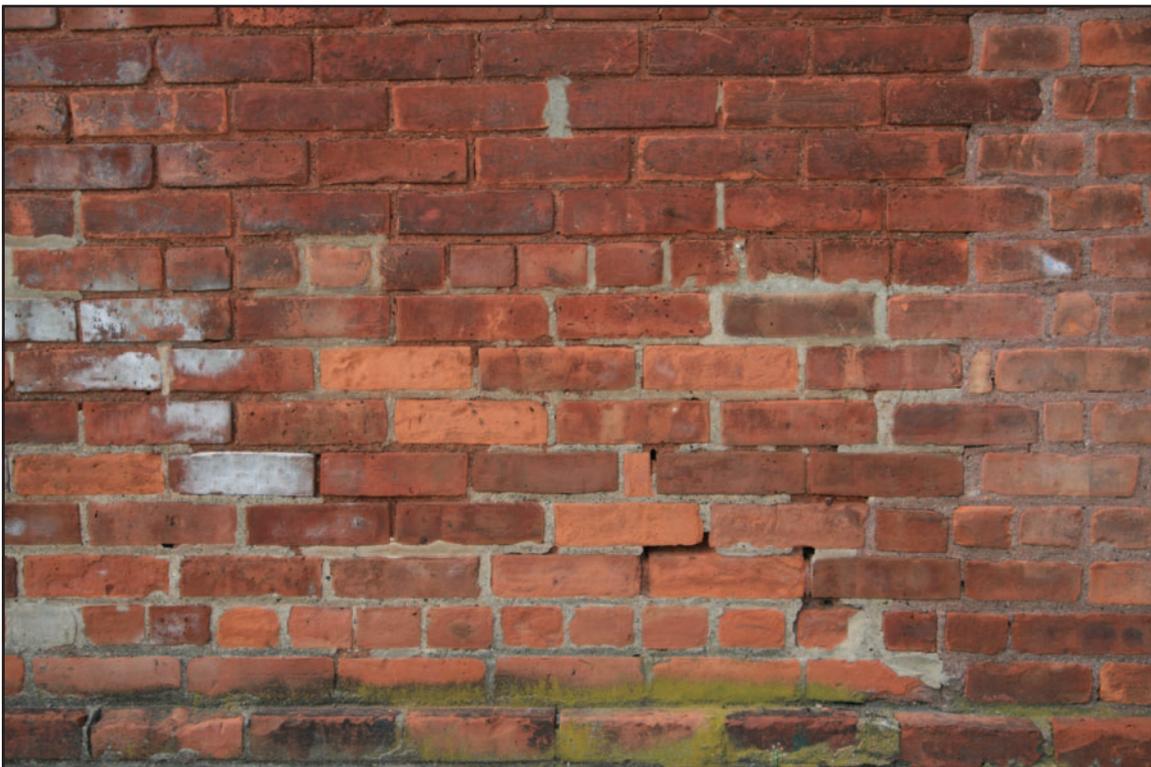


Mismatched Tinted Mortar in Pointing Application

FIGURE 4: Examples of Inappropriate Brick Pointing



Spalling Resulting from Inappropriate Brick Pointing



Inappropriate Application of Pointing with Portland Cement Mortars

FIGURE 5: Examples of Inappropriate Brick Pointing

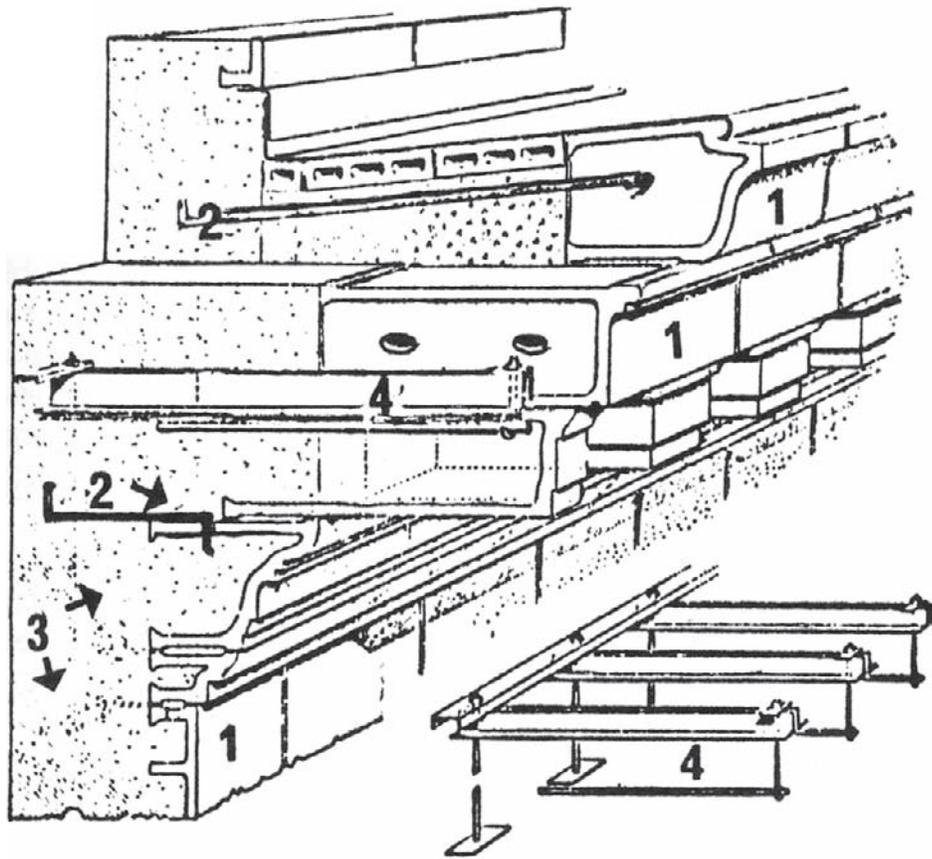


Example of Biogrowth Damage Caused by Creeping Vines



Example of Graffiti Damage

FIGURE 6: Examples of Common Types of Brick Damage



- 1 - Terra Cotta Units
- 2 - Metal Anchors (Z - Straps)
- 3 - Masonry Backfill
- 4 - Metal Dowels or Outriggers

FIGURE 7: Placement of Terra Cotta Fasteners

Source: Department of the Interior,
Preservation Brief No. 7



Example of Failing Stucco Application on an Adobe Structure



Example of Structural Cracks in an Adobe Structure

FIGURE 8: Examples of Common Historic Adobe Problems

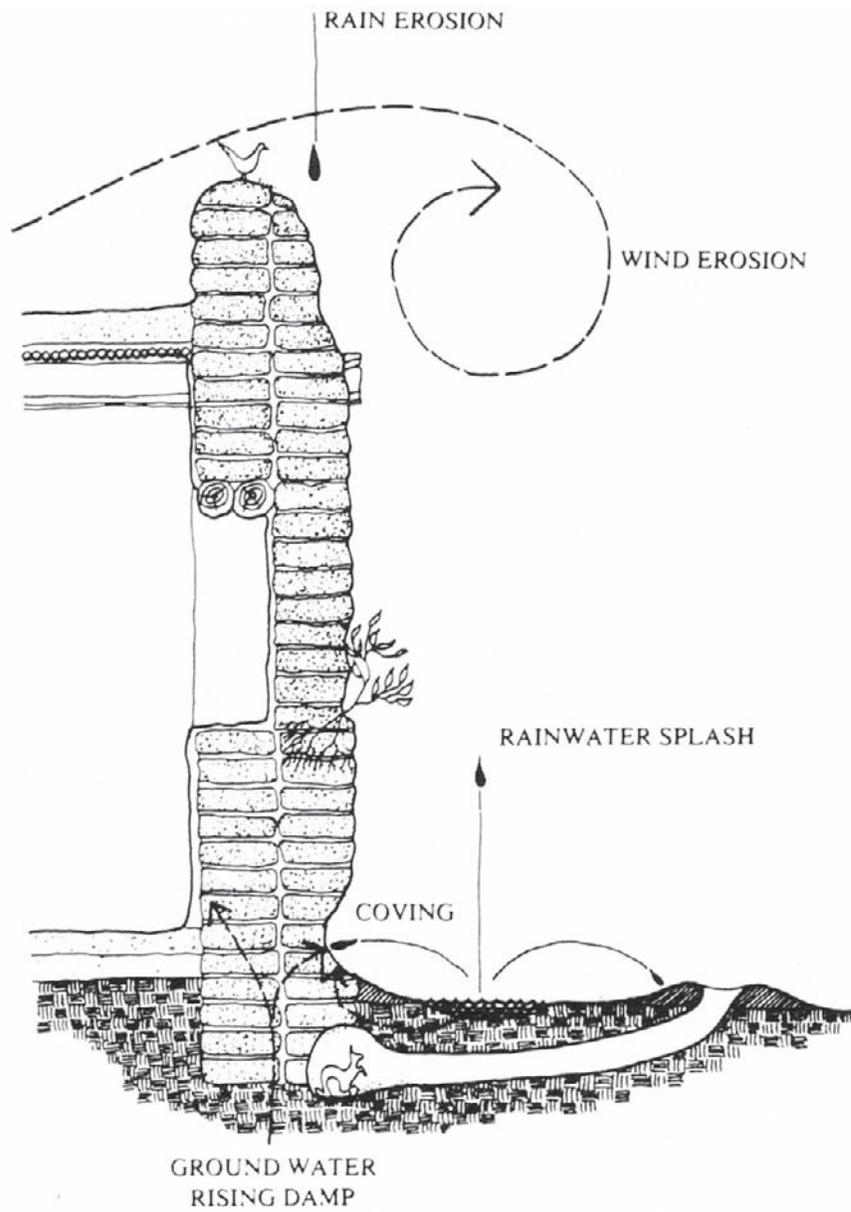
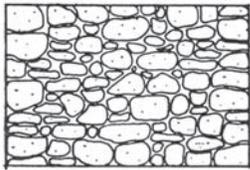


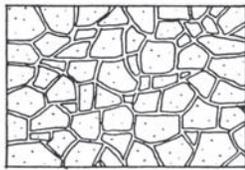
FIGURE 9: Examples of the Causes of Erosion for Masonry Exteriors

Source: Department of the Interior, Preservation Brief No.5

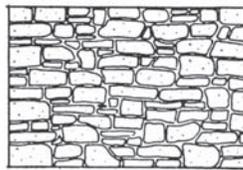
STONE WORK



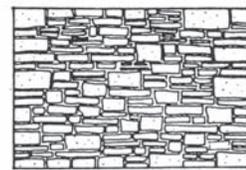
UNCOURSED FIELDSTONE
ROUGH OR ORDINARY.



POLYGONAL, MOSAIC
OR RANDOM.

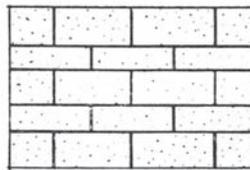


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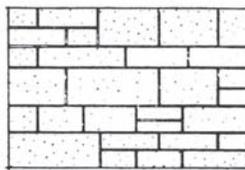


Laid of stratified stone fitted on job
It is between rubble & ashlar. Finish
is quarry face, seam face or split
Called rubble ashlar in granite.
SQUARED-STONE MASONRY

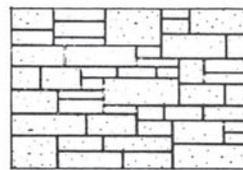
TYPES OF RUBBLE MASONRY



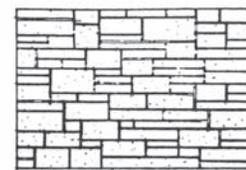
RANGE.
Coursed



BROKEN RANGE.



RANDOM
Interrupted coursed



RANGE.
Coursed (Long stones)

TYPES OF ASHLAR MASONRY

This is stone that is sawed, dressed, squared or Quarry faced.

ELEVATIONS SHOWING FACE JOINTING FOR STONE.



For both hard and
soft stones.
Rock or Pitch Face.



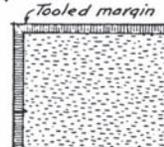
Smooth, but saw mark
visible. All stones.
Sawed Finish (Sang).



More marked than
sawed. Soft stones.
Shot Sawed (Rough).



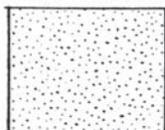
Smooth finish with some
texture. Soft stones.
Machine Finish (Planer).



May be coarse, medium or
fine. Usually on hard stones.
Pointed Finish.



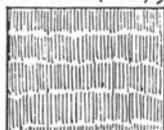
After pointing on
hard stones.
Pean Hammered.



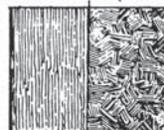
For soft stones
Bush-hammered.



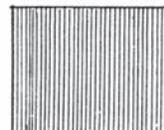
All stones. Used much on
granite 4 to 8 cut in 7/8".
Patent Bush-hammer.



For soft stones.
Drove or Boasted.



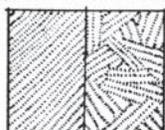
For soft stones.
Random
Hand Tooled.



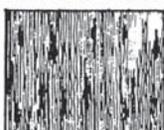
Tool marks may be 2 to 4 per inch.
Machine Tooled.



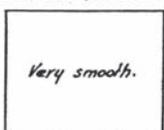
For soft stones.
Tooth-chisel.



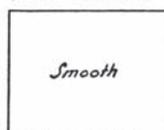
For soft stones.
Random
Crandalled.



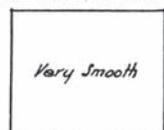
Textured by machine.
For Limestone
Plucker Finish.



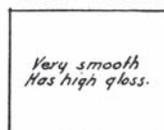
Very smooth.
For Limestone.
Done by machine.
Carborundum Finish.



Smooth
All stones. May use
sand or carborundum.
Rubbed (Wet).



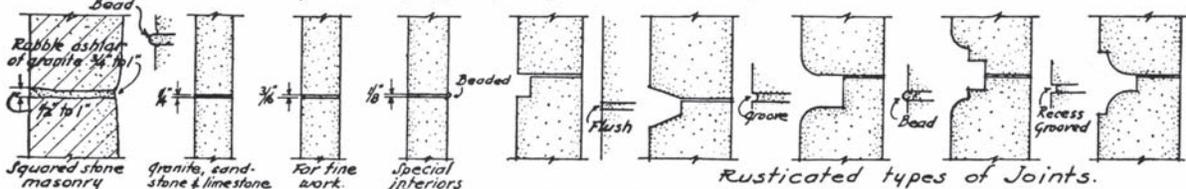
Very Smooth
Marble, granite. For
interior work. Soft stones.
Honed (rubbed first).



Very smooth
Has high gloss.
Marble and Granite.
Polished (honed first)

STONE FINISHES.

Seam face and split face (or Quarry face) not shown as they are not worked finishes.



Squared stone masonry

granite, sandstone & limestone ashlar. General use.

For fine work. Limestone

Special interiors

Rusticated types of Joints.

STONE JOINTS

TYPES, FINISH AND JOINTING OF STONE MASONRY.

A perch is nominally 16'6" long, 1'0" high & 1'6" thick = 24 3/4 cu.ft. In some localities 16'2" & 22 cu.ft. are used.

FIGURE 10: Examples of Masonry Types

Source: Weaver 1997



Example of Spalling Brownstone



Example of Spalling Granite Arrises

FIGURE 11: Examples of Common Types of Masonry Damage

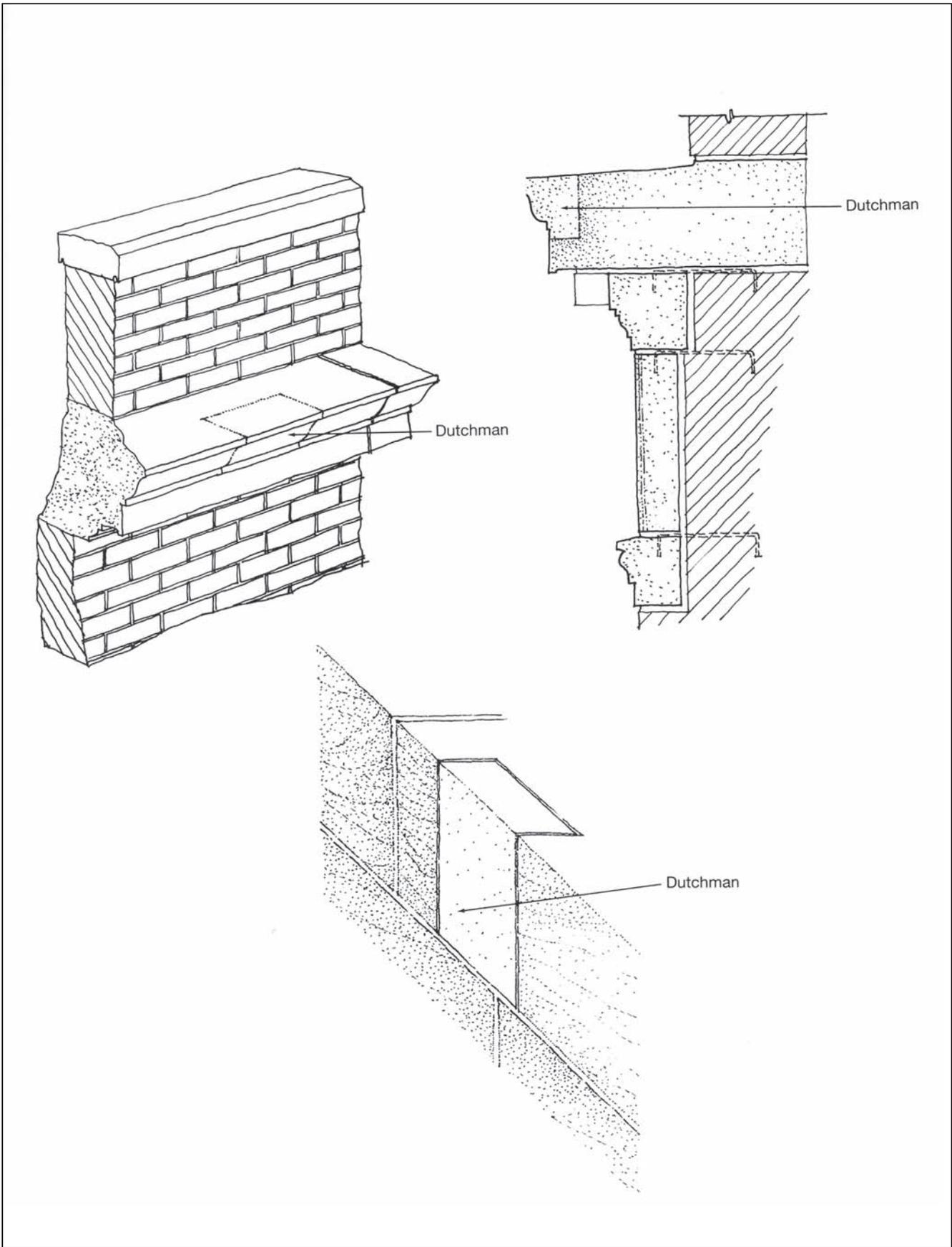


FIGURE 12: Examples of Dutchman Masonry Repairs

Source: *New York Landmark Conservancy, 1997*



Example of Inappropriate Masonry Repair

FIGURE 13: Examples of Inappropriate Masonry Patch



Example of Biogrowth on Exterior Masonry



Example of Iron Staining on Exterior Masonry

FIGURE 14: Examples of Common Types of Masonry Concerns