

## REVISED CONCEPT REPORT: CLADDING PROPOSAL SUBMISSION

National Capital Planning Commission  
28 June 2017

# *Smithsonian Institution* *National Air and Space Museum* National Mall Building Envelope and HVAC Revitalization

SF Project No. 1206101  
QEA Project No. 31301800





This page intentionally left blank





Introduction	5
Cladding Replacement	19
Paving Replacement	35
Appendix A: Initial Cladding Matrix Stone Survey	45
Appendix B: Global Stone Research List and Stone Filtering Matrix	49
Appendix C: Cladding and Paving Aesthetic Mockup	57







PROJECT NAME  
National Mall Building Envelope and HVAC Revitalization

LOCATION  
Smithsonian Institution  
National Air and Space Museum  
Washington, DC

CONTACT  
Smithsonian Institution  
Smithsonian Facilities (SF)  
Office of Planning, Design and Construction (OPDC)  
Capital Gallery  
600 Maryland Avenue SW Suite 5001  
MRC 511, PO Box 37012  
Washington, DC 20013-7012

Jane Passman, Senior Facilities Master Planner  
Phone: 202.633.6549  
Email: [passmj@si.edu](mailto:passmj@si.edu)







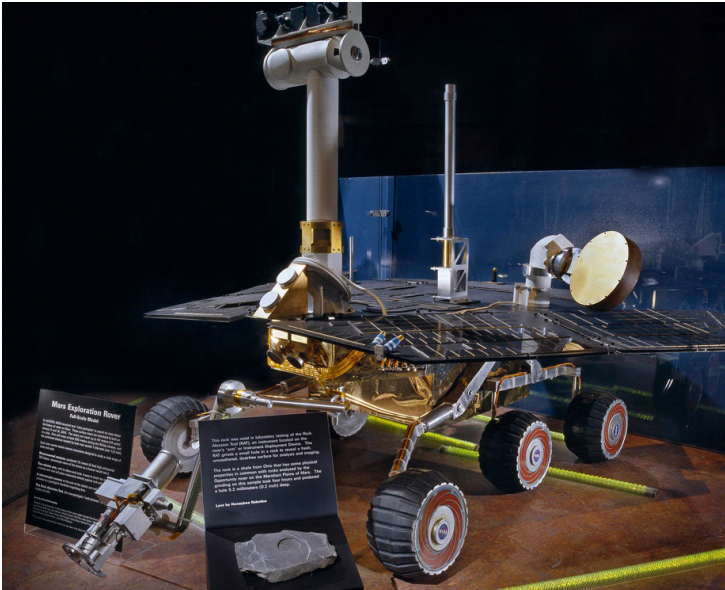
Museum Vision and Mission	6
Context Maps	7
Development Timeline	8
Existing Site Plan and First Floor Plan	9
Existing North and South Elevations	10
Existing East and West Elevations	11
Project Data	12
Section 106 Compliance	13
NCPC Comments on Cladding and Commission of Fine Arts Concept Approval Letter	15
Commission of Fine Arts Revised Concept Approval Letter	16
Consultation Milestones and Associated Dates	17

Table of Contents





National Mall Building Envelope and HVAC Revitalization



The Smithsonian has selected Colonial Rose granite (also known as Lac Du Bonnet) as the cladding material for the NASM envelope based on an extensive evaluation of the aesthetics, technical performance, procurement, and risk for a wide range of stone and man-made options. Colonial Rose is an elegant stone with monumental presence. This report documents the analysis leading to the selection

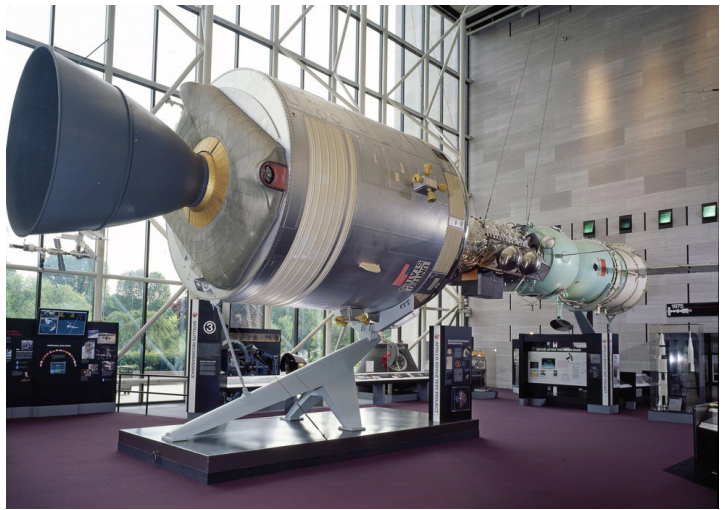
A preliminary evaluation of paving materials is also presented in this report, including an analysis of the paving options as paired with Colonial Rose. The selection of the paving material will be included in the Preliminary Design Submission.

The front end of the report focuses on the short list of cladding options that were identified for further review. The broader range of materials initially evaluated is documented in the appendices as located at the end of the report.



**NASM Vision: “Transforming NASM for the future”**

The Smithsonian’s National Air and Space Museum will assess and improve our programs, processes, and tools; revitalize our facilities and refresh our exhibitions to better engage and educate the public; preserve and share our collections; and perform original research in planetary science and the history of aviation and spaceflight.



**NASM Mission: “Commemorate, Educate, Inspire”**

The Smithsonian’s National Air and Space Museum collects, preserves, studies, and exhibits artifacts, archival materials, and works of art related to the history, culture, and science of aviation and spaceflight and the study of the universe. Its research and outreach activities serve all audiences, within and beyond its walls. The Museum commemorates the past and is committed to educating and inspiring people to foster appreciation for the importance of flight to humanity.

Museum Vision and Mission



Smithsonian Institution  
*National Air and Space Museum*

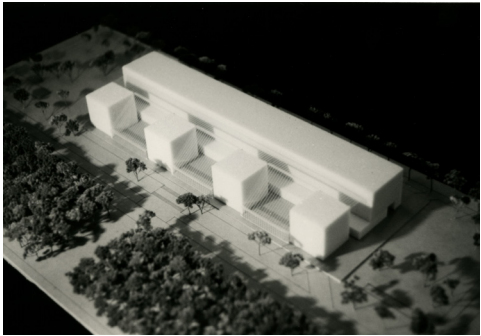
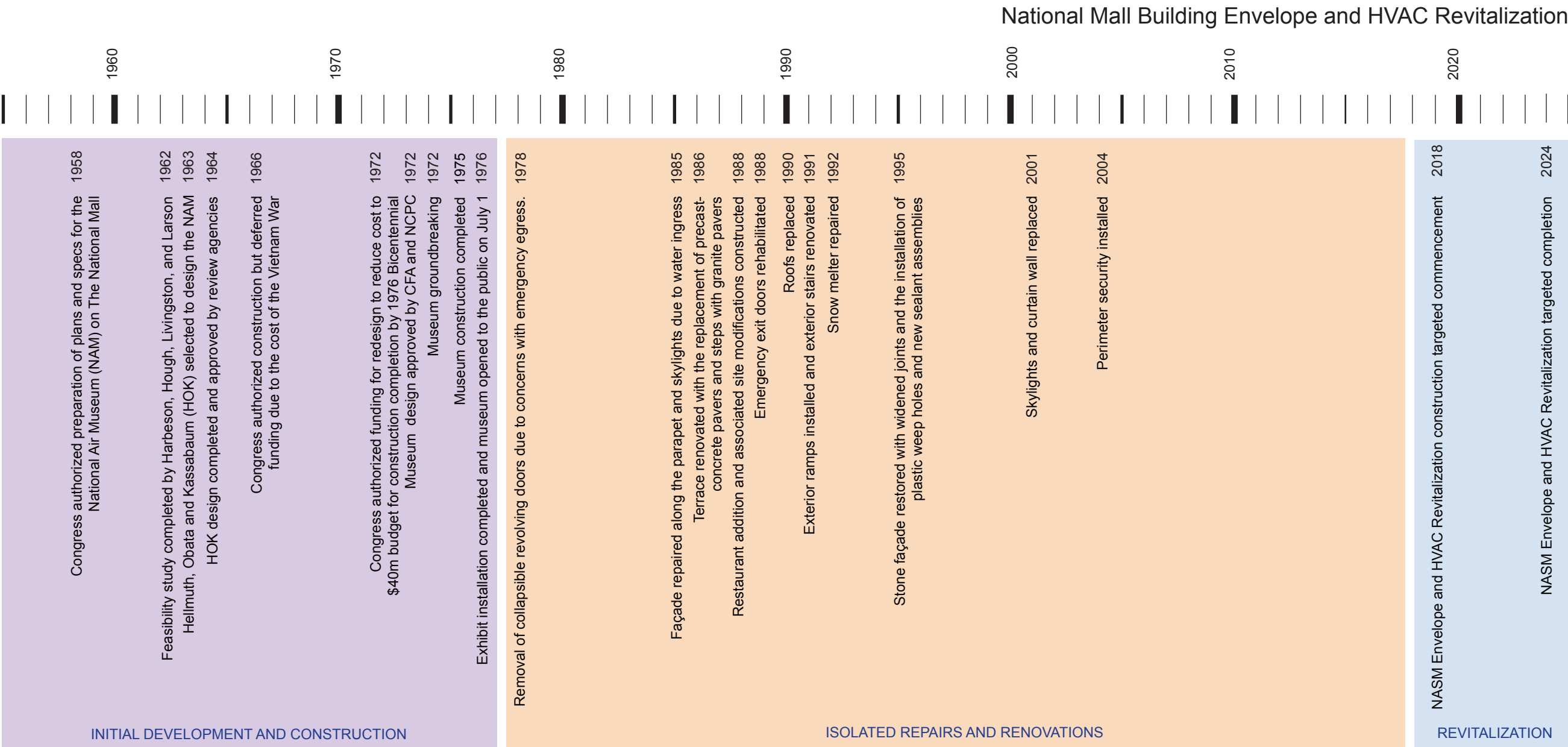




National Air and Space Museum Mall Building - Context Map







Early Proposal to Review Agencies in 1972



Grand Opening 1976



Restaurant Addition 1988



Perimeter Security 2004



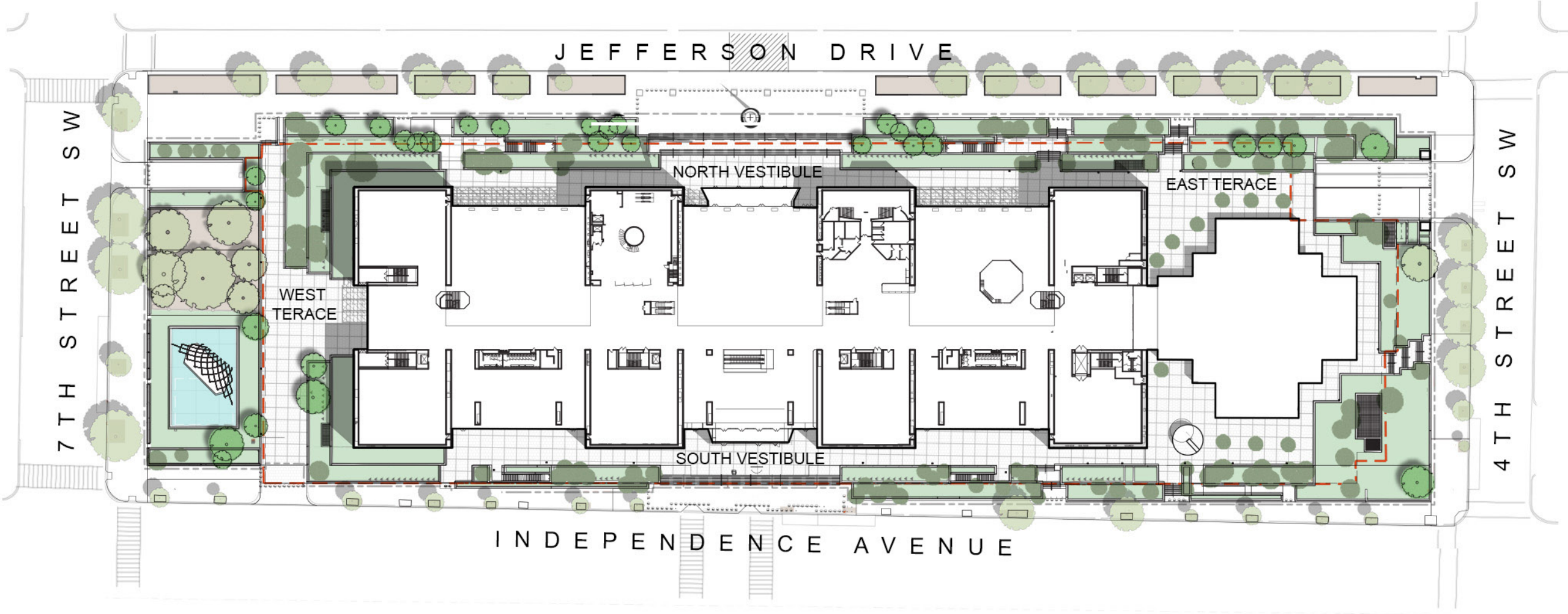
Proposed Revitalization 2024

## National Mall Building Development Timeline



Smithsonian Institution  
*National Air and Space Museum*

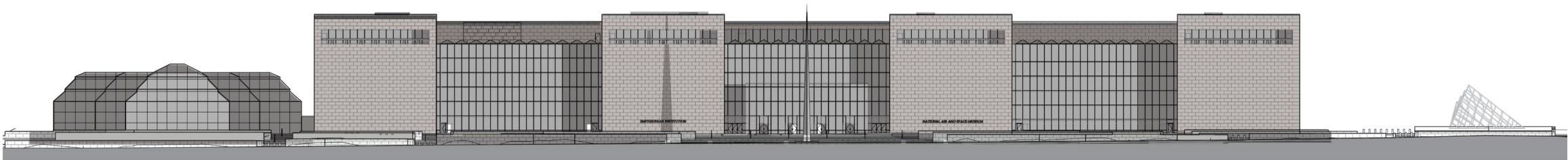




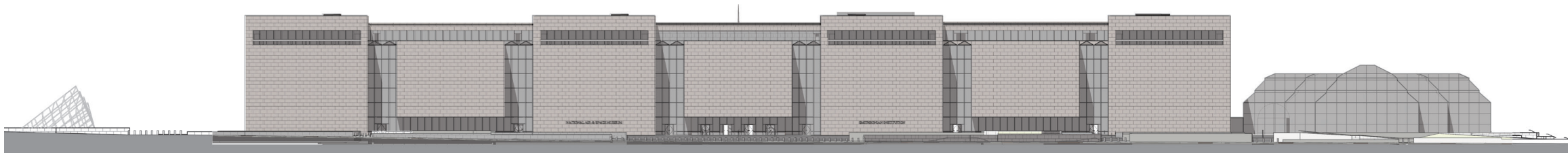
Existing Site Plan and First Floor Plan







Existing North Elevation



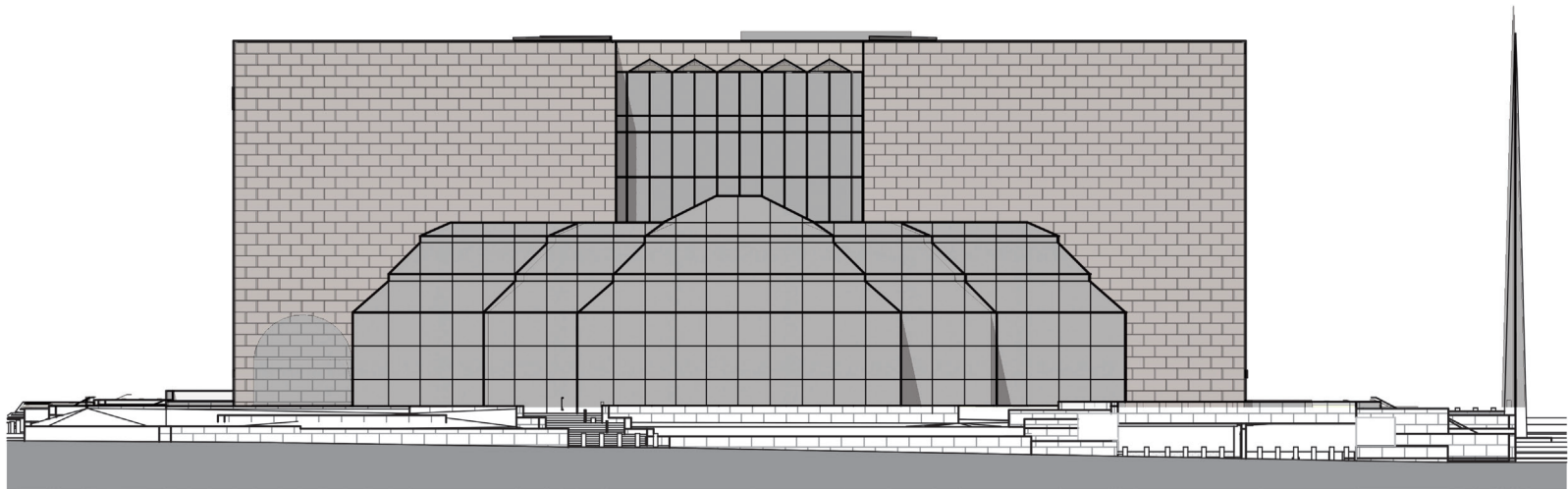
Existing South Elevation



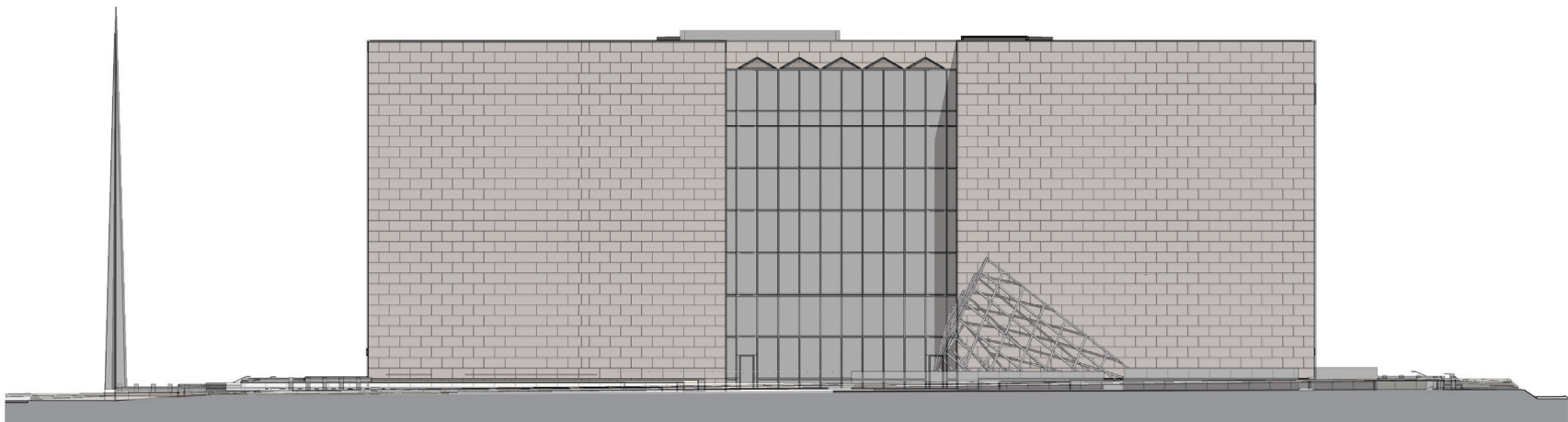
Existing Elevations







Existing East Elevation

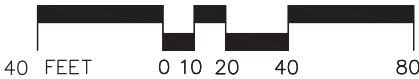


Existing West Elevation

Existing Elevations



Smithsonian Institution  
*National Air and Space Museum*



1.1 PROJECT DATA

Project Area & Building Area

The project comprises the renovation and restoration of the existing 687,000 gsf (63,824 m²) National Air and Space Museum (NASM) National Mall Building, including 112,000 gsf (10,405 m²) terrace revitalization. The overall site area is 448,530 gsf (41,670 m²). The cladding replacement includes 160,600 gsf (14,920 m²) stone facade, 40,000 gsf (3,716 m²) curtain wall, 52,000 gsf (4,830 m²) skylight, and 70,000 gsf (6,503 m²) roof. The proposed vestibule additions are a combined 4,800 gsf (446 m²).

Assigned Employment

There is a combined total of approximately 530 employees and volunteers assigned to the NASM Mall Building. No change of assigned employees is envisioned as a result of this project.

Schedule

The project is scheduled to be constructed beginning in early 2018 with an estimated six year period of construction. Public access to the Museum will be maintained but restricted while under construction.

Project Funding

Federal funding for revitalization is expected to be requested in increments over FY18-FY22.

1.2 PROJECT NARRATIVE

The proposed design for the National Mall Building envelope and HVAC revitalization addresses the need for upgrades to a facility with out-of-date systems and significant deferred maintenance. The project objectives include the following goals:

- The revitalization of the museum to protect its mission for a century or more to come.
- The replacement of the currently failing Tennessee marble clad envelope with a material that is compatible with the original design of the building, has a life span of 100 years with proper maintenance, and meets requirements for energy performance and insulation.
- Select materials and systems that accommodate the project schedule and cost without increasing risk
- Maintain eligibility of the museum to be added to the National Register of Historic Places
- The replacement of currently outdated utility systems with upgrades that are to be designed and selected to endure for prolonged service timespans, maintainable and serviceable without major renovations.
- The enhancement of the visitor experience with greater accessibility and amenities.

Development History

The Smithsonian’s aeronautical collection was established in 1876 with a group of kites acquired from the Chinese Imperial Commission. In 1946, Congress established a National Air Museum to memorialize the national development of aviation. In 1966, the name of the museum was changed to the National Air and Space Museum to memorialize the development of both aviation and spaceflight. In 1971, Congress passed a funding measure for \$40 million toward the new building.

NASM became an important beacon of cultural and technological innovation in Washington, D.C. when it was added to the promenade of the National Mall in 1976. With the largest collection of historic aircraft and spacecraft in the world, the design of this museum offered both unique architectural opportunities and complex challenges.

In 1965, Hellmuth Obata and Kassabaum Architects (HOK) was commissioned to design the museum and surrounding landscape by the GSA, who at that time managed design and construction of Smithsonian facilities. Lead Architect Gyo Obata aspired to design a building that was in harmony with the character of the National Mall and reflected the architectural elements of the surrounding buildings, while also pursuing modern architectural principles. Through several iterations, Obata explored design ideas including the way the building meets the ground, attention to scale, the interplay between solids and voids, and the relationship to the surrounding buildings on the Mall.

Obata’s solution was skillfully simple: four large marble-clad pavilions, separated by three recessed steel-and-glass atria. Drawing inspiration from neighboring buildings, primarily the National Gallery, Obata reflected formal massing and materials in his design. The alternation of solids and voids are placed and proportioned to respond to corresponding projections and recesses of the West Building of the National Gallery, which sits directly across the Mall. Equivalent volumes face Independence Avenue, but the recessed glass-enclosed bays of the Mall façade have been replaced by floating marble cubes, cantilevered to be flush with the south façade. The volumes are clad in Tennessee Pink marble, as used in the construction of its neoclassical predecessor.

In 1972, the design was approved by the federal review commissions after several revisions, as GSA oversaw the design of SI facilities at that time. Construction began later that year. The museum was opened on July 1, 1976. With this, the project requirements were accomplished by opening in time for the

Bicentennial and within the \$40 million construction budget. The project was awarded with the “anti-golden fleece” prize by Senator William Proxmire in honor of this feat.

The popularity of the museum brought more visitors than anticipated, creating increased impact on certain building systems. The weathering of the building was also accelerated by the limited longevity of certain building components that were downgraded as part of the original construction in order to reduce cost and meet the budget.

The initial building system repairs and replacements began in 1978 with the replacement of the collapsible revolving doors due to concerns regarding emergency egress. Later renovations included the replacement of precast concrete exterior pavers with granite in 1985. The acrylic skylights, which were introduced as a value engineering substitution for the glass enclosure originally proposed, were replaced in glass in 2001 as part of glazing replacement that included the curtain wall and vestibule as well.

The envelope and HVAC studies conducted by Quinn Evans Architects in 2013 determined the stone cladding system is failing, as well as the HVAC systems, which have reached the end of their usable life. Due to the integration of the exterior cladding with the mechanical air distribution system, it is necessary to undertake these upgrades together. Further analysis established that the waterproofing enclosure of the plaza and the main roof are similarly aging and beyond their projected life span.

Historic Preservation

NASM is identified as a contributing building to The National Mall, which was listed on the National Register of Historic Places in 1966 as an historic site. NASM is not currently listed individually on the National Register of Historic Places or the District of Columbia Inventory of Historic Sites. However it is potentially eligible for individual listing. A Determination of Eligibility study for NASM has been initiated by the Smithsonian. At the time of this report the building is 40 years old.

Organization of Report

The remainder of the report is divided into five sections: (1) cladding replacement, (2) paving replacement, (3) appendix a: stone survey, (4) appendix b: global stone research list and stone filtering matrix, and (5) appendix c: cladding and paving aesthetic mockup.

Project Data and Narrative





2.0 TRANSPORTATION MANAGEMENT PROGRAM

Not applicable to this project because the assigned employees are below 500.

3.0 ENVIRONMENTAL DOCUMENTATION

NEPA Compliance  
In accordance with the National Environmental Policy Act of 1969, the Smithsonian Institution has initiated an Environmental Assessment study for the National Air and Space Museum with public and agency scoping meetings having been conducted. NCPC serves as the Lead Federal Agency for this NEPA process. The NEPA scoping meeting was conducted on 12 November 2014. The Draft Environmental Assessment was issued on March 31, 2017. The Environmental Assessment public review period concluded on 1 May 2017.

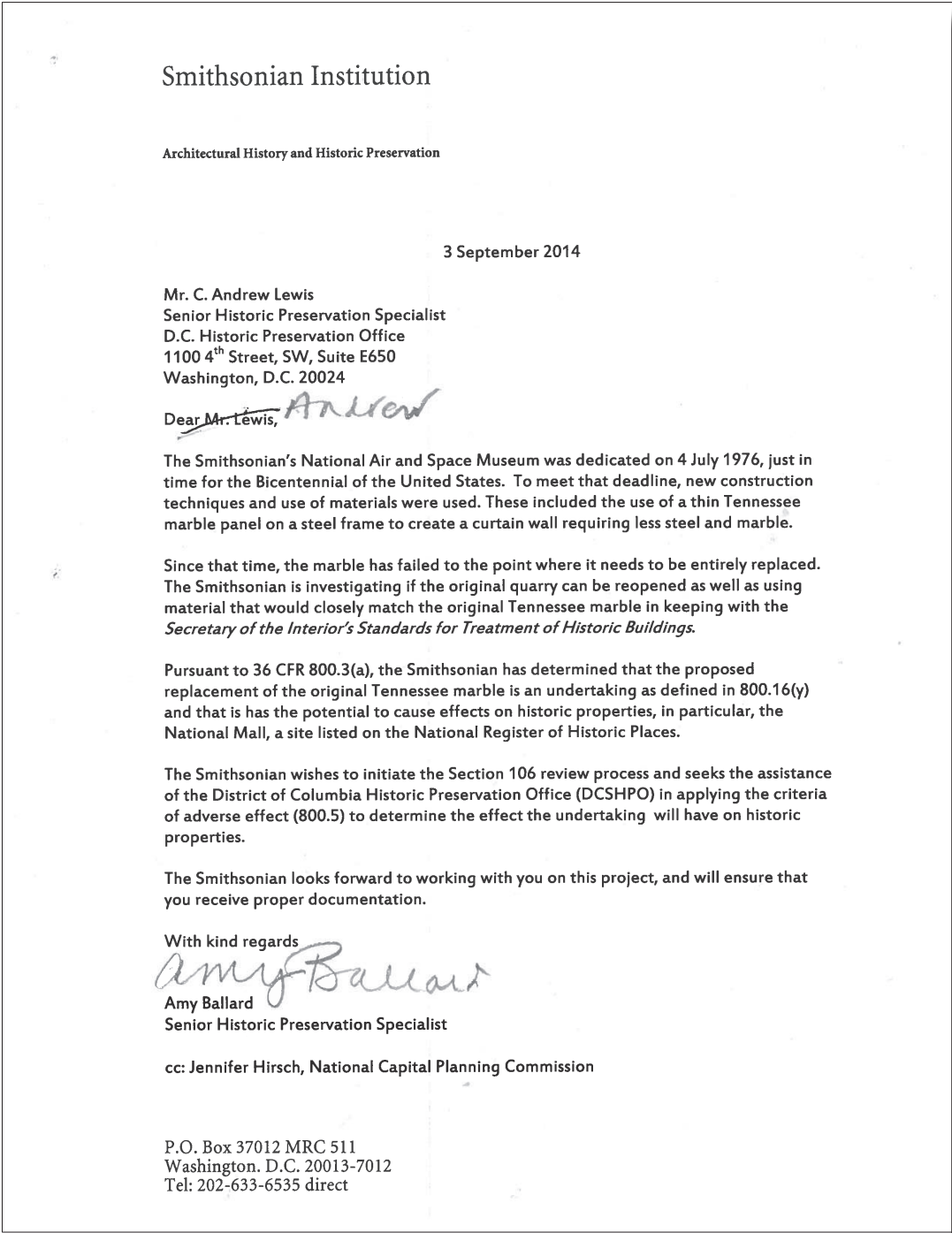
4.0 HISTORIC PRESERVATION DOCUMENTATION

Compliance  
Refer to adjacent letter from the SI office of Architectural History and Historic Preservation that formally initiates the Section 106 process for this project on 3 September 2014. Four meetings with consulting parties have been conducted to date. Additional consultation will be conducted as needed in the future.

5.0 FLOOD PLAINS MANAGEMENT AND WETLANDS PROTECTION

Located Within Floodplain, No Impact on Wetlands  
The north and east portions of the site are within the 100-year (1% annual chance) flood plain as designated by FEMA's 2010 map. This flood plain, with Base Flood Elevation (BFE) +/- 12.5 feet, overlaps the east garage ramp, which serves as the entrance to NASM's loading dock. Mitigation will include waterproofing and a flood wall at the garage entrance ramp that accommodates the 100-year flood plain plus 3 feet per Executive Order 13690.

This project does not impact a wetlands area.



Smithsonian Institution

Architectural History and Historic Preservation

5 September 2014

Mr. C. Andrew Lewis  
Senior Historic Preservation Specialist  
D.C. Historic Preservation Office  
1100 4<sup>th</sup> Street, SW, Suite E650  
Washington, D.C. 20024

Dear Mr. Lewis,

The Smithsonian's National Air and Space Museum is one of the most highly visited museums in the world. Since September 11, 2001 the threat level has increased to the museum, and security was elevated upon entering the museum. These security measures consist of magnetometers and x ray machines manned by security officers.

Presently the security screening is conducted just as one enters the museum at the north and south entry points. In the summer and during school holidays, this creates long lines outside the museum and overcrowding inside. During inclement weather there is no place for visitors to shelter. Moreover there is no transition point between the security screening and the museum.

Pursuant to 36 CFR 800.3(a), the Smithsonian has determined that the proposed addition of security pavilions on the north and south entries to the National Air and Space Museum is an undertaking as defined in 800.16(y) and that it has the potential to cause effects on historic properties, in particular, the National Mall, a site listed on the National Register of Historic Places.

The Smithsonian wishes to initiate the Section 106 review process and seeks the assistance of the District of Columbia Historic Preservation Office (DCSHPO) in applying the criteria of adverse effect (800.5) to determine the effect the undertaking will have on historic properties.


The Smithsonian looks forward to working with you on this project, and will ensure that you receive proper documentation.

With kind regards  
*Amy Ballard*  
Amy Ballard  
Senior Historic Preservation Specialist

cc: Jennifer Hirsch, National Capital Planning Commission

P.O. Box 37012 MRC 511  
Washington, D.C. 20013-7012  
Tel: 202-633-6535 direct

GOVERNMENT OF THE DISTRICT OF COLUMBIA  
STATE HISTORIC PRESERVATION OFFICER



October 3, 2014

Ms. Amy Ballard, Senior Historic Preservation Specialist  
Smithsonian Institution  
Architectural History and Historic Preservation  
P.O. Box 37012 MRC 511  
Washington, DC 20013-7012

RE: Initiation of Section 106 Consultation; National Museum of Air & Space Façade Replacement Project

Dear Ms. Ballard:

Thank you for formally initiating consultation with the District of Columbia State Historic Preservation Officer (SHPO) regarding the above-referenced undertaking. We are writing in accordance with Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800, to provide our initial comments regarding effects on historic properties.

As you are aware, the National Air & Space Museum is a contributing element of the National Register of Historic Places-listed National Mall Historic District. Based upon our review of the project submittal and our participation in the site visit and informal discussions held on June 17<sup>th</sup> and September 22<sup>nd</sup> of this year, we understand that the original, Tennessee marble panels that make up the exterior façades – and the museum's most prominent character-defining feature – are failing to the point that they must be completely replaced. Repair/reuse of the original marble is not an option because the panels are very thin and much of the deterioration consists of significant warping. However, we are encouraged that the Smithsonian Institution is actively investigating the possibility of reopening the original quarry and acquiring matching stone to complete the project. Since this approach has the potential to completely avoid adverse effects, we strongly encourage *in-kind* replacement if at all possible. Alternative materials such as granite, metal or synthetic panels are likely to result in adverse effects on the museum and the surrounding historic district.

Please keep us posted as more is learned about the possibility of obtaining matching marble panels. In the meantime, we look forward to continuing consultation with the Smithsonian Institution and other parties, including assisting in the preparation of an Area of Potential Effect (APE) and an initial list of potential consulting parties. If you should have any questions or comments regarding this matter, please contact me at [andrew.lewis@dc.gov](mailto:andrew.lewis@dc.gov) or 202-442-8841. Otherwise, thank you for providing this initial opportunity to comment.

Sincerely,  
*Andrew Lewis*  
C. Andrew Lewis  
Senior Historic Preservation Specialist  
DC State Historic Preservation Office

14-433  
cc: Jennifer Hirsch, NCPCH

1100 4<sup>th</sup> Street, SW, Suite E650, Washington, DC 20024 Phone: 202-442-7600, Fax 202-442-7637





PREVIOUS NCPC COMMENTS ON CLADDING:

July 2016 Concept Submission of Vestibules and Site Improvements:

(NCPC) “Recommends that the applicant continue to work closely with NCPC, the U.S. Commission of Fine Arts, and the District of Columbia State Historic Preservation Office to identify an appropriate cladding material that meets the performance criteria. If Tennessee Pink Marble, the original stone, is determined to be infeasible, consider ways to achieve a seamless transition between the exterior cladding and the interior stone treatment, and to avoid, minimize, or mitigate adverse effects on the National Air and Space Museum Building and the National Mall Historic District.”

April 2017 Comments on Informational Briefing and Mockup Site Visit:

Commissioners who visited the mockup in the rain commented during the Informational Briefing on the value of having the mockup to evaluate cladding options but varied in their preferences and dislikes. Several commissioners favored the Ultra High Performance Concrete, several found the Echo Lake Granite to be too busy, and one suggested that Tennessee Pink be considered if technical and cost issues could be resolved. The Commission expressed flexibility regarding manmade vs. natural stone as well as emphasizing the criterion of an inherently beautiful material over that of matching the National Gallery of Art. The Colonial Rose (Lac Du Bonnet) granite was not part of the mockup seen on April 6, 2017.

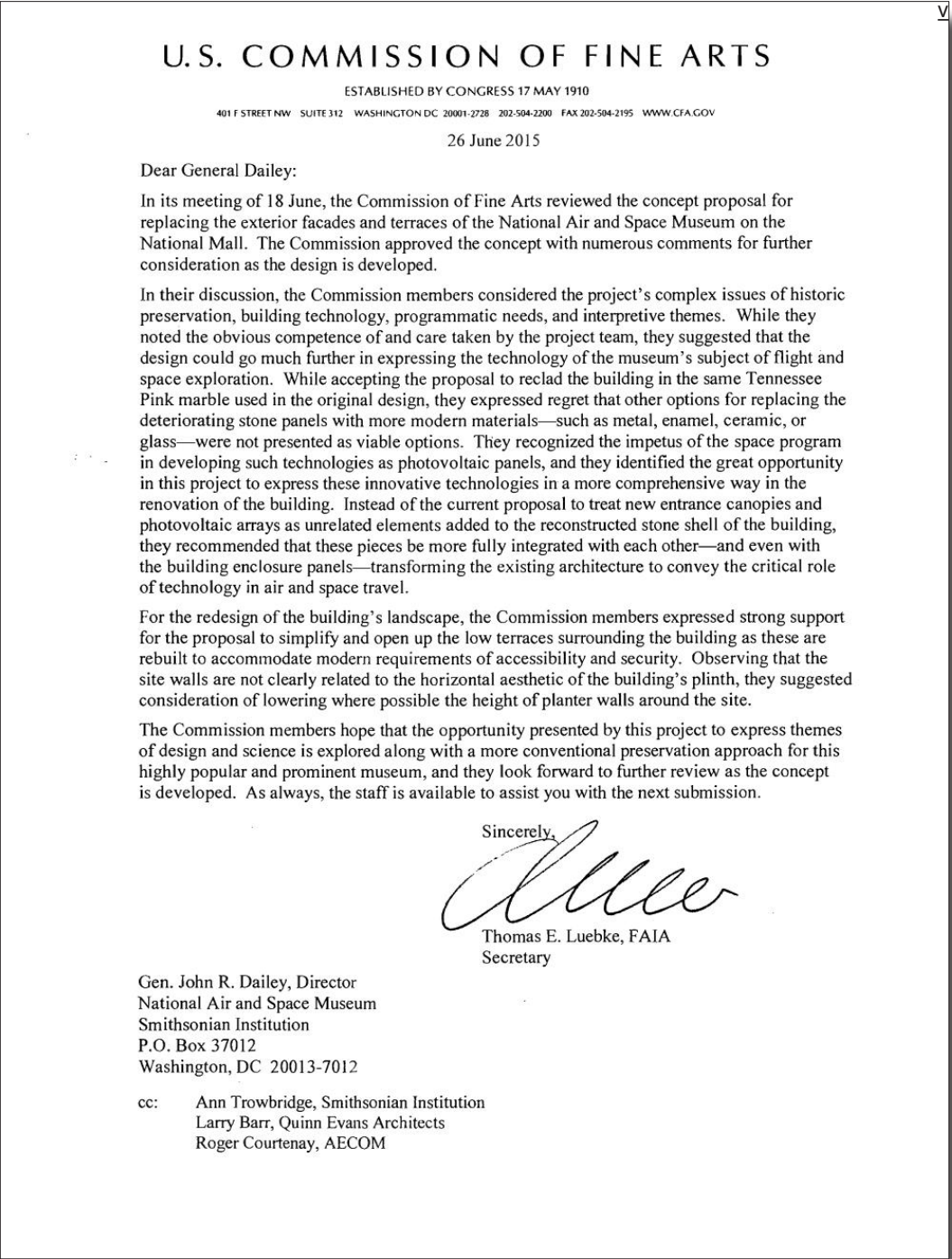
JUNE 2015 COMMISSION OF FINE ARTS CONCEPT HEARING

Following several months of consultation from agency staff, a concept report and presentation was provided in June 2015 of the following scope items for the NASM revitalization project:

- Terrace
- Vestibules
- Envelope Replacement
  - Stone Cladding
  - Glazing
  - Roof Solar Panels
  - Solar Wall

COMMISSION OF FINE ARTS CONCEPT APPROVAL

The concept proposal was granted concept approval for all aspects of the scope, with comments providing direction on how to advance the design. The letter from the Commission of Fine Arts is included on this page for reference.



JUNE 2016 COMMISSION OF FINE ARTS CONCEPT HEARING

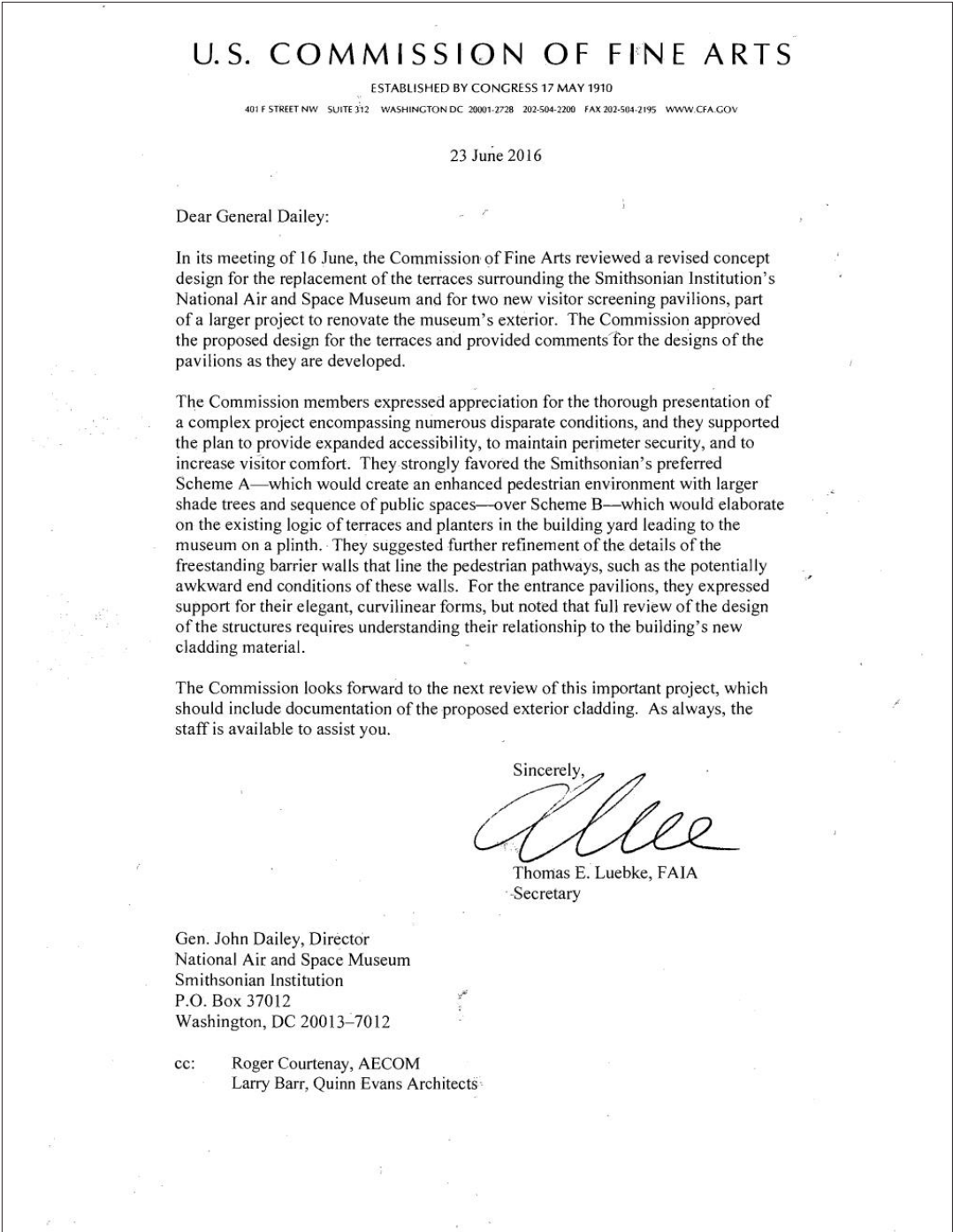
Following several months of consultation from agency staff, a revised concept report and presentation was provided in June 2016 of the following scope items for the NASM revitalization project:

- Terrace
- Vestibules

COMMISSION OF FINE ARTS CONCEPT APPROVAL

The revised concept proposal was granted concept approval for site design Scheme A and the updated vestibules, with comments providing direction on how to advance the design.

The letter from the Commission of Fine Arts is included on this page for reference. The request from the Commission to present the proposed exterior cladding is documented in this report.



CFA Revised Concept Approval

Smithsonian Institution  
National Air and Space Museum



The project has been developed with an ongoing application of due diligence. This includes an extensive consultation program with the federal design review agencies, as well as multiple risk analyses and third party technical reviews. This process began with the initial building studies, and will continue through the completion of design and documentation.

A summary of the project development and consultation milestones completed to date is outlined here for reference. Consultation with federal design review agencies is highlighted in **bold** font.

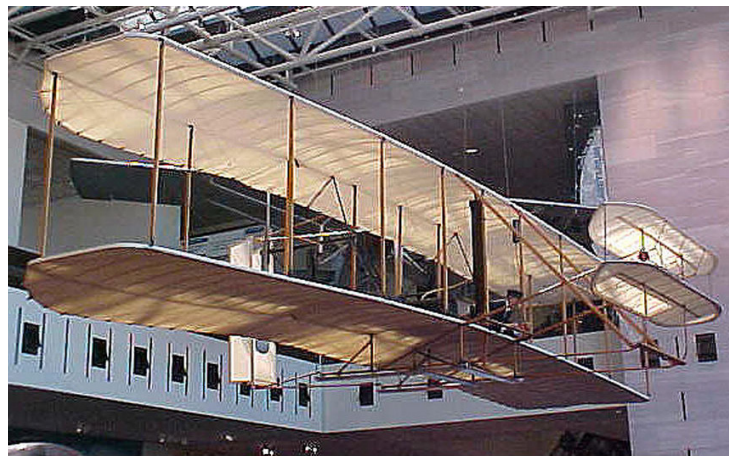
- October 18, 2013 – Final building envelope study by Quinn Evans Architects
- December 18, 2013 – Final feasibility study by Quinn Evans Architects
- March 10, 2014 – Peer review report/study validation by Jacobs/WJE
- **June 17, 2014 – site visit & informational presentation of NASM master plan and Envelope feasibility study in preparation for July 10, 2014 NCPC and July 17, 2014 CFA meetings.**
- **September 5, 2014 – SI HP letter to DC HPO to formally initiate Section 106 process. Acknowledged by October 3, 2014 letter from Andrew Lewis of DC HPO.**
- **November 12, 2014 – Agency and public scoping meetings.**
- **January 15, 2015 – EA Alternatives Presentation to NCPC Staff**
- **June 15, 2015 – Concept Presentation to CFA Commissioners**
- **January 12, 2016 – Agency staff consultation (with all, at NASM)**
- **February 9, 2016 – Agency staff consultation (with all, at NASM, including viewing of onsite cladding options)**
- **February 12, 2016 – NCPC Staff consultation in preparation for Consulting Parties**
- **February 22, 2016 – Consulting Parties session (at NCPC)**
- March 14, 2016 – Receipt of preliminary WJE/Jacobs Stone Feasibility Report
- **April 14, 2016 – Agency staff consultation (with all, at CFA)**
- **June 16, 2016 – Revised Concept Presentation to CFA Commissioners**
- **July 7, 2016 – NCPC Commissioners’ site tour & Concept Presentation**
- July 25, 2016 – Receipt of final WJE/Jacobs Stone Feasibility Report
- **October 17, 2016 – Agency staff consultation & viewing of updated cladding options (with all, at NASM)**
- **March 30, 2017 – Agency staff consultation & viewing of updated cladding options (with all, at NASM)**
- **April 6, 2017 – NCPC Commissioners’ site visit & Informational Briefing**
- **April 7, 2017 – Section 106/Consulting Parties Public Meeting**
- **April 20, 2017 – CFA site visit & Informational Briefing**
- April 21, 2017 – Receipt of WJE/Jacobs Stone Testing Report (with full results of Tennessee Marble battery of stone tests)
- **May 19, 2017 – DC HPO staff site visit & consultation**
- **May 22, 2017 – NCPC/CFA staff site visit & consultation**
- **June 8, 2017 – Section 106/Consulting Parties Meeting - viewing of additional stone**

Consultation Milestones and Associated Dates



This page intentionally left blank





Cladding Replacement Narrative	21
Cladding Selection Criteria Matrix	23
Existing and Proposed Stone Cladding Replacement Details	24
June 2016 Revised Concept CFA Report and Commission Response	25
Cladding Alternates	26
- Tennessee Pink Marble	28
- St. Clair Limestone	29
- Echo Lake Granite	30
- Colonial Rose (aka Lac Du Bonnet) Granite	31
Colonial Rose Granite Cladding Selection and Visualizations	32

Table of Contents



This page intentionally left blank



### 1.2.3 CLADDING REPLACEMENT

This section summarizes the need for and methodology of the replacement of the stone cladding wall assembly, as well as the incorporation of sustainability initiatives within the revitalized building envelope.

The revitalization of NASM will involve significant improvements to the building envelope systems (water, air, thermal, and vapor barriers) and require modifications to all of the building envelope components, including the exterior cladding, curtain walls, skylights, and roofing. This renovation project presents tremendous opportunities to improve the overall envelope performance through establishing water, air, thermal, and vapor barrier continuity. This will have significant impact on building energy use, provide appropriate system durability / service life, and establish NASM as a model for sustainable design.

#### 1.2.3.1 STONE CLADDING REPLACEMENT

##### Original Design and Existing Conditions

The existing exterior walls consist of a 1 1/4" (32mm) thick Tennessee Pink Marble barrier wall system with backer rod and sealant filling the joints between 2'-6" (610mm) tall x 5'-0" (1220mm) wide panels and spray applied urethane foam insulation covering the back of the stone. A vertical plenum within the wall cavity provides air flow through the interstitial space.

The stone facade must be removed for several reasons. Extensive warping ("hysteresis") and cracking is irreversible as exacerbated by the spray-foam insulation applied to the back of the stone panels, introducing a risk that some of the stone panels could fall from the building; temporary protection has been installed where needed to protect people from this risk. The existing exterior wall construction does not

provide adequate resistance to water penetration or air infiltration. It also lacks effective flashings and does not include any means for air barrier continuity between the exterior walls and other building envelope systems (curtain wall, skylight, roofing, or soffits). Further, the reintroduction of mechanically-controlled humidification will create significant potential for condensation within the wall cavities inboard of the exterior wall assembly (particularly those used as return air plenums for the HVAC system) and this will drive certain design decisions related to the exterior wall concept.

##### Envelope Performance Criteria

The exterior wall assemblies must meet the following performance criteria:

- Provide the durability of a 100 year envelope with proper maintenance
- Prevent water infiltration
- Provide a continuous air barrier
- Minimize the potential for moisture accumulation within the exterior wall assembly and condensation, while maintaining interior operating conditions
- Provide thermally broken cladding attachment system to prevent condensation within the wall
- Provide blast resistance and limit fire propagation
- Provide the longest service life possible

##### Cladding Material Option Analysis

The analysis of cladding options included consideration of a wide range of options in order to find the material that best suits the extensive performance criteria. Both natural and manufactured panel systems were studied, with metallic, ceramic, stone, and composites reviewed among others along the way. Whereas many progressive systems provide the desired longevity,

that was only one of many requirements that must be met. The unique nature of the building context was both inspiring and demanding of a material that not only meets technical standards, but numerous design objectives and regulatory requirements as well. Ultimately, the selection will be based on the material that appropriately meets the longevity, performance, stewardship, and mission criteria.

In order to preserve NASM's eligibility for potential future listing in the National Register of Historic Places per project requirements, the revitalization project must maintain the existing character of the building. Thus the design intent is to implement stone cladding with the facade replacement with a similar appearance to the original stone cladding installation.

Current analysis has indicated that 3" thick limestone or 2" thick granite provides the desired balance of strength and weight, while offering an enclosure system that can be expected to meet the targeted lifespan requirements. The additional thickness also permits increased allowances for anchorage positioning within the panel thickness which in turn translates to increased construction tolerances.

## Cladding Replacement Narrative



Stone Cladding Options

Over 80 different stones and numerous manufactured materials were analyzed in the search for the most suitable cladding replacement. This included a risk analysis of the procurement of Tennessee Pink Marble relative to alternate stone materials per due diligence. Both the original stone and the replacement candidates were evaluated based on extensive criteria including aesthetics, technical performance, procurement, and risk. From this process, numerous alternates have been identified, all of which have a slightly different appearance than the existing.

Excerpts from the evaluation of the broader range of materials initially considered is documented in Appendices A and B, located at the end of this report.

The criteria for the cladding replacement material includes aesthetic, technical, and procurement objectives.

- Aesthetic
- Provide a material with a warm tone
  - Provide a material that has a limited veining pattern
  - Provide a material that has tonal variation among adjacent panels
  - Provide a material that has a mineral composition
  - Provide a material that has a monumental appearance appropriate for application on the National Mall
  - Provide a material that has limited visual contrast relative to the existing interior stone to remain
  - Provide a material that supports the original design concept

- Technical
- Provide a material that supports a 100 year envelope with proper maintenance
  - Provide a material that is suitable for application on a light steel framed building without masonry backup
  - Provide a material that is resistant to pollutants, surface mold and algae growth

- Procurement
- Provide a material that is quarried within North America and fabricated within the United States
  - Maintain the eligibility of the building to be added to the National Register of Historic Places

- Risk
- Material to be available in a sufficient quantity that can be extracted at a rate that accommodates the construction schedule

From an aesthetic perspective, a limited number of alternates have a striated pattern that closely resembles the sedimentary nature of Tennessee Pink Marble. Other alternates have been identified which have a warm color tone similar to Tennessee Pink Marble. However an alternate stone has not been identified which has both the linear veining pattern and the warm tone of Tennessee marble as installed on the building. Tonal variation among adjacent panels was also considered in the analysis of cladding options as it helps modulate the facade for a more human scale, articulating the existing volumetric stone clad pavilions that are otherwise void of architectural ornamentation.

The technical aspects of the replacement cladding are also of significant importance to help ensure the sufficient durability and mitigate the risk of the performance issues evident with the existing installation. Although the development of the wall assembly details can be based on the design criteria as informed by petrographic analysis and performance mockup testing, one of the most effective methods of predicting how it will perform long term is based on the performance of similar installations on other buildings through the study of exemplar projects. The study of exemplars has shown that limestone cladding performs adequately when installed on a wall assembly with masonry back for thermal mass. Unfortunately the introduction of a masonry backup is cost-prohibitive with the NASM revitalization project due to the subsequent need for extensive reinforcement of the existing structural frame and foundation, as it was originally designed for the light steel cladding support system per the existing condition. This was considered when analyzing the various cladding replacement options.

Cladding Replacement Narrative





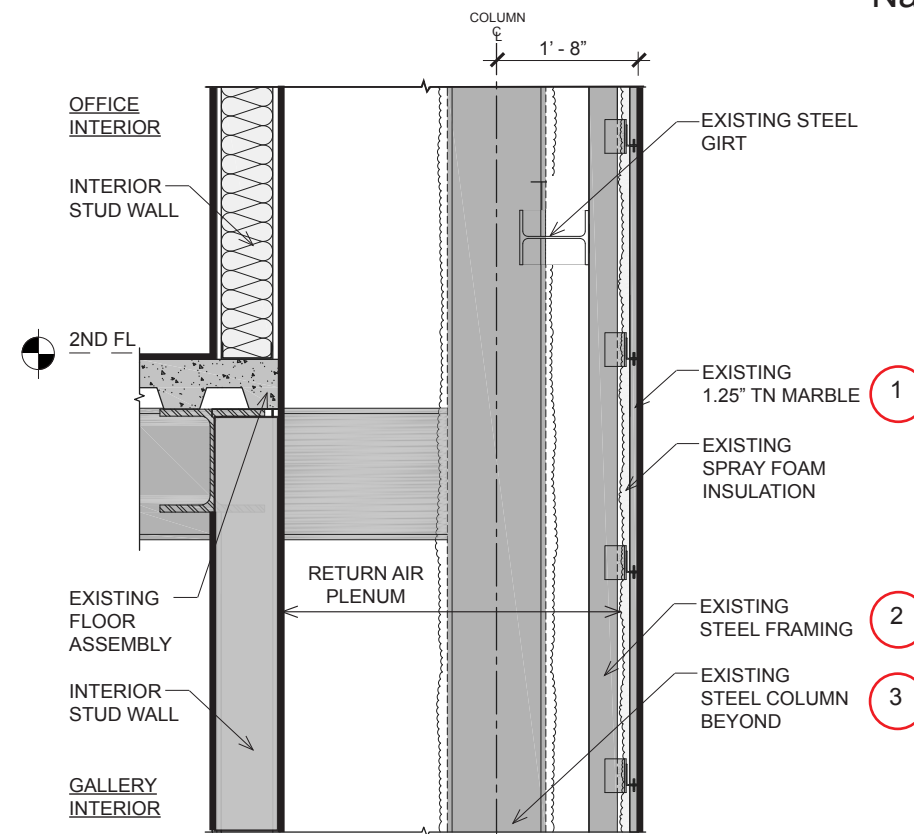
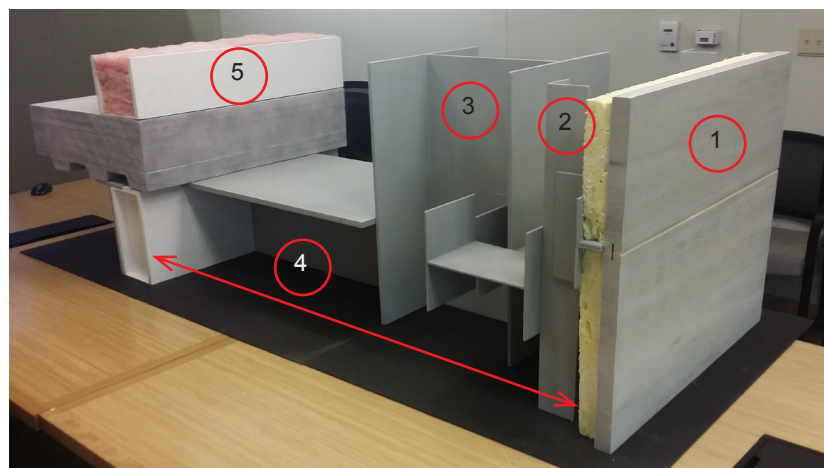
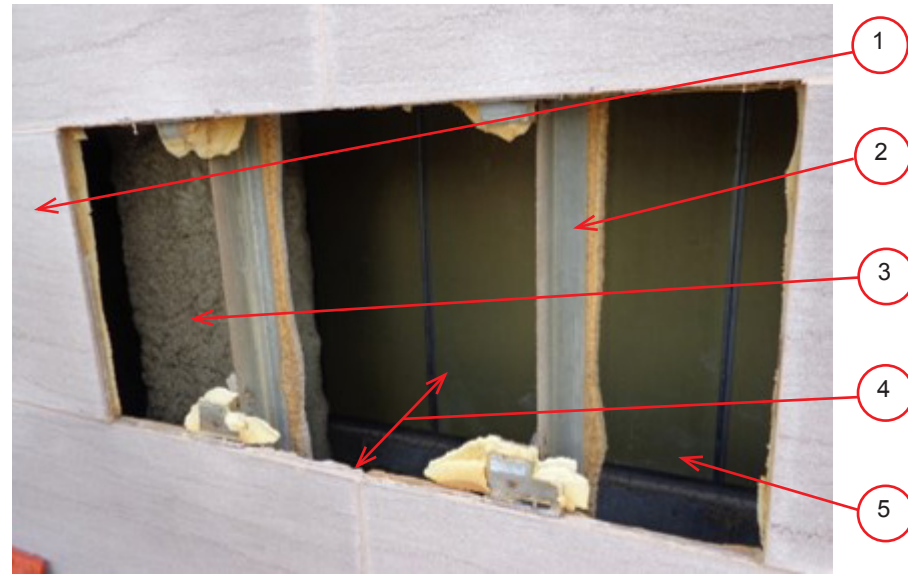
Material	Tennessee Marble		Saint Clair		Echo Lake	Colonial Rose
		The original material currently on the NASM Mall Building, this stone has a distinctive color and varied horizontal veining well-suited to the massing and architectural style of the building. Selection of this material today would require the quarry to restart production and develop new quarries, resulting in increased upfront and material costs and risk of reduced quality control and color range. The thickness will need to be 3 inches to ensure longevity and durability.**		Considered by a number of observers to be too gray and monotone in the mockup, this stone could be finished differently and the color span broadened to lighten the range, which is more compatible with neighboring buildings along Independence Ave. The consistency of the horizontal veining and quality control in the mockup is impressive. Similar to Tennessee Marble, the thickness will need to be 3 inches to ensure longevity and durability.**	This stone is readily available and shows a high degree of tonal variation and movement. However, the material may be too decorative for the simple architectural style of the building. There is some ability to obtain a tighter range to reduce gray swirls. Quality assurance can be driven by an available lay down area. This stone is also stronger than Tennessee Marble and therefore can be used in a 2-inch minimum thickness to ensure longevity and durability.	Currently not part of the larger mockup, with a similar color tone to Tennessee Marble, but quite different in texture and is readily available. This stone is somewhat grayer and darker in tone than Tennessee marble, but warmer than the other stones considered. Quality assurance can be driven by an available lay down area. This stone is also stronger than Tennessee Marble and therefore can be used in a 2-inch minimum thickness to ensure longevity and durability.
Type		Limestone		Limestone	Granite	Granite
Aesthetics						
Maintains Existing Stone Character		Closest (Tone and Texture)		Similar (Texture Only)		Similar (Tone Only)
Color Range (Panel to Panel)		Good		Limited		Some
Texture / Banding		Striations		Striations		Variegated with Large Dark Swirls
Tonal Warmth		Yes		Limited		Yes
Finish		Bush Hammered (one step)		Light Water Jet / Sand Blast (two step)		Sand Rubbed (one step)
Technical						
Full Fabrication Infrastructure (in place as of today)		No		Yes		Yes
Ability to Meet Project Schedule / Construction Rate		No		Yes		Yes
Recovery Rate (% Yield) Anticipated		10-25%		25-30%		20-25%
Quality Control (QC) of Panel Materials		Significant Additional QC Required		Least Complicated		Some Complication (Tighter Range Required)
Quarry Site Lay-Down* Area Available		No		Yes		Yes
Procurement						
Location of Quarry (within/beyond 500 miles)		Within (Friendsville, TN)		Beyond (Marble City, OK)		Beyond (Ely, MN)
Location of Production (within/beyond 500 miles)		Within (Friendsville, TN)		Beyond (Tate, GA)		Beyond (Cold Spring, MN)
Risk						
Schedule Impacts (QC / Yield / Constructability)		High		Low		Low
Availability of Acceptable Material & Range		Uncertain		Certain		Uncertain
Durability (100 year material lifespan)		Good**		Good**		Good
Available for Future Selective Replacement		Fair		Good		Fair
Analysis						
Acceptable		8		9		7
Requires Further Consideration		2		5		8
Not Ideal		6		2		1
General Notes						

Capacity assumed good at all quarries. Available variation to be confirmed through further analysis of stones other than Tennessee Marble; this impacts recovery rate.  
\* Lay-down area refers to controlled space at the quarry that is large enough to assemble one entire NASM stone facade bay.  
\*\* No long-term precedent of these materials in a rain-screen, steel frame construction installation in a similar climate.



# Cladding Replacement

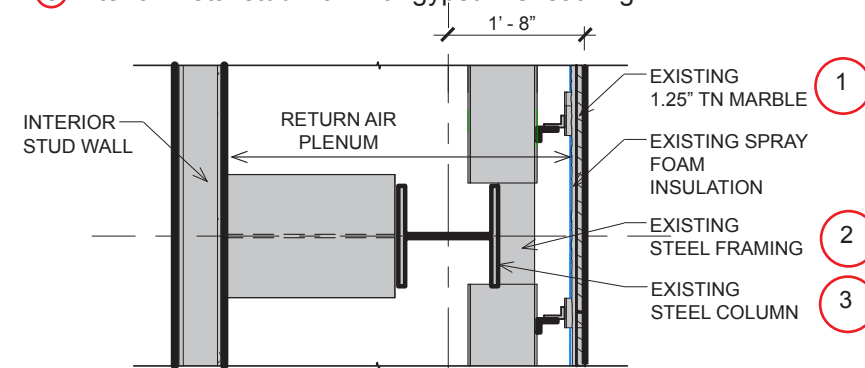
## National Mall Building Envelope and HVAC Revitalization



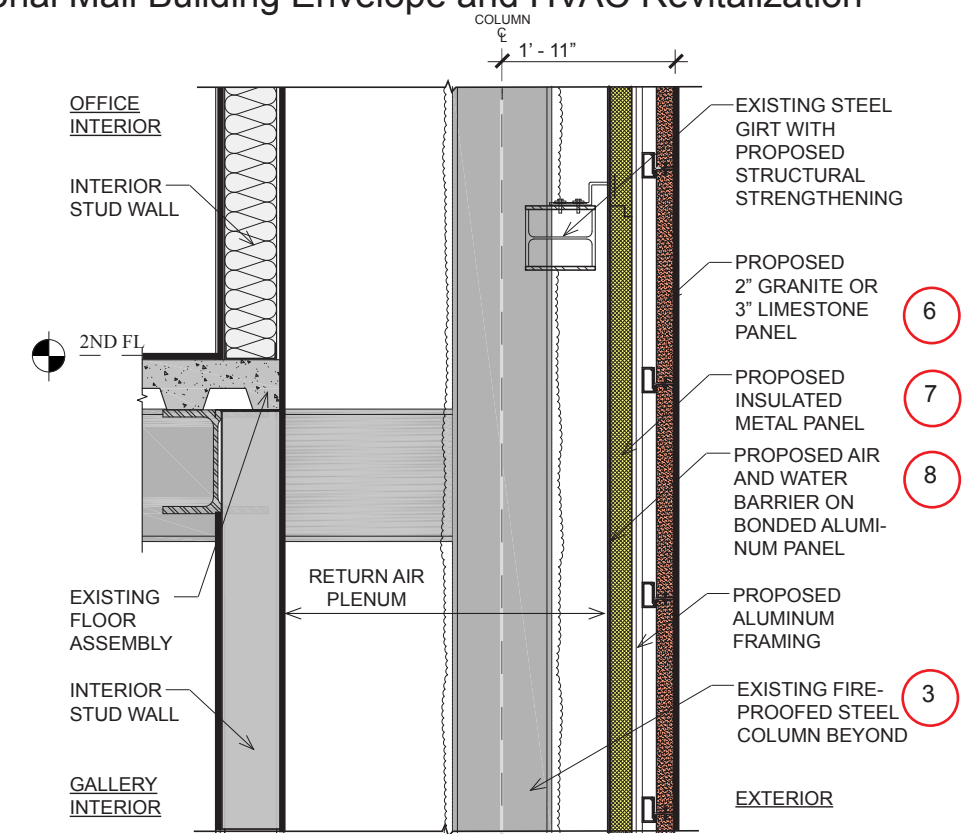
Existing Wall Section

The typical exterior wall construction consists of the following from exterior to interior:

- ① 1.25" Tennessee Pink Stone panels with spray foam insulation
- ② Steel framing
- ③ Steel column
- ④ Air Cavity (Return Air Plenum)
- ⑤ Interior metal stud wall with gypsum sheathing



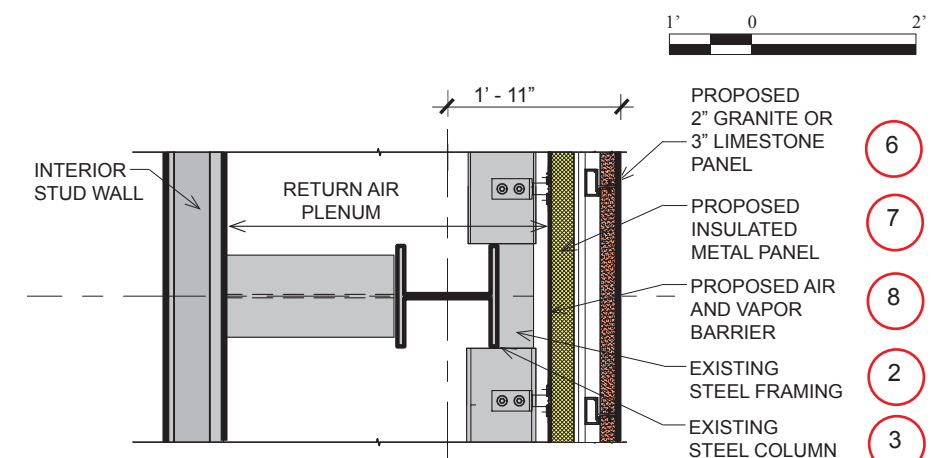
Existing Plan Detail



Proposed Wall Section

Proposed new wall construction consists of the following upgrades from exterior to interior:

- ⑥ Proposed 2" Granite or 3" Limestone Panel
- ⑦ Proposed Insulated Metal Panel
- ⑧ Proposed Air and Water Barrier (Rain Screen)



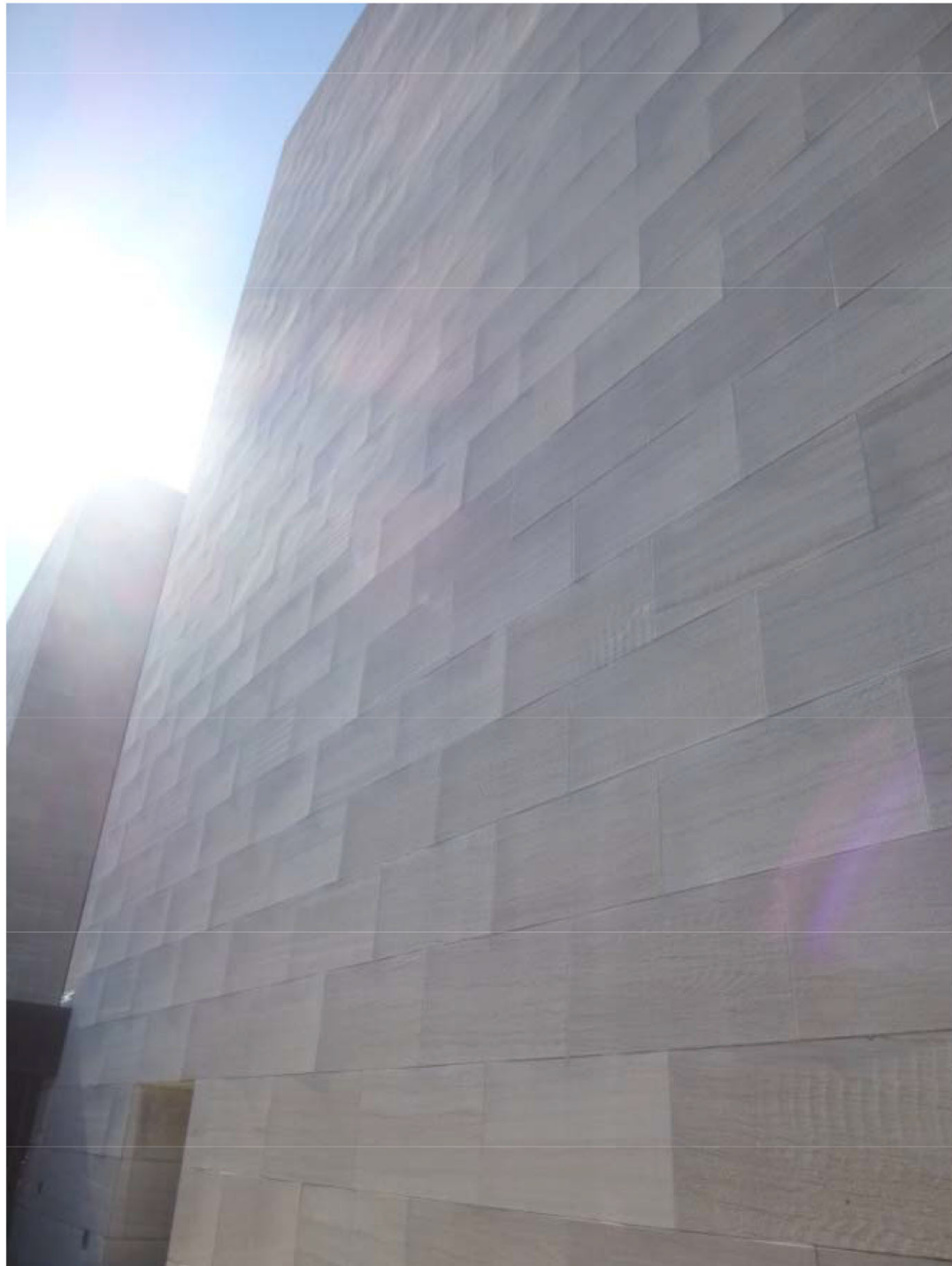
Proposed Plan Detail

## Existing and Proposed Stone Cladding Replacement Details



Smithsonian Institution  
National Air and Space Museum





Warped Stone Panels on North Facade

**Comments from the Commission of Fine Arts, Revised Concept Design**

“For the entrance pavilions, [the Commissioners] expressed support for their elegant, curvilinear forms, but noted that full review of the design of the structures **requires understanding their relationship to the building’s new cladding material.** The Commission looks forward to the next review of this important project, **which should include documentation of the proposed exterior cladding.**”

From the letter, June 23, 2016, from Thomas E. Luebke, FAIA, Secretary

**Smithsonian Institution Consideration of CFA Comments**

The Smithsonian has addressed the comments of June 16, 2016 with the following actions:

- This report summarizes the analysis of the numerous different material options for the basis of a proposed cladding selection.
- The proposed cladding selection is shown in a composition with the proposed north vestibule on page 31. The further development of the vestibules will be documented in a forthcoming report dedicated to overall exterior design development.
- There has been an exploration of more than 80 different alternate stone and manufactured cladding options to find the most suitable replacement to the Tennessee marble of the existing building.



Warped Stone Panels on West Facade

The photos on this page document hysteresis, or warping, of the existing stone cladding. This process was exacerbated by the application of spray foam insulation on the back face of the exterior stone panels, which trapped moisture at the interface with the insulation. Exposure to the exterior allowed water to evaporate, causing differential expansion conditions within the section of the facade material.

**June 2016 Concept CFA Report and Commission Response**







Tennessee Pink Marble



Alternate Stone

The analysis of cladding alternates included consideration of a wide range of options in order to find the material that best suits the extensive performance criteria. The images shown here are renderings of the museum based on a photograph of the southwest elevation, with a digital application of scanned images of the various materials.

The Tennessee Pink Marble rendering represents a replacement of the existing stone cladding with a thicker panel. Among the alternate stones being considered are materials that have a similar pattern or tone to Tennessee Pink Marble, as well as numerous technical advantages. The curtain wall jamb detail could be developed to help mitigate the visual contrast between the new exterior cladding and the existing Tennessee marble to remain on the interior of the north atrium galleries.



Titanium



Ultra High Performance Concrete

The analysis of man-made materials included the study of ceramic and titanium panels among others. Both materials offer a substantial duration of usable life, but do not meet the performance criteria for 100 years. Although there is a benefit of using such lightweight materials that include contemporary, technological associations similar to that of the exhibits within the museum, their monochromatic appearance lacks the visual randomness and scale-giving modulation of the existing cladding. Further, a man-made material would significantly alter the character of the building, and was considered the least desirable option by the DC HPO and the Smithsonian's preservation office.

## Cladding Alternates





Following the analysis of over 80 different stones and numerous manufactured materials, a list of four different cladding options was identified as the most worthy of consideration as the selected material based on the extensive criteria noted on the previous pages in this report.

A summary of each of the four short-listed cladding materials is documented in this section, including the information and images listed below.

- Advantages and Disadvantages -- based on aesthetic, technical, and procurement criteria
- Detail Photo -- image provides an indication of the appearance of the material as photographed at close range, formatted not to scale
- Photomontage -- digital representation of an 80' x 80' facade (approximate dimensions of the northern half of the NASM east elevation), based on photos of the applicable stone panels used in the cladding aesthetic mockups installed at NASM
- Comparable Examples -- photos of similar installations are provided where applicable; in some cases, "other examples" are referenced in lieu of a relevant precedent
- Quarry Photo -- shows an areas where at least some of the material would be extracted

CLADDING OPTIONS CONSIDERED:

Tennessee Pink Marble

The existing cladding on the museum offers aesthetic benefits, however the failing state of the installation is indicative of its technical limitations as exacerbated by the existing wall assembly. Whereas the technical limitations could be mitigated with proper detailing, an exemplar installation has not yet been identified that demonstrates the successful long term performance of Tennessee marble on a steel frame without masonry backup as would be required with the cladding replacement at NASM. Acquiring new Tennessee marble may impact the project schedule.

St. Clair Limestone

The horizontal veining pattern for St Clair limestone is similar to that of Tennessee Marble, and available at relatively lower risk to schedule impacts. However the lack of a warm tone similar to Tennessee marble was noted during the agencies' review of the cladding aesthetic mockup. St Clair is available with a beige tone (as integrated into the photomontage, but not in the aesthetic mockup), however there would not be sufficient quantity to clad the entire museum with beige St Clair. As a limestone, St Clair has technical disadvantages as a rain screen cladding relative to granite.

Echo Lake Granite

As a granite, Echo Lake offers the advantages of a material that is more dense and durable than limestone in a rain screen cladding application. Due to its warm tone similar to Tennessee marble, a limited number of Echo Lake panels were installed in the NASM facade in 2014 as a replacement for existing cladding panels with a substantial degree of visual integration when seen from a distance. However the pronounced flueri pattern and broad range of color that would be required when applying Echo Lake to the entire facade due to the availability creates a significant amount of variegation.

Colonial Rose (aka Lac Du Bonnet) Granite

Colonial Rose combines the technical advantages of granite, with the aesthetic benefit of a warm tone that is void of a pronounced fleuri pattern. It was recently installed across the National Mall from NASM at the National Gallery of Art East Building roof terrace in a planter wall cladding and paver application in lieu of Tennessee marble. Although it is typically installed with consistent tone and pattern, tonal variety and accent color bands are available to help establish the visual modulation of the existing facade as an important characteristic of the original design.

CLADDING OPTIONS CONSIDERED AND DISMISSED:

Ultra High Performance Concrete (UHPC)

UHPC was installed in the cladding aesthetic mockup as the only manufactured material, but was later dismissed due to numerous concerns, and thus is not included in the following pages of cladding replacement options summary. The capability to reuse a portion of the existing Tennessee marble cladding as a non-structural aggregate was an advantage with UHPC, in addition to substantial durability, high density, and customizable color and tone. However, this material is relatively new with a longevity that is promising but as yet unproven as a 100 year rain screen cladding. Further, the replacement of the existing stone cladding with a manufactured material was objectionable among some of the design review agencies with preservation concerns, and may not be compatible with monumental, iconic buildings on the National Mall. Additional quality control requirements were also considered problematic.

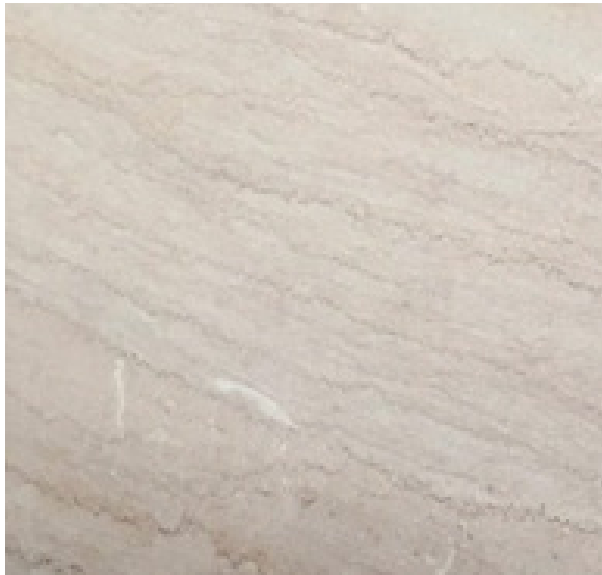
Cladding Options Introduction





# Cladding Replacement Options

## National Mall Building Envelope and HVAC Revitalization



Tennessee Marble Panel



Tennessee Marble Photomontage

### Advantages:

- Matches existing exterior cladding in kind (warm color tone and fine linear veining pattern modulates scale of monolithic façade) and intended to match National Gallery of Art West Building
- Matches existing interior wall cladding that will remain
- High density, durable limestone (100+ year stone longevity when installed with 3” thickness and properly detailed wall section)

### Disadvantages:

- Procurement will include time for quarry start-up and longer fabrication schedule
- Broad color range requires more extensive quality control
- Requires less aggressive cleaning process to avoid surface damage
- Less resistant to pollutants, and surface mold and algae growth
- Fabrication facility does not have space available for on-site dry lay of facade



Comparable Example: National Gallery of Art East Building on the National Mall in Washington, DC, Opened in 1978, Sandblasted Finish



Recently expanded Tennessee Pink Endsley Quarry in Friendsville, Tennessee

## Tennessee Pink Marble



Smithsonian Institution  
*National Air and Space Museum*

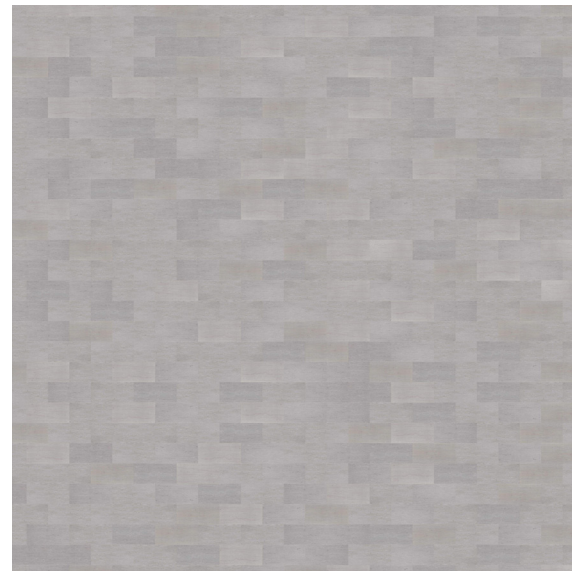


## Cladding Replacement Options

### National Mall Building Envelope and HVAC Revitalization



St Clair Sample



St Clair Photomontage

#### Advantages:

- Fine, linear veining pattern comparable to Tennessee marble
- High density, durable limestone (100+ year stone longevity)
- Fabrication facility has space available for on-site dry lay of facade

#### Disadvantages:

- Light grey color tone is too grey and not appealing for the large areas of stone involved on the NASM exterior facade
- Less resistant to pollutants, and surface mold and algae growth
- Requires less aggressive cleaning process to avoid surface damage



Comparable Example: Pioneer Building in Oklahoma City, Oklahoma, Opened in 1906, Sandblasted Finish



St Clair Quarry in Marble City, Oklahoma

## St. Clair Limestone



Smithsonian Institution  
*National Air and Space Museum*





Echo Lake Sample



Echo Lake Photomontage

Advantages:

- Warm tone (when dry) comparable to Tennessee marble
- High density, durable granite (100+ year stone longevity)
- Best cost value
- Resistant to pollutants, and surface mold and algae growth
- Allows more aggressive cleaning process
- Fabrication facility has space available for on-site dry lay of facade

Disadvantages:

- Fine, linear veining pattern not present (busy swirling texture that is less compatible with interior Tennessee Pink)
- Broad range of color and pattern requires more extensive quality control
- Darkens considerably when wet



Other Example: Granite Community Bank in Cold Spring, Minnesota, Opened in 2003, Sandblasted Finish



Echo Lake Quarry in Ely, Minnesota

Echo Lake Granite



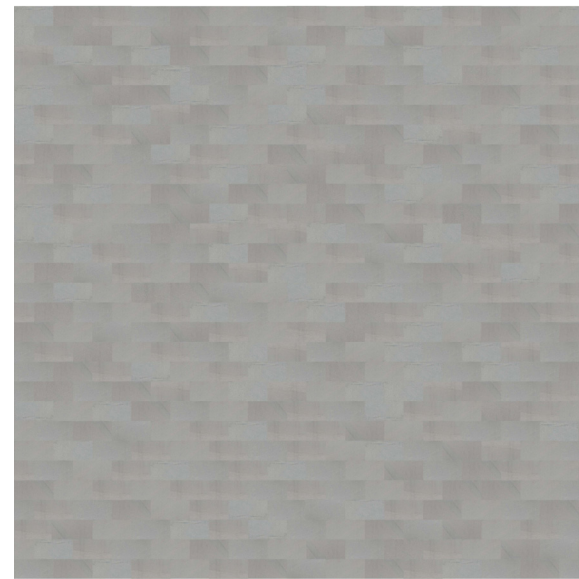


## Cladding Replacement Options

### National Mall Building Envelope and HVAC Revitalization



Colonial Rose Panel, National Japanese American Memorial



Colonial Rose Photomontage

#### Advantages:

- Warm tone comparable to Tennessee marble
- High density, durable granite (100+ year stone longevity)
- Local precedent on the National Mall; installed at the National Gallery of Art East Building roof terrace planters and pavers as a substitute for Tennessee marble
- Bands of color accents could be arranged in a horizontal orientation
- Best cost value
- Resistant to pollutants, and surface mold and algae growth
- Allows more aggressive cleaning process
- Fabrication facility has space available for on-site dry lay of facade

#### Disadvantages:

- Fine, linear veining pattern not present



Comparable Example: National Japanese American Memorial, Washington, DC, Opened 2000, Sandblasted Finish



Comparable Example: BYU Museum of Art in Provo, Utah, Opened in 1993, Honed Finish



Colonial Rose Quarry in Lac du Bonnet, Manitoba

## Colonial Rose (aka Lac Du Bonnet) Granite



Smithsonian Institution  
*National Air and Space Museum*





South Elevation

#### Proposed Cladding: Colonial Rose Granite

Colonial Rose is the most appropriate selection for the cladding replacement of the National Air and Space Museum as it most effectively meets the goals of the project. The aesthetic, technical, and procurement criteria are accomplished as listed below.

- Warm tone comparable to Tennessee marble
- High density, durable granite (100+ year stone longevity)
- Can be installed 2" thick, which is thinner and lighter than limestone, allowing corresponding reduction in frame reinforcing
- Successfully installed at the National Gallery of Art East Building roof terrace as a substitute for Tennessee marble
- Tonal variation among adjacent panels modulates facade
- Bands of color accents could be arranged in a horizontal orientation similar to linear veining
- Relatively low impact to project schedule
- Resistant to blue green algae and pollutants
- Allows more aggressive cleaning process
- Fabricated within the United States
- Full fabrication infrastructure is installed as of today
- Extensive quantity and fabrication capability available, reducing risk for procurement
- Fabrication facility has space available for on-site dry lay of facade
- Fabricator has demonstrated that the procurement schedule can be accommodated
- Stone recovery rate (quarry yield) is 30% to 35%, highest among the short-listed cladding options documented in this report
- Least complicated quality control required for panel materials among the short-listed cladding options documented in this report
- Good availability for future selective replacement

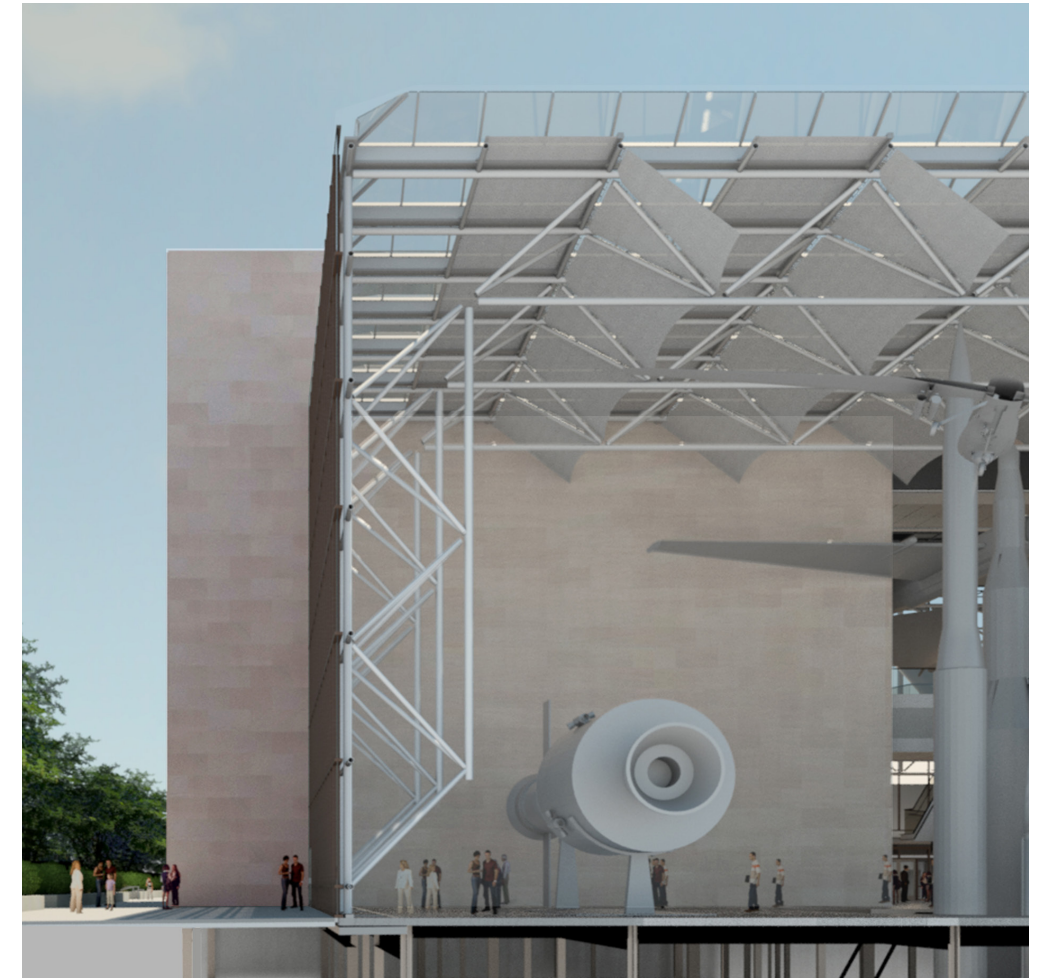
## Colonial Rose Granite Cladding Proposal and Visualization







Partial North Elevation with North Vestibule Option



Building Section with Colonial Rose Cladding Applied to Exterior and Existing Tennessee Marble Cladding to Remain on the Atrium Interior



Full North Elevation with North Vestibule Option

## Colonial Rose Granite Exterior Renderings



Smithsonian Institution  
*National Air and Space Museum*



This page intentionally left blank





Paving Stone Options Considered	36
Paving Stone Research Matrix	37
Paving Replacement Options:	
- Stoney Creek (reuse existing)	38
- Chester Grey	39
- Chelmsford Grey	40
- Concrete Pavers	41
Northwest Corner Pavers Option Renderings	42
North Entrance Pavers Option Renderings	43



The paving option summary is being presented for information as an update on the project development, but is not being submitted as a proposal as part of this report. The paving material proposal will be submitted with the forthcoming revised concept design for the updated site design.

The analysis of paver materials is summarized in this section with the shortlist of five different options considered for selection. This list was culled from a broader range initially studied, which was later informed by the 6 options included in the cladding and paving aesthetic mockup. The existing Stoney Creek paving has been added for consideration as a value engineering option.

A summary of each of the five short-listed cladding materials is documented in this section, including the information and images listed below.

- Advantages and Disadvantages -- based on aesthetic, technical, and procurement criteria
- Detail Photo -- image provides an indication of the appearance of the material as photographed at close range, formatted not to scale
- Comparable Examples -- photos of similar installations are provided where applicable; in some cases, “other examples” are referenced in lieu of a relevant precedent.

PAVING OPTIONS CONSIDERED:

Stoney Creek Granite

The existing paving currently installed at NASM is Stoney Creek granite. This was introduced to the site in 1986 to replace the concrete pavers that were installed as part of the original construction, but had substantially deteriorated. Correspondence with HOK included the statement that the original design intent was for granite pavers, however the lowest bidder won the commission based on the substitution of concrete for granite. The selection of Stoney Creek was based on its use elsewhere on the National Mall at the time, according to anecdotal evidence. Whereas the brightness of the tones and intensity of the pattern of the Stoney Creek paving visually dominates the existing Tennessee marble cladding, it may be better suited for granite cladding proposed as Colonial Rose in this report.

Chester Grey Granite

The use of grey paving may be more compatible with pink cladding than pink paving. Chester Grey has a darker tone than the other grey paving materials referenced in this section, with limited discernible pattern.

Chelmsford Grey Granite

Chelmsford Grey has a lighter tone than the other grey paving materials referenced in this section, with linear veining pattern.

Hanover Prest Paver “Natural” Concrete Pavers

The use of concrete is being explored as a means of incorporating the reuse of the existing Tennessee marble cladding as an aggregate. The Hanover Prest Paver “Natural” has a lighter grey tone than the other concrete paver referenced in this section. Earlier considerations included the use of a less durable paving material such as concrete if it is to be discarded in approximately 30 years when the terrace plaza waterproofing is to be re-installed, however it was determined that stone can be reused, as facilitated by the specification of a sand-cement setting bed in lieu of a bituminous setting bed.

Hanover Prest Paver “Limestone Grey” Concrete Pavers

The Hanover Prest Paver “Limestone Grey” has a darker grey tone than the other concrete paver referenced in this section, and can also receive Tennessee marble aggregate as a reuse of the existing cladding.

Paving Stone Options Considered





1.2.3. STONE PAVING

Original Design and Existing Conditions

It is believed that the original design intention for the paving was a stone paver. However, it is known that an exposed aggregate, concrete paver was ultimately installed as the terrace paving, a decision that was likely influenced by budget concerns. By the mid-1980s, less than ten years after the opening of the museum, the concrete pavers had begun to show noticeable signs of failure. In 1986, during the construction of the restaurant addition, all concrete terrace pavers and stairs were replaced with Stony Creek granite pavers. The 30"x30"x2" Stony Creek granite pavers exist on the terrace today.

Stony Creek is a reddish-pink granite with a dynamic color composition that includes variegated black and white elements. The stone is sourced from a quarry by the same name in Branford, Connecticut.

Performance Criteria

The exterior paving assemblies must meet the following performance criteria:

- Integrity in strength and durability
- Ability to bear the 60' boom lift
- Flexible assembly to allow pavers to be easily lifted and reused
- Continuous drainage surface
- Hand tight joint for accommodation of heels and wheels
- Skid and slip resistance
- Relatively easy to maintain
- Resistance to staining and weathering
- Resistance to surface wearing in consideration to heavy foot traffic
- Large and small module size to accommodate pedestrian and large vehicles respectively
- An appropriate albedo ratio that balances the reduction of heat island and sunlight glare

Aesthetic Criteria






- The aesthetic criteria for the exterior paving material as outlined below:
- A muted character that doesn't compete with the liveliness of the building cladding stone
  - Continuity in color and texture
  - Applicable for on-structure terrace

- Maintain the monumental appearance of the historic place
- A paving module that will integrate with the building cladding and planter wall module
- Consideration that the proposed paving module and pattern have been approved by CFA, NCPC and SHPO

Paving Material Option Analysis

Twenty-three North American stones and two concrete pavers were analyzed in search for a paver that met both the established performance and aesthetic criteria. Ultimately these options were narrowed to three granites, including the reuse of the existing Stony Creek (2" thickness) and one concrete paver.

Current structural analysis indicates that a 3" thick paver is necessary to support the maintenance vehicle (60ft boom lift) point load. The large vehicle access corridor along the western end of the building requires a 4" paver and a smaller unit size to support the point loads of exhibit transport vehicles.

Paving Stone	Building Stone Options	Type	Image	Color	Compressive Strength Psi	Absorption by Weight (%)	Country source	Samples finish received
Stone Paver	Colonial Rose							
Stony Creek (reuse existing)		Granite		Variation of pink and Yellow			US	Thermal
Chester Gray		Granite		Dark Cool Gray			US -	Thermal
Chelmsford Gray		Granite		Light Cool Gray			US	Thermal
Concrete paver								
Hanover Prest Paver - 'Natural'		Conc.		Light Gray	8500	0.05	US - PA	Tudor
Hanover Prest Paver - 'Limestone Gray'		Conc.		Medium Gray			US - PA	Tudor

Paving Stone Research Matrix







Colonial Rose Cladding (not to scale)



Stoney Creek Paving (not to scale)

#### Advantages:

- The existing stone can be re-used, perhaps with some cost savings – to be confirmed
- Square pattern and east-west running bond paving pattern matches HOK 1970's hand-drawn paving sheet but provenance of that sheet is unknown with respect to original design and execution – to be confirmed (Section 106 issue)

#### Disadvantages:

- Color varies from tan, yellow to pink, may compete with pink building stone options - Tennessee Pink, Echo Lake and Colonial Rose
- Cost of lifting, moving, storing, cleaning, moving back to site and replacing stone pavers needs to be confirmed
- Existing pavers are 2" thick and 3" is proposed to meet the structural load capacity of service vehicles on the main terrace
- Ability to match both finish and character of existing pavers, once cleaned, to new pavers of the same stone and finish, is unknown; some variation can be expected
- Square pattern of existing pavers does not match the CFA/NCPC/SHPO approved paving design, which proposes a similar east-west running bond pattern of pavers cut in a module related to that of the building and landscape wall cladding



#### Comparable Example:

Stoney Creek Granite, National Air and Space Museum, SW service corridor

## Existing Paving Stone - Stoney Creek



Smithsonian Institution  
*National Air and Space Museum*





Colonial Rose Cladding (not to scale)



Chester Grey Paving (not to scale)

#### Advantages:

- 3" proposed thickness meets the structural load capacity of service vehicles on the main terrace
- Proposes a similar east-west running bond pattern of pavers cut in a module related to that of the building and landscape wall cladding
- Dark Grey color has complementary natural 'liveliness' appropriate to the pink building stone options - Tennessee Pink, Echo Lake and Lac Du Bonnet
- Re-useability; can be lifted and put back when replacing the waterproofing
- Compared to concrete paver, granite is less likely to chip, crack, higher resistance to staining

#### Disadvantages:

- Higher initial cost compared to concrete paver



Comparable Example: PAVING: Chester Grey granite (Note: photo taken in overcast light, damp pavers)

## Paving Stone Options - Chester Grey







Colonial Rose Cladding (not to scale)



Chelmsford Grey Paving (not to scale)

#### Advantages:

- 3" proposed thickness meets the structural load capacity of service vehicles on the main terrace
- Proposes a similar east-west running bond pattern of pavers cut in a module related to that of the building and landscape wall cladding
- Light Grey color has complementary natural 'liveliness' appropriate to the pink building stone options - Tennessee Pink, Echo Lake and Colonial Rose
- Re-useability; can be lifted and put back when replacing the waterproofing
- Compared to concrete paver, granite is less likely to chip, crack, higher resistance to staining
- Low SRI contributes to heat island effect reduction

#### Disadvantages:

- Higher initial cost compared to concrete paver



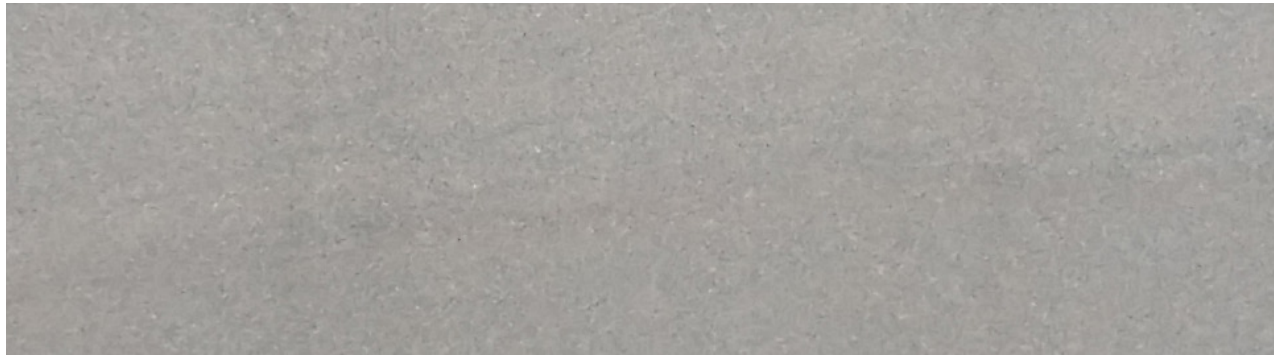
Comparable Example: CLADDING: Tennessee Pink - sandblasted finish  
PAVING: Chelmsford Grey granite (Note: photo taken in shade)

## Paving Stone Options - Chelmsford Grey



Smithsonian Institution  
*National Air and Space Museum*





Colonial Rose Cladding (not to scale)



Natural (not to scale)



Limestone Grey (not to scale)

### In Comparison to Stone Pavers

#### Advantages:

- Lower initial cost
- Custom mixes likely available to integrate recycled building stone or to make the most complementary match with the proposed building stone
- Designed with 'tabs' for interlocking moment

#### Disadvantages:

- More difficult to match 'lively' stone façade
- Likely higher life cycle cost (replacement, repair)
- Less durable; more likely to chip, crack; more wastage when lifted
- Less resistance to staining and weathering; more porous
- Less likely to carry 'character' and aesthetic for life of the slab
- Typically beveled edges, reduces tight rectangular feel, tougher on heels and wheels
- Bevel can be removed by grinding the entire surface of the paver, resulting in custom costs and a thinner paver
- Surface grinding may require sealing
- Bevels create more open joints / transition issue at top and bottom of gentle walkways
- When pavers are saw-cut to fit, bevel is put on cut edge by on-site grinding – less control
- Interlocking tabs mean wider joint - which must be filled (typically with sand)

## Paving Stone Options - Concrete Pavers





# Cladding and Paving Visualizations

## National Mall Building Envelope and HVAC Revitalization



Colonial Rose Granite/Stoney Creek Pavers



Colonial Rose Granite/Chester Stone Pavers

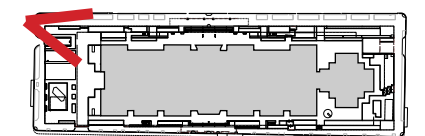


Colonial Rose Granite/Chelmsford Pavers

### Northwest Corner Pavers Option Renderings



Smithsonian Institution  
*National Air and Space Museum*







Colonial Rose Granite/Stoney Creek Pavers



Colonial Rose Granite/Chester Stone Pavers



Colonial Rose Granite/Chelmsford Pavers

## North Entrance Pavers Option Renderings



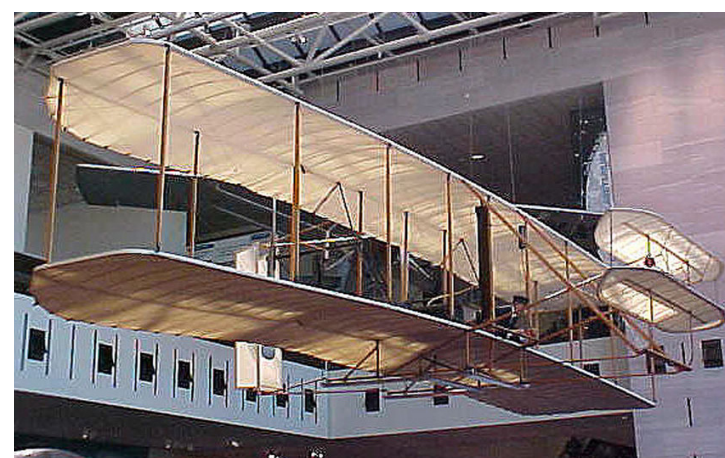
Smithsonian Institution  
*National Air and Space Museum*





This page intentionally left blank







This page intentionally left blank



APPENDIX A: Initial Cladding Matrix

National Mall Building Envelope and HVAC Revitalization

NASM MALL BUILDING  
BUILDING ENVELOPE AND HVAC REVITALIZATION

CLADDING MATRIX

PREPARED BY:  
QUINN EVANS ARCHITECTS  
1/6/15

EXTERIOR WALL CLADDING OPTIONS															
	NATURAL MATERIALS								MAN-MADE MATERIALS						
	REPLACEMENT IN KIND	STONE							METALS			CERAMICS		CONCRETE	
	ENV-3B	ENV-3D			ENV-4	ENV-5	N/A	N/A	N/A	N/A	ENV-8	N/A	ENV-10	N/A	N/A
CLADDING MATERIAL	2 1/2" TN PINK MARBLE	ECHO LAKE GRANITE	STONY CREEK GRANITE	SALMON TROPICAL GRANITE	NEW STONE ON HONEYCOMB CORE	REMILLED EXISTING STONE ON HONEYCOMB CORE	GEORGIA PINK MARBLE	TUSCARORA SANDSTONE	ALUMINUM PANELS	PORCELAIN ENAMEL PANELS	TITANIUM PANELS	TERRA COTTA	PORCELAIN TILE	PRECAST CONCRETE	POLYMER-BASED CONCRETE
AESTHETICS															
MAINTAINS EXISTING APPEARANCE	YES	SIMILAR	SIMILAR	SIMILAR	SIMILAR	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
2'-6" X 5'-0" MODULE AVAILABLE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES
ACCEPTABLE COLOR RANGE	LIKELY	YES	YES	LIKELY	SIMILAR	LIKELY	NO	NO	NO	SIMILAR	N/A	NO	SIMILAR	YES	NO
ACCEPTABLE TEXTURE	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	SIMILAR	SIMILAR
AGENCY APPROVAL PROCESS	LEAST CHALLENGING	MORE CHALLENGING	MORE CHALLENGING	MORE CHALLENGING	MORE CHALLENGING	LEAST CHALLENGING	MOST CHALLENGING	MOST CHALLENGING	MOST CHALLENGING	MOST CHALLENGING	MOST CHALLENGING	MOST CHALLENGING	MOST CHALLENGING	MOST CHALLENGING	MOST CHALLENGING
ANTICIPATED PLANE CHANGE (OUTSIDE EXISTING FACE)	3"	2 1/4"	2 1/4"	2 1/4"	2 - 1/8"	2 - 1/8"	YES	3"	1 3/4"	1 3/4	1 3/4"	YES	1 1/2"	2"+	2"+
STRUCTURAL PERFORMANCE															
CLADDING MEETS BLAST DESIGN CRITERIA	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
OBTAINING SUFFICIENT FLEXURAL AND ANCHORAGE STRENGTH	VARIABLE – NATURAL MATERIAL	VARIABLE – NATURAL MATERIAL	VARIABLE – NATURAL MATERIAL	VARIABLE – NATURAL MATERIAL	CONTROLLED – MANUFACTURED MATERIAL	CONTROLLED – MANUFACTURED MATERIAL	VARIABLE – NATURAL MATERIAL	VARIABLE – NATURAL MATERIAL	CONTROLLED – MANUFACTURED MATERIAL	CONTROLLED – MANUFACTURED MATERIAL	CONTROLLED – MANUFACTURED MATERIAL	CONTROLLED – MANUFACTURED MATERIAL	CONTROLLED – MANUFACTURED MATERIAL	CONTROLLED – MANUFACTURED MATERIAL	CONTROLLED – MANUFACTURED MATERIAL
REINFORCEMENT FOR WEIGHT (CLADDING WIND PRESSURE INCLUDED)	REQUIRED	REQUIRED	REQUIRED	REQUIRED	NONE	NONE	REQUIRED	REQUIRED	NONE	NONE	NONE	REQUIRED	NONE	REQUIRED	REQUIRED
REINFORCEMENT FOR SEISMIC	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED
REINFORCEMENT FOR WIND	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED
DURABILITY AND MAINTENANCE															
EXPECTED CLADDING MATERIAL LIFESPAN	100 YEARS	100 YEARS	100 YEARS	100 YEARS	>40 YEARS	UNKNOWN	100 YEARS	100 YEARS	50+ YEARS	50+ YEARS	UNKNOWN	50+ YEARS	40+ YEARS	50+ YEARS	50+ YEARS
EASE OF MAINTENANCE/SELECTIVE REPLACEMENT	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE	POSSIBLE
ENVELOPE PERFORMANCE															
INCORPORATING THERMAL BREAKS	TECHNICALLY CHALLENGING, WILL INCREASE WALL SECTION	TECHNICALLY CHALLENGING, WILL INCREASE WALL SECTION	TECHNICALLY CHALLENGING, WILL INCREASE WALL SECTION	TECHNICALLY CHALLENGING, WILL INCREASE WALL SECTION	SIMILAR TO OTHER BACKUP SYSTEMS	SIMILAR TO OTHER BACKUP SYSTEMS	TECHNICALLY CHALLENGING, WILL INCREASE WALL SECTION	TECHNICALLY CHALLENGING, WILL INCREASE WALL SECTION	SIMILAR TO OTHER BACKUP SYSTEMS	SIMILAR TO OTHER BACKUP SYSTEMS	SIMILAR TO OTHER BACKUP SYSTEMS	SIMILAR TO OTHER BACKUP SYSTEMS	SIMILAR TO OTHER BACKUP SYSTEMS	SIMILAR TO OTHER BACKUP SYSTEMS	SIMILAR TO OTHER BACKUP SYSTEMS
CONSTRUCTIBILITY															
PANEL LEAD TIME AND PROCUREMENT	MOST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	CHALLENGING	CHALLENGING	MOST CHALLENGING	CHALLENGING	CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING
CONSTRUCTION TIME SAVINGS	NO	NO	NO	NO	YES	YES	NO	NO	YES	YES	YES	NO	YES	NO	YES
EASE TO MEET MOUNTING TOLLERANCES	DIFFICULT	MORE DIFFICULT	MORE DIFFICULT	MORE DIFFICULT	SYSTEM SHOULD PROVIDE FOR MORE ADJUSTABILITY	SYSTEM SHOULD PROVIDE FOR MORE ADJUSTABILITY	DIFFICULT	DIFFICULT	SYSTEM SHOULD PROVIDE FOR MORE ADJUSTABILITY	SYSTEM SHOULD PROVIDE FOR MORE ADJUSTABILITY	SYSTEM SHOULD PROVIDE FOR MORE ADJUSTABILITY	DIFFICULT	SYSTEM SHOULD PROVIDE FOR MORE ADJUSTABILITY	DIFFICULT	DIFFICULT
QUALITY CONTROL OF PANEL MATERIALS, FABRICATION, AND INSTALLATION	MOST CHALLENGING	CHALLENGING	CHALLENGING	CHALLENGING	CHALLENGING	MOST CHALLENGING	CHALLENGING	CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING	LEAST CHALLENGING
MATERIAL HANDLING ON-SITE	LIFTING AID	LIFTING AID	LIFTING AID	LIFTING AID	HAND CARRY	HAND CARRY	LIFTING AID	LIFTING AID	HAND CARRY	HAND CARRY	HAND CARRY	LIFTING AID	HAND CARRY	LIFTING AID	HAND CARRY
ENERGY SAVINGS (% OVER BASELINE)															
SITE (kBtu) %	1.0%	1.0%	NOT EVALUATED	NOT EVALUATED	1.3%	1.3%	NOT EVALUATED	NOT EVALUATED	NOT EVALUATED	NOT EVALUATED	1.0%	NOT EVALUATED	1.0%	NOT EVALUATED	NOT EVALUATED
SOURCE (kBtu) %	1.0%	1.0%	NOT EVALUATED	NOT EVALUATED	1.1%	1.1%	NOT EVALUATED	NOT EVALUATED	NOT EVALUATED	NOT EVALUATED	1.0%	NOT EVALUATED	1.0%	NOT EVALUATED	NOT EVALUATED
CO <sub>2</sub> (lbs CO <sub>2</sub> ) %	1.0%	1.0%	NOT EVALUATED	NOT EVALUATED	1.1%	1.1%	NOT EVALUATED	NOT EVALUATED	NOT EVALUATED	NOT EVALUATED	1.0%	NOT EVALUATED	1.0%	NOT EVALUATED	NOT EVALUATED
UTILITY COST (\$) %	1.3%	1.3%	NOT EVALUATED	NOT EVALUATED	1.4%	1.4%	NOT EVALUATED	NOT EVALUATED	NOT EVALUATED	NOT EVALUATED	1.3%	NOT EVALUATED	1.3%	NOT EVALUATED	NOT EVALUATED
RECOMMENDATIONS															
VIABLE ENVELOPE SYSTEM	YES	YES	YES	YES	YES	UNKNOWN	YES	YES	YES	YES	YES	YES	YES	YES	YES
RECOMMENDED ENVELOPE SYSTEM	YES	YES	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Concept Design Report Cladding Matrix



Smithsonian Institution  
National Air and Space Museum



This page intentionally left blank

APPENDIX B: Global Stone Research List

National Mall Building Envelope and HVAC Revitalization



Global Stone Research List	50
----------------------------	----

Stone Filtering Matrix	53
------------------------	----



Table of Contents





Global Stone List

Stone Name	Type	Source
Academy Black	Granite	Coldspring
Acajou Granite	Granite	Granicor
Adair Grey	Ledgerock	Owen sound Ledgerock
Agate	Granite	Coldspring
Agra Brown Sandstone	Sandstone	Coldspring
Agra Red Sandstone	Sandstone	Coldspring
Alabama Marble	Mountain	Purple Mountain
Algonquin	Limetone	Ledge Rock
Aluminum Panels	Aluminum	Various
Arkansas Sandstone	Sandstone	Oran McBride Stone Quarries
Aurora Pink	Marble	ABC
Azul Luna	Travertine	New Mexico Travertine
Batesville Limestone	Limestone	Oran McBride Stone Quarries
Beige Rose	Granite	Various (Africa, China)
Bellingham	Granite	Dakota Granite
Belmont Rose Granite	Granite	Belmont Rose Granite
Betchouan	Granite	Graniteland.com
Bloom Run	Stone	Russell Stone
Brazil Indiana sandstone	Sandstone	Mansfield Stone Company
Brentwood Sandstone	Sandstone	Semco
Canadian Mahogany	Granite	Nelson Bros.
Carnelian	Granite	Coldspring
Castle Cream Sandstone	Sandstone	Krukowski Stone Company,
Charcoal Black	Granite	Coldspring
Chelmsord Grey	Granite	Fletcher
Cold Spring Black	Granite	Coldspring
Colorado Red Sandstone	Sandstone	Loukenen Bros. CO
Colorado Rose Red	Sandstone	Colorado Rose Red. Inc.
Coral Grey	Granite	Fletcher Granite
Country Rose Quartzite	Quartzite	Various
Dakota Mahogany	Granite	Fletcher Granite
Danby Marble	Marble / Limestone	Vermont Marble
Deer Brown	Granite	Hillcrest Granite
Deer Isle	Granite	Fletcher Granite



Global Stone List

Stone Name	Type	Source
Digitally Printed Glass	Glass	Various
Dunnville Sandstone	Sandstone	Coldspring
Echo Lake	Granite	Cold Spring Granite
Enamel Panels	Enamel	Various
Eramosa	Marble / Limestone	Ledge Rock
Ethowa Marble	Marble	Polycor
Georgia Pink Marble	Marble	Reynolds Marble & Granite Company
Glacial Rose	Granite	Michels Stone- WI
Glacier Buff – Fleuri Cut	Minnesota Stone	Vetter Stone
Glacier Buff – Veine Cut	Minnesota Stone	Vetter Stone
Golden Brasil	Granite	Coldspring (Brazil)
Hendrix Purple	Granite	Dakota Granite
Indian Sunset	Granite	ColdSpring
Indiana Limestone	Limestone	Indiana Limestone Company
Iridian	Granite	Coldspring
Jonesboro	Granite	Cold Spring
Kasota Valley Limestone	Limestone	Coldspring
Kenoran Sage	Granite	Coldspring
Kershaw	Granite	Fletcher Granite
Kershaw Pink	Granite	Granites of America
Colonial Rose	Granite	Coldspring
Lake Placid Blue	Granite	Coldspring
Lake Superior Green	Granite	Coldspring
Laminated Glass with New Stone Core	Floatstone	Various
Laminated Glass with Existing Stone Core	Floatstone	Various
Lauentian Pink	Granite	Polycor (Canada)
Lavender Grey Quartzite	Quartzite	Michels Stone, Portland, WI
Madison Granite	Granite	Granites of America
Mesabi Black	Granite	Coldspring
Milford Pink	Granite	Granites of America
Minnesota Travertine	Travertine	Vetter Stone Company
Missouri Red	Granite	Granites of America
Missouri Red	Granite	Keystone Granite
Montana Travertine	Travertine	Idaho travertine





Global Stone List

Stone Name	Type	Source
Mountain Green	Granite	Coldspring
Mountain Rose	Granite	Nelson Granite
Muskoka Pink	Gneiss	Graniteland.com
Napoleon Gray	Marble/Limestone	Phenix
Natural Strata	Minnesota Stone	Vetter Stone
Honeycomb Core with New Stone	Strongbacked Stone	Various
Honeycomb Core with Existing Stone	Strongbacked Stone	Various
Northern Buff – Fleuri Cut	Minnesota Stone	Vetter Stone
Northern Buff – Veine Cut	Minnesota Stone	Vetter Stone
Northern Cream – Fleuri Cut	Minnesota Stone	Vetter Stone
Northern Gold – Fleuri Cut	Minnesota Stone	Vetter Stone
Northern Grey Buff – Fleuri Cut	Minnesota Stone	Vetter Stone
Northern Pink	Limestone	Vetter Stone
Northern Pink – Veine Cut	Minnesota Stone	Vetter Stone
Northern Pink Buff – Fleuri Cut	Minnesota Stone	Vetter Stone
Oklahoma Taupe Granite	Granite	MS International Inc.
Pearl Gray	Marble	Polycor
Pink Travertine	Travertine	New Mexico Travertine
Pink Travertine	Travertine	Idaho travertine
Polychrome	Granite	Margranite
Polymer-Based Concrete	Concrete	Various
Porcelain Tile	Porcelain	MS International Inc.
Prairie Brown	Granite	Coldspring
Precast Concrete	Concrete	Various
Purple Veined Glenmont	Sandstone	Briar Hill
Radiant Red	Granite	Coldspring
Rainbow	Granite	Coldspring
Raven Noir	Granite	Coldspring
Reed Indiana Grey Top ledge	Limestone	Reed Quarries
Remilled Existing Tennessee Pink Marble On Honeycomb Core	Marble	Various
Rhone Mountain Sandstone	Sandstone	Coldspring
Rib Mountain Granite	Granite	Michels Stone- WI
Roaring Run	Stone	Russell Stone
Rockville Beige	Granite	Coldspring
Rockville White	Granite	Coldspring



Global Stone List

Stone Name	Type	Source
Rosa Porrino	Granite	Stonepanels.com
Royal Auburn	Granite	Coldspring
Royal Canadian Red Granite	Granite	Polycor (Canada)
Salisbury Pink	Granite	Polycor
Salmon Tropical Granite	Granite	Various
San Sebastian	Granite	Polycor
Sandstone Blush and Buff	Sandstone	Briar Hill
Serpeggiante	Marble	Various (Italy)
Sherwood	Granite	Fletcher Granite
Sierra White	Granite	Coldspring
Silver Cloud	Granite	Silver Cloud Quarry
Silver Shadow – Fleuri Cut	Alabama Stone	Vetter Stone
Silver Shadow – Veine Cut	Alabama Stone	Vetter Stone
Silver Shadow Vein	Limestone	Vetter Stone Company
Sintered Stone	Engineered Stone	Marva, The Size
Sparta Pink	Granite	Granites of america
Sparta Pink	Granite	Georgia Stone Industries
St. Clair Limestone	Limestone	Polycor OK
Sterling – Fleuri Cut	Alabama Stone	Vetter Stone
Sterling – Veine Cut	Alabama Stone	Vetter Stone
Stony Creek Granite	Granite	Stony Creek Quarry Company
Sunset Beige	Granite	Coldspring
Sunset Red	Granite	Coldspring
Tadoussac	Granite	Various
Tapestry	Granite	Fletcher Granite
Tapestry	Granite	Granites of America
Tennessee Crab Orchard	Orchard	Turner Bros., Crossville TN
Tennessee Pink Marble	Marble	Tennessee Marble Co.
Terracotta	Terracotta	Boston Valley, Shildan, NBK
Texas Pearle	Granite	Coldspring
Texas Rose Granite	Granite	Granites of America
Titanium Panels	Titanium	Various
Tuscarora Sandstone	Sandstone	Various
Ultra High Performance Concrete	Concrete	TAKTL, Ductal











































Global Stone List

Stone Name	Type	Source
Valders Grey Vein	Vein	Valders Stone and Marble
Variegated Indiana Limestone	Limestone	Indiana Limestone Company
Vegas Rock	Quartzite	Las Vegas Rock
Vein Pink Limestone	Limestone	Vetter Stone Company
Watertown Pink Quartzite	Quartzite	Jasper Stone Company, MN
Wausau Red	Granite	Michels
Whetstone	Granite	Dakota Granite
Winneway	Granite	Polycor
Winter Birch	Granite	Nelson Granite
Wyoming Pink granite	Granite	Eldon Strid
Zacateca Peach Travertine	Travertine	Various



APPENDIX B: Global Stone Research List

National Mall Building Envelope and HVAC Revitalization

Honed Finish										
										
Abraded Finish										
										

Stone Filtering Matrix



This page intentionally left blank

APPENDIX C: Cladding and Paving Aesthetic Mockup  
National Mall Building Envelope and HVAC Revitalization



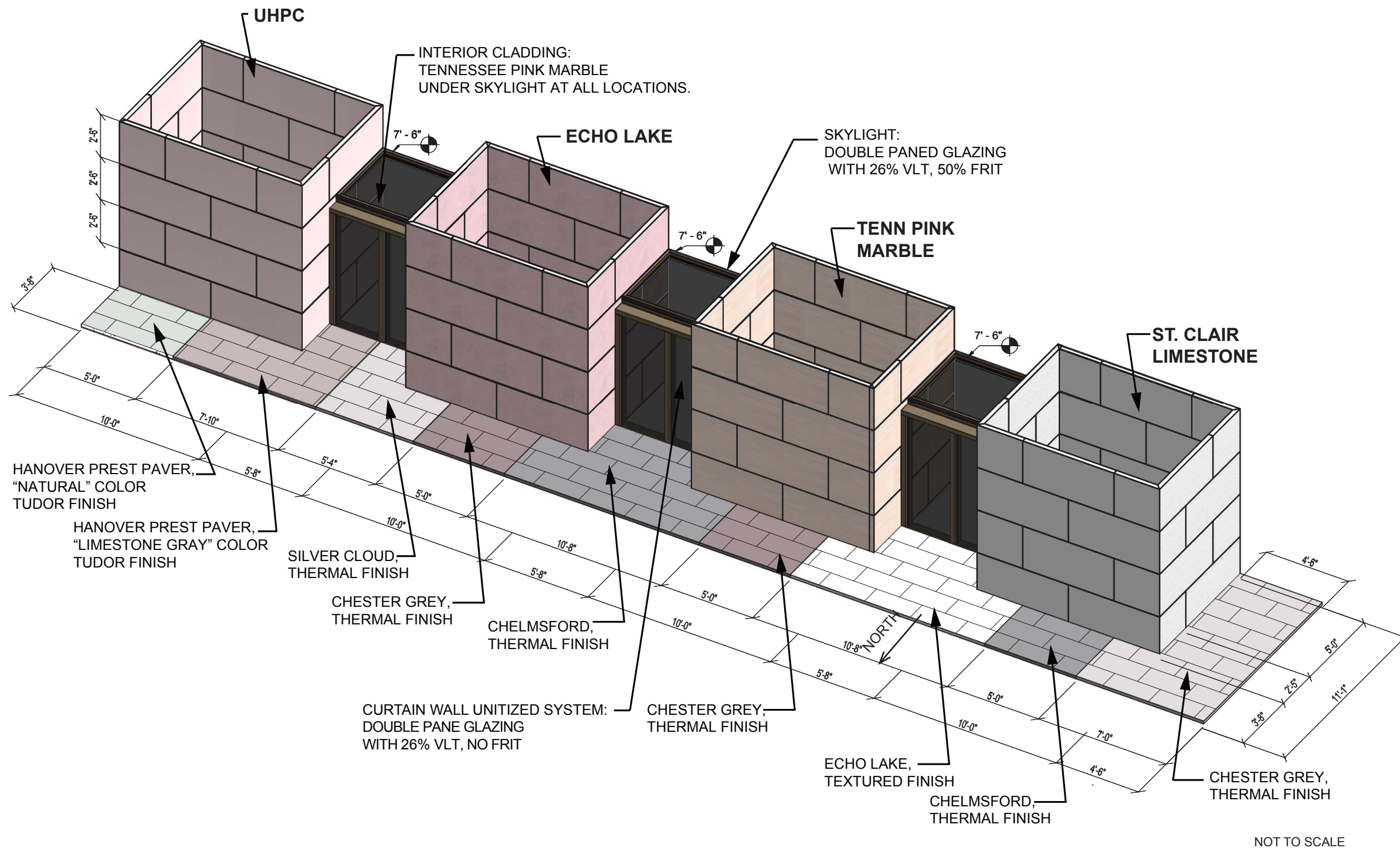
Cladding and Paving Aesthetic Mockup Isometric	58
Cladding and Paving Aesthetic Mockup Photo	59
Tennessee Marble Existing Cladding and Mockup	60
St Clair, Echo Lake, and UHPC Mockups	61
Echo Lake and Colonial Rose Supplemental Mockups	62
Colonial Rose with Paving Pairings	63





## APPENDIX C: Cladding and Paving Aesthetic Mockup

### National Mall Building Envelope and HVAC Revitalization



## Cladding Aesthetic Mockup Isometric



Smithsonian Institution  
National Air and Space Museum



## APPENDIX C: Cladding and Paving Aesthetic Mockup

National Mall Building Envelope and HVAC Revitalization



Cladding Aesthetic Mockup Photo (photos taken in overcast light, stone retaining some moisture)

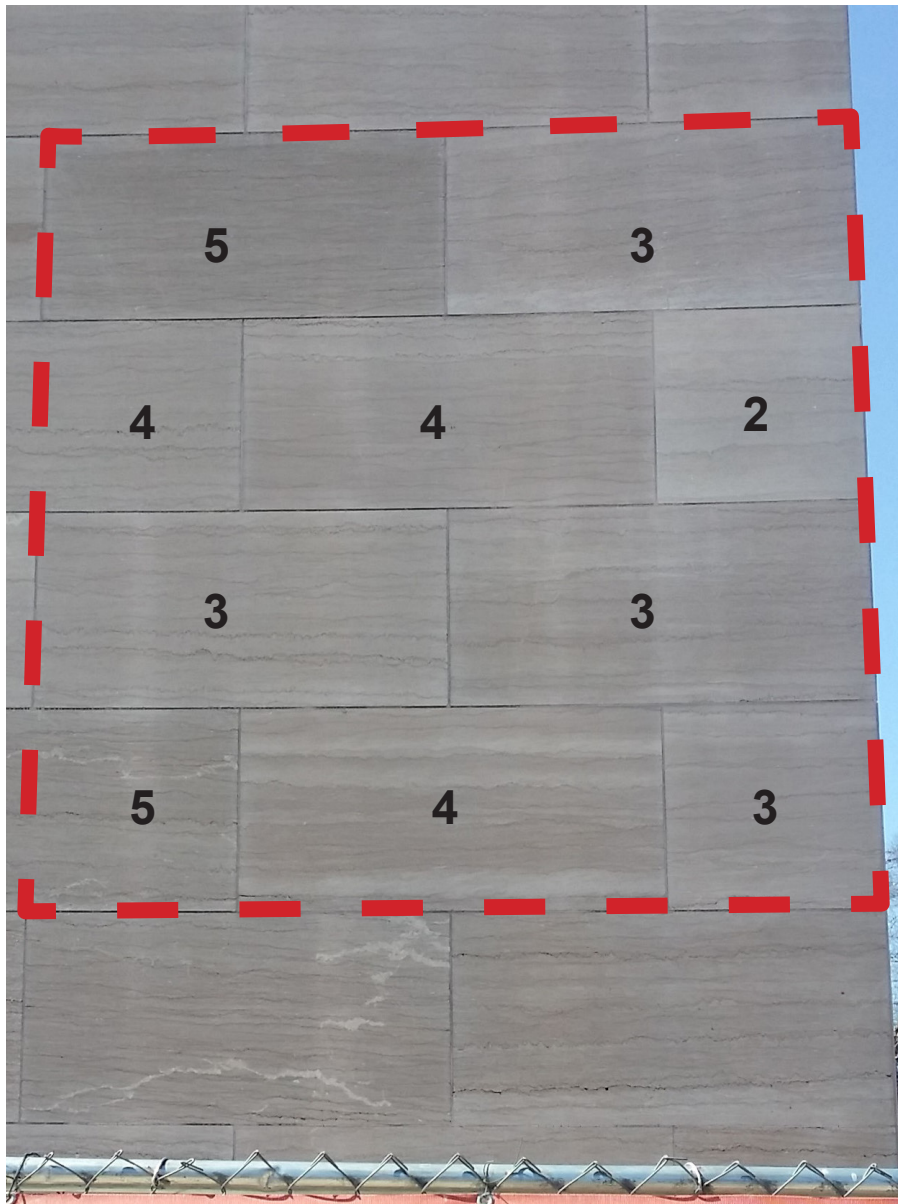




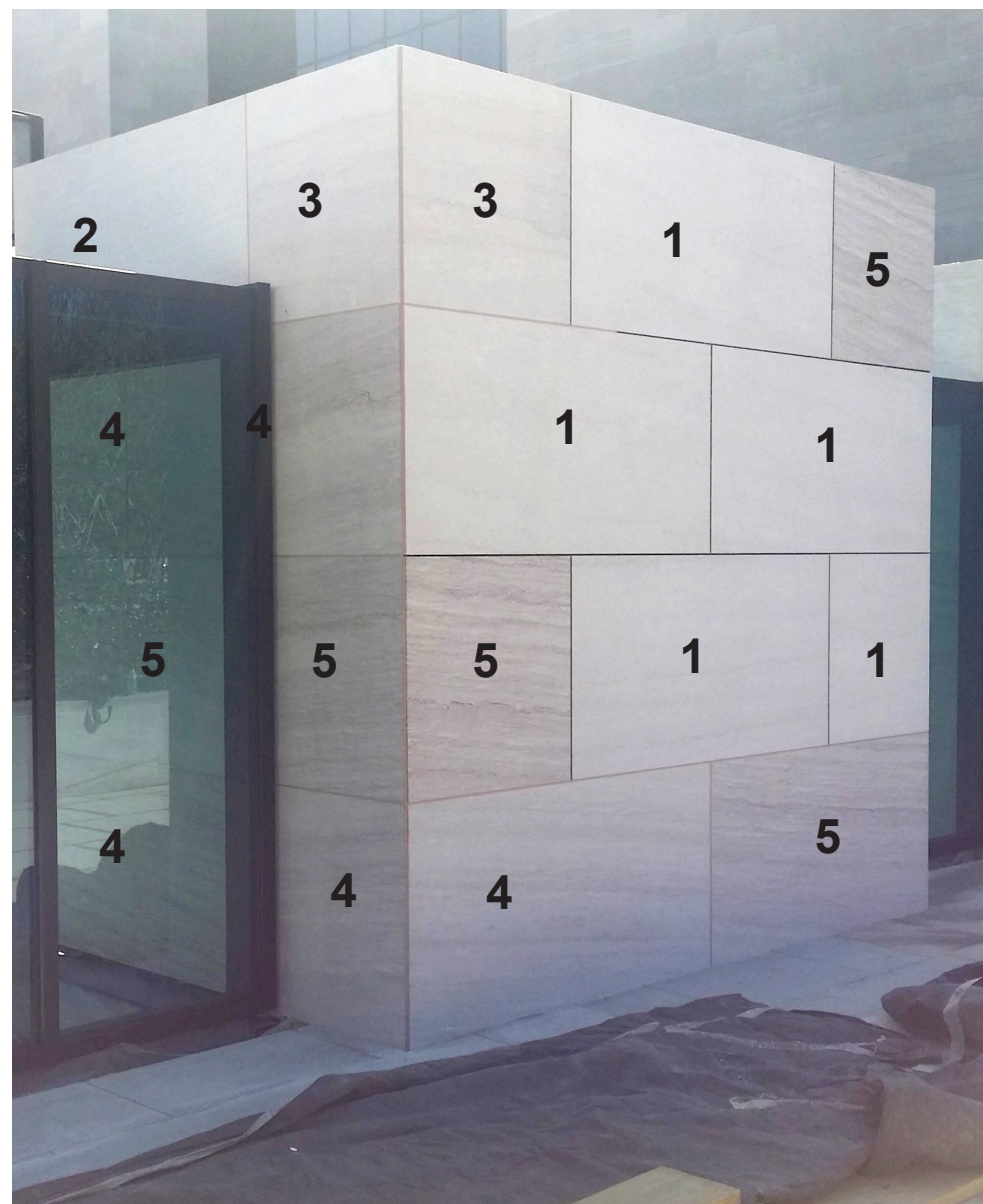
## APPENDIX C: Cladding and Paving Aesthetic Mockup

National Mall Building Envelope and HVAC Revitalization

Existing Tennessee Marble  
East Elevation



Tennessee Marble Mockup  
North & East Elevations



Tennessee Marble Mockup  
South & West Elevations



### TENNESSEE MARBLE COLOR RANGE KEY

1. Light Pink

2. Medium Pink

3. Dark Pink

4. Light Cedar

5. Medium Cedar

### Tennessee Marble Existing Cladding and Mockup



Smithsonian Institution  
*National Air and Space Museum*



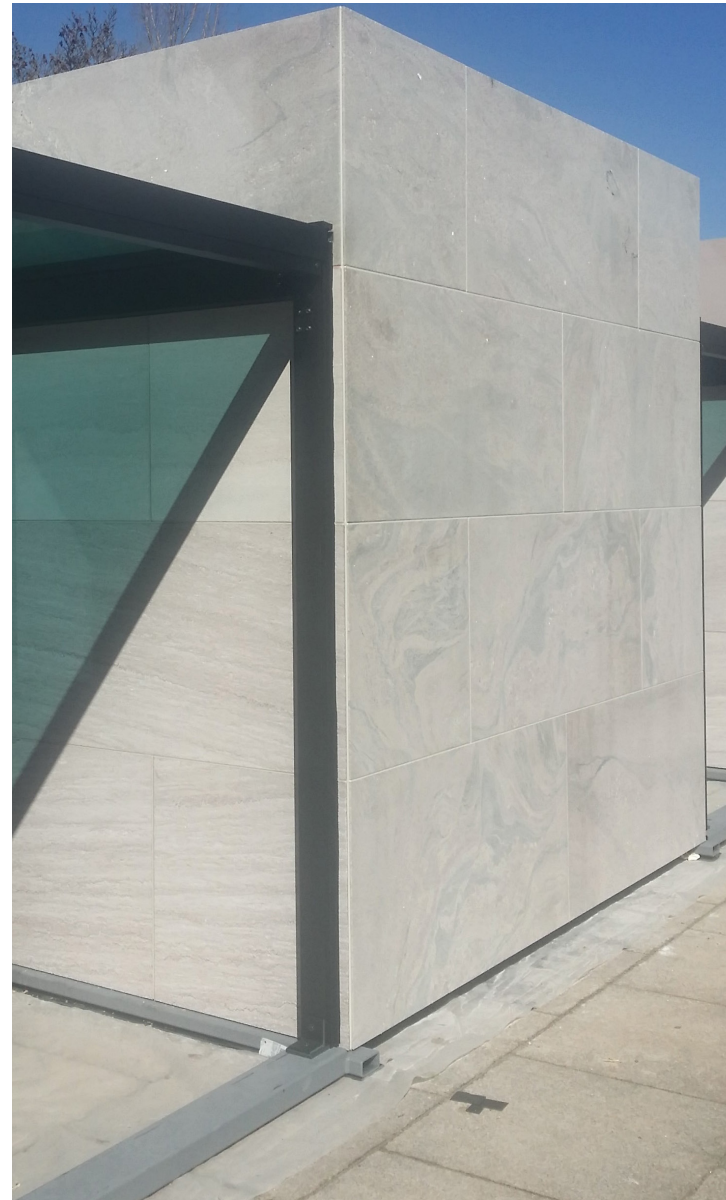
## APPENDIX C: Cladding and Paving Aesthetic Mockup

National Mall Building Envelope and HVAC Revitalization

St Clair Mockup  
South & East Elevations



Echo Lake Mockup  
South & West Elevations



UHPC Mockup  
South & West Elevations



### St Clair, Echo Lake, and UHPC Mockups

Smithsonian Institution  
*National Air and Space Museum*



## APPENDIX C: Cladding and Paving Aesthetic Mockup

National Mall Building Envelope and HVAC Revitalization



### Echo Lake Mockup - Select Range

A second mockup of Echo Lake was installed to demonstrate a select range of panels that exhibit more of the targeted color range, and less of the pronounced fleur-de-lis pattern relative to the initial Echo Lake mockup. The select range would represent 25% of the total building cladding, with the remaining 75% of the cladding represented by the initial Echo Lake mockup.



### Colonial Rose Mockup

Mockup represents the more consistent color tones with limited pattern available. If selected, the design intent is to incorporate more tonal variation and pattern to modulate the facade for a more human scale.

## Echo Lake and Colonial Rose Supplemental Mockups



Smithsonian Institution  
*National Air and Space Museum*



Tennessee Pink - sandblasted finish

Colonial Rose - sand blasted

Tennessee Pink - sandblasted finish



Chelmsford Grey - thermal finish

Chester Grey - thermal finish

Colonial Rose Cladding With Paving Pairings





Colonial Rose Cladding with  
Concrete Paver 'Natural'



Colonial Rose Cladding with  
Concrete Paver 'Limestone Grey'



Colonial Rose Cladding with  
Chelmsford Grey Granite Pavers



Colonial Rose Cladding with  
Chester Grey Granite Pavers

