Executive Director's Recommendation

Commission Meeting: July 13, 2017

PROJECT
Building Exterior, Vestibules and Site Improvements – Cladding Replacement
National Air and Space Museum
Independence Avenue at 6th Street, SW
Washington, DC

SUBMITTED BY
Smithsonian Institution

REVIEW AUTHORITY
Federal Projects in the District
per 40 U.S.C. § 8722(b)(1) and (d)

NCPC FILE NUMBER
7585

NCPC MAP FILE NUMBER
1.41(38.00)44574

APPLICANT'S REQUEST
Approval of comments on revised concept design

PROPOSED ACTION
Approve comments on revised concept design

ACTION ITEM TYPE
Staff Presentation

PROJECT SUMMARY

The Smithsonian Institution has submitted a revised concept design for the cladding replacement at the National Air and Space Museum (NASM), located on the National Mall in Southwest Washington, DC. The site is bound by Jefferson Drive to the north, 4th Street to the east, Independence Avenue to the south, and 7th Street to the west. The current submission is part of a larger project, which involves significant improvements to the building systems and envelope, including replacement of exterior cladding, curtain walls, skylights and roofing; as well as revitalization of the landscape and addition of security vestibules. The project objectives are the following:

1. Protect the museum's mission for a century or more to come.
2. Replace the currently failing Tennessee Pink Marble (limestone) 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 requirement for energy performance and insulation.
3. Select materials and systems that accommodate the project schedule and cost without increasing risk.
4. Maintain eligibility of the museum to be added to the National Register of Historic Places.
5. Replace outdated utility systems with upgrades to endure a prolonged service timespan without major renovations.
6. Enhance the visitor experience with greater accessibility and amenities.

Designed by lead architect Gyo Obata, from Hellmuth Obata and Kassabaum (HOK), in a modern architectural style and constructed in 1976 as part of the United States Bicentennial celebration, the NASM design consists of four simple but monumental solid cubes, separated by three recessed glass atriums. The NASM has an axial relationship with the West Building of the National Gallery of Art (NGA), which was designed in a neoclassical style and constructed in 1941, located directly

across the National Mall. The West Building influenced the NASM massing, exterior cladding and main entrance location. The symmetry of both buildings was meant to frame the US Capitol and provide continuity along the National Mall. To correspond in texture, and color to the West Building, the NASM was clad inside and out with the same Tennessee Pink Marble (limestone). Further, the stone panel size and horizontal orientation correspond to the NGA's facade.

In order to meet a limited construction budget and schedule, building components were downgraded from the original design and value engineering was applied for the exterior wall system. As a result of the unusual wall system design and the spray-foam insulation applied on the back of the stone panels, the existing stone has experienced extensive deterioration and must be completely replaced. In addition, the heating, ventilation and air conditioning systems (HVAC) have reached the end of their usable life, and due to the integration of the exterior cladding with the mechanical system, it is necessary to undertake these upgrades together.

In order to address these deficiencies, the Smithsonian has selected Colonial Rose granite as the cladding material for the NASM exterior envelope based on a two year-long evaluation process of aesthetics, technical performance, procurement, and risk for a wide range of natural and manufactured materials. The cladding replacement includes a total stone surface area of 198,450 gross square feet (including 160,600 gross square feet of building façade plus 37,850 gross square feet of site walls). Construction of the project is anticipated to begin in 2018 until 2024, during this time the SI will maintain restricted public access to the museum.

KEY INFORMATION

- On July 7, 2016, the Commission commented favorably on the overall concept design for the rehabilitation of the National Air and Space Museum (NASM) building and grounds. The initial concept focused on the proposed site improvements and vestibules, and did not include the cladding selection. The Commission comments were organized into eight categories including building envelope; terrace improvement alternatives; perimeter security; streetscape amenities; circulation and visitor experience; landscape; west terrace; and security vestibules.
- On April 6, 2017, the Smithsonian provided an information presentation to the Commission and conducted a field trip to review a mockup of four cladding options at the NASM, including Ultra High Performance Concrete (UHPC), Echo Lake Granite, Tennessee Pink Marble and Saint Claire Limestones. Since then, the Smithsonian has identified a fifth cladding option, Colonial Rose granite which is their preferred alternative.
- The NASM is a contributing building to the National Mall Historic District, which was listed in the National Register of Historic Places in 1966. Since early consultation, the DC SHPO has indicated that the building's most visible character-defining feature is the Tennessee Pink Marble (limestone) cladding. Therefore, the SHPO recommended to preserve the museum's historic integrity through in-kind replacement, as recommended by the Secretary of the Interior's Standards.
- The Commission of Fine Arts (CFA) reviewed the revised concept at its June 15, 2017 meeting, and approved the Smithsonian's preferred choice of Colonial Rose granite in a sandblasted finish. CFA advised the careful specification of the stone, with varied tonal

qualities and pronounced horizontal veining to ensure a suitable level of visual modulation on the building's facades.

- Tennessee Pink Marble, the existing stone cladding, is a unique limestone characterized by a broad color range from light pink to medium cedar, and fine linear veining pattern. Both color variation and horizontal striations provide visual randomness that help modulate the monumentality of the building and provide a more human scale.
- The Smithsonian has installed temporary protection around the museum grounds, as needed, to protect people from the risk of stone panels falling from the building due to the existing conditions of the exterior wall. A limited number of Echo Lake granite panels were installed in the NASM facade in 2014 as a temporary replacement for existing cladding panels.
- Sixty-five percent of the overall building façade is enclosed with stone cladding; thirty-five percent of the overall building façade is enclosed with glass.

RECOMMENDATION

The Commission:

Finds that Tennessee Pink Marble (limestone) is the most appropriate cladding material based on aesthetic and historic preservation criteria because it offers a combination of pattern and color range appropriate for a monumental building where the cladding is one of the main architectural expressions. The Commission also recognizes that these are not the only criteria informing the cladding decision.

Notes that the Smithsonian analyzed over eighty different stones, and several manufactured materials over the last two years, which resulted in a shortlist of five cladding options most compatible with the original design of the building. Selection criteria included aesthetic, historic preservation, technical performance, procurement, and risk.

Notes the shortlisted options included: Tennessee Pink Marble (Limestone), St. Clair Limestone, Echo Lake Granite, Colonial Rose Granite and Ultra High Performance Concrete.

Notes that since the shortlist was developed, the Smithsonian has conducted additional analysis regarding the technical performance of each option and has arrived at the following findings:

- Tennessee Pink Marble (Limestone) has technical performance issues both because of the building's metal frame and the stone itself; and therefore, it is not a long-term solution.
- Limestones have durability and maintenance challenges. Limestones are generally less resistant to pollutants, surface mold and algae growth; and require additional cleaning which can lead to surface damage.
- While a thicker panel of Tennessee Pink Marble (Limestone) or another limestone could address the issues associated with technical performance, there is no example of a successful long-term performance application of limestone on a light steel frame without masonry backup.

- Granite is more durable for a light steel frame application without masonry backup and provides a better long-term solution. Granite is also resistant to pollutants, surface mold and algae growth; and allows a more aggressive cleaning process.

Notes that the Smithsonian has selected Colonial Rose Granite as their preferred stone because they have found it provides the best overall value considering all the criteria.

Finds that while Colonial Rose Granite has a warm pink color comparable to the existing cladding, and is durable; it is also a very homogenous stone, lacking the wide range of color variation and horizontal striations that characterize Tennessee Pink Marble (Limestone) and make the museum's façade interesting.

Upon consideration of the Smithsonian's findings, supports Colonial Rose Granite as the preferred cladding alternative and strongly encourages increasing the percentage of stone panels with color variation and horizontal pattern in the design specifications to avoid a monolithic facade. If uniform panels must be used, disperse and minimize its use, increase tonal variation and avoid juxtaposing similar panels to achieve the randomness of the original façade.

Supports the sandblasted finish because it provides a timeless effect similar to the existing building.

Requests that the Smithsonian continue to consult with NCPC staff on any future mockup of Colonial Rose Granite to test different combinations of color pattern and veining, as well as the glazing mockup.

PROJECT REVIEW TIMELINE

Previous actions	**July 10, 2014** – Information presentation for the Smithsonian National Air and Space Museum (NASM) Comprehensive Facilities Master Plan. **July 7, 2016** – Approval of comments on the overall concept design for the Building Exterior, Vestibules and Site Improvements at the NASM. The cladding selection was not included in the concept submission. **April 6, 2017 –**Information presentation on the NASM exterior cladding options and site visit to review cladding and paving aesthetic mockup on site.
Remaining actions (anticipated)	**–** Preliminary and final approval of site and building plans for the overall project components.

PROJECT ANALYSIS

Executive Summary

The revitalization of the National Air and Space Museum has more challenges than a new construction project, in particular the cladding replacement of this existing building is a complex task due to the museum's prominent location and significance on the National Mall; its unique exterior wall system; and project goals, such as maintaining the character of the original design; ensuring 100-year cladding longevity, and keeping the museum open during construction. The Smithsonian has performed an extensive evaluation of aesthetics and historic preservation; technical performance; procurement and risk to find a quality, durable material that provides a permanent solution. The cladding is one of the most significant characteristics of the building's original design that contributes to its identity within the National Mall Historic District. The cladding replacement will improve safety, the visitor experience and allow the museum to better perform its mission. The cladding replacement will also enhance the envelope performance by providing proper insulation, and reducing energy consumption. The project is consistent with the Comprehensive Plan for the National Capital, in particular with policies in the Urban Design; Federal Environment; Historic Preservation; and Visitors and Commemoration Elements.

Analysis

The staff analysis focused on urban design, environmental, historic preservation and visitor experience considerations and the project's consistency with relevant policies included in the Comprehensive Plan.

Original Design Intent
When the building was originally designed in the 1970s, the design intent was to create 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." Staff finds that the final result was successful by achieving a timeless design that blends with the context.

The designers carefully studied the way the building met the ground, scale, massing, and the relationship to the surrounding buildings on the National Mall, in particular the West Building of the National Gallery of Art (NGA), which is located directly across the National Mall, and was built 35 years earlier. The NASM responds to the West building through its massing and materiality, in particular through the use of the following common elements:

- Height, alternation of solids and voids, and entrance axis.
- Exterior cladding consisting of Tennessee Pink Marble (Limestone), as well as similar stone panel size and horizontal orientation.

Although the cladding replacement will not affect the building massing or height, it might change the scale perception and its relationship with the context. The cladding itself, is the most visible connection between the NASM and the National Gallery of Art, playing an important role in the design, not only in the larger context of the National Mall but within the building itself. Given that

the NASM building is massive, consisting of 685 feet in length, 225 feet in width, and 83 feet in height; occupies three city blocks; and lacks of ornamentation; both color variation and texture soften the scale of the building. At a closer view, the horizontal striations of Tennessee Pink Marble parallel to the coursing of the panels, the rectangular panel size, and cladding horizontal orientation emphasize horizontality and mitigate the height of the building, thus, contributing to the human scale. Across the Mall, and from the US Capitol the cladding color variation and random gradation provide an interesting façade, complementing the simple massing of the building.

The National Mall Context

The NASM has a strong visual relationship with the National Gallery of Art complex, in particular the West Building (built in 1941) which is located directly to the north across the National Mall. After the NASM was built, new additions to the National Gallery of Art complex along the National Mall followed the same exterior cladding selection to maintain a visual harmony. Both the East Wing of the National Gallery of Art, which was under construction concurrently with NASM, opening two years later in 1978; and the National Gallery of Art Sculpture Garden, which opened in 1999, used Tennessee marble to reflect the historic character of the West Building. The stone cladding is used on the benches that surround the fountain and the piers at the garden entrances. The NGA complex and the NASM were designed by different architects, following different architectural styles, and built at different periods. However, the common material palette weaves the different elements, and provides a sense of continuity along the National Mall.

Another building clad in the same material on the National Mall is the National Museum of the American History (1964). Its visual relationship with NASM and the National Gallery of Art is less evident, given the stone panels vertical orientation and lighter color range, and also its location a few blocks to the west. While the material connection is stronger on the north side of the National Mall, in particular within the NGA complex, the NASM is the only building on the south side of the National Mall clad in Tennessee Pink Marble. Several museums have been built on the National Mall before and after the NASM. Overall, the museums facing the National Mall have a warm color palette, which contrast with the white color of the US Capitol. Refer to *Table 1* for a list of museums along the National Mall and their respective exterior cladding.

From the beginning, the choice of building material has been an important consideration to express the distinction of Smithsonian's buildings. The Castle, the Smithsonian's first building, was clad in red sandstone to provide a striking contrast to the pale sandstone used for the capital's earlier public buildings. Similarly, the Hirshhorn Museum, located to the west of the NASM, was clad in precast concrete mixed with a crushed aggregate of pink granite; and the National Museum of American Indian, located to the east, was clad in yellow tone limestone. Although each museum represents a specific time in history, both examples reflect their mission through their unique massing and warm cladding expression. The National African American History and Culture, the most recent Smithsonian's museum, has a unique bronze-colored metal lattice cladding. Although the cladding materials are different, including concrete, limestone, and metal, the color palette is consistently warm throughout the National Mall.

While the relationship with the West Building of the National Gallery of Art is still important due its location directly across the NASM, as well as the rest of the NGA complex, the NASM should

consider its relationship with the rest of the buildings along the National Mall, and its cladding selection should be consistent with the warm color palette. While earlier museums tried to blend easily and relate to each other through the use of similar cladding materials to unify the entire Mall, recent museums have been more expressive of their missions, using unique cladding materials.

	Museums and Gardens on the National Mall	Completion Date	Exterior Cladding	Architectural Style	Architect
1	The Castle	1855	Red Seneca Sandstone	Romanesque Revival	James Renwick Jr.
2	Arts and Industry Building	1881	Polychrome (red and buff) Brick	High Victorian	Adolf Cluss
3	National Museum of Natural History	1911 (after McMillan Commission)	Bethel, Milford Pink, and Mount Airy Granites	Beaux Arts	Hornblower and Marshall
4	Freer Gallery of Art	1923	Stoney Creek Granite (courtyard is faced with a white Tennessee Marble)	Italian Renaissance Revival	Charles A. Platt
5	West Building of the National Gallery of Art*	1941 (35 years before NASM)	Tennessee Pink Marble	Neoclassical	John Russell Pope
6	National Museum of American History	1964 (12 years before NASM)	Tennessee Pink Marble	Post-War Modern	Walter O. Cain of McKim, Mead and White
7	Hirshhorn Museum and Sculpture Garden	1974	Precast concrete mixed with a crushed aggregate of pink granite	Brutalist Modern	Gordon Bunshaft of Skidmore, Owings and Merrill
8	National Air and Space Museum	1976	Tennessee Pink Marble	Late 20th-century Modern	Gyo Obata, of Hellmuth, Obata Kassabaum
9	East Building of the National	1978 (two years after NASM)	Tennessee Pink Marble	Modern	I. M. Pei

	Gallery of Art*				
10	The Quadrangle Complex: Ripley, Sackler, African Art, and Enid A. Haupt Garden	1987	Limestone, warm gray Granite	Post-Modern	Jean-Paul Carlhian of SBRA and Junzo Yoshimura
11	National Gallery of Art Sculpture Garden*	1999 (23 years after NASM)	Tennessee Pink Marble	Post-Modern / Art-Nouveau	OLIN landscape architect
12	National Museum of the American Indian	2004	Textured golden-colored Kasota Limestone	Expressionist	Douglas Cardinal with GBQC; Polshek Partnership
13	National Museum of African American History and Culture	2016	Latticework of Bronze-colored cast-aluminum panels	Expressionist	David Adjaye and lead architect Philip Freelon
	Installations clad in Tennessee Pink Marble			**Not part of the Smithsonian Institution*	

Table 1: List of museums along the National Mall

Sources: https://www.si.edu/content/ahhp/pdf/ahhp_brochure_web.pdf
A Guide to Smithsonian Architecture by Heather Ewing and Amy Ballard

As mentioned above, the building design consist of four simple but monumental limestone volumes, linked by atria, void of traditional ornamentation. The alternation of solids and voids varies along the main facades, 65 percent of the overall building façade is enclosed with stone cladding; and 35 percent of the overall building façade is enclosed with glass. While the north elevation along Jefferson Drive has a more even proportion of stone and glass, with 40 percent glazing, 60 percent stone; the southern façade consist mostly of stone, with 25 percent glazing, 75 percent stone. The cladding plays a key role complementing and flattering the building design.

Across the National Mall, the tone variation provides an interesting visual effect that emphasize the building horizontality. At a close distance, the horizontal striations of each panel add detail and make the building appear less massive. Aside from the visual connection along the National Mall, and historic preservation implications, staff **finds** that Tennessee Pink Marble (Limestone) is the most appropriate cladding material based on aesthetic and historic preservation criteria because it offers a combination of pattern and color range appropriate for a monumental building where the

cladding is one of the main architectural expressions. The Commission also recognizes that these are not the only criteria informing the cladding decision

Existing Conditions

The existing exterior wall consist of two feet and six inches tall by five feet wide, and one and a quarter inch thick Tennessee Pink Marble (Limestone) panels with spray applied foam insulation covering the back of the stone, and a vertical plenum within the wall cavity to provide air flow.

On July 4, 1976, the National Air and Space Museum was dedicated as the first event in America's bicentennial celebration. The NASM was built under a tight budget and schedule, in order the complete the building on time value engineering solutions that differed from the original design intent included:

- Thin (one and a quarter inch thick) Tennessee Pink Marble limestone panels instead of three-inch-thick stone panel.
- Light steel frame cladding support instead of more traditional masonry back-up wall construction.
- Spray foam insulation applied on the back of the stone with an adjacent air cavity.
- Precast concrete exterior pavers with exposed aggregate, instead of stone pavers, which were replaced with granite pavers in 1986 (ten years after the museum opening).
- Acrylic skylights instead of glass, which were replaced in 2001.

As a result of downgrading building components from the original design and applying alternative design solutions to create a curtain wall that required less steel and stone, the building has a very unusual exterior wall system design and cladding support. Forty years later, the stone facade must be removed for several reasons:

1. Extensive warping (hysteresis) and cracking is irreversible and has been intensified 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.
2. Lack of adequate resistance to water penetration or air infiltration.
3. Lack of effective flashings and air barrier continuity between the exterior walls and other building envelope systems (curtain wall, skylight, roofing, or soffits).
4. Condensation within the wall cavities.

Previous Commission comments

Last summer, the Commission commented favorably on the overall concept design for the Building Exterior, Vestibules and Site Improvements at the Smithsonian National Air and Space Museum (NASM). At the time, the cladding selection was not included in the concept submission. The Commission comments focused on the terrace improvement alternatives, perimeter security, streetscape amenities, circulation, landscape, and security vestibules. With its comments, the Commission noted that the existing exterior stone cladding needed to be completely replaced due to extensive deterioration caused by the original wall system design. The Commission recommended further consultation with NCPC, the U.S. Commission of Fine Arts, and the District of Columbia State Historic Preservation Office to identify an appropriate cladding material. If Tennessee Pink Marble, the original stone, was determined to be infeasible, the Commission recommended to 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.

In April 2017, SI provided an information presentation to the Commission on the building exterior and site walls cladding options. SI also presented a large on-site mockup to the Commission prior to the meeting to evaluate how four proposed cladding options and the associated terrace paving fitted within the setting of the National Mall. During the information presentation, the applicant sought input on the cladding alternatives based on historic preservation and aesthetic considerations. The mockup included four cladding options under consideration: 1) Ultra High Performance Concrete (UHPC), 2) Echo Lake Granite, 3) Tennessee Pink Marble and 4) Saint Claire Limestone. Colonial Rose, the fifth cladding option, was not part of the mockup.

During the mockup review, the Commissioners had to opportunity to see the samples wet due to the weather. The Commissioners appreciated the Smithsonian's effort of providing a mockup to evaluate cladding options and commented that Tennessee Pink Marble was a perfectly viable solution, if the technical problems could be solved. They noted that Saint Claire Limestone was problematic due to its gray color since the objective was to preserve the existing look. They found that concrete had a certain appeal to it, but it was flat due to the lack of aggregate. They noted that Echo Lake granite was too busy and swirly, especially when wet, and seemed contrary of the simplicity of the building. The Commissioners noted that emphasis should be given in finding an inherently beautiful material rather than matching the West Building of the National Gallery of Art, since there are very different cladding materials along the Mall.

Envelope Performance Criteria

According to the submission materials, the exterior wall assembly must meet the following performance criteria:

1. Provide durability of a 100 year envelope with proper maintenance;
2. Prevent water infiltration;
3. Provide a continuous air barrier;
4. 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;
5. Provide blast resistance and limit fire propagation;

The cladding analysis is based on criteria that includes four categories:

1	Aesthetic	1. Provide a material with a warm tone 2. Provide a material that has a limited veining pattern 3. Provide a material that has tonal variation among adjacent panels 4. Provide a material that has a mineral composition 5. Provide a material that has a monumental appearance appropriate for application on the National Mall 6. Provide a material that has limited visual contrast relative to the existing interior stone to remain 7. Provide a material that supports the original design concept

2	Technical Performance	1. Provide a material that supports a 100 year envelope with proper maintenance 2. Provide a material that is suitable for application on a light steel framed building without masonry backup 3. Provide a material that is resistant to pollutants, surface mold and algae growth
3	Procurement	1. Provide a material that is quarried within North America and fabricated within the United States 2. Maintain the eligibility of the building to be added to the National Register of Historic Places
4	Risk	1. Material to be available in a sufficient quantity that can be extracted at a rate that accommodates the construction schedule

Table 2: Cladding Selection Criteria

Tonal variation among adjacent panels was an important consideration to help modulate the facade for a more human scale, articulating the existing stone clad volumes that are otherwise void of architectural ornamentation. The technical aspects of the replacement cladding are also important to ensure durability and mitigate the risk of the performance issues evident with the existing installation.

Comments on the Cladding Mockup

As mentioned above, the Smithsonian constructed a cladding mockup on the northeast corner of the NASM terrace. The following are staff comments for each option based on aesthetics.

Saint Claire Limestone

1. The horizontal pattern is consistent with the existing Tennessee Pink Marble pattern.
2. The simple pattern will work with the etched signage of the museum.
3. The appearance of the stone does not change significantly in wet or dry conditions.
4. The gray color lacks the warmth from the existing stone.
5. The color looks even among panels, lacking the randomness achieved with the original Tennessee Pink.
6. There is insufficient quantity of the preferred beige tone, according to the Smithsonian.
7. It has technical disadvantages relative to granite, according to the Smithsonian.

Tennessee Pink Marble (Limestone)

Based on the aesthetic mockup, staff found that Tennessee Pink was the most appropriate choice. Staff agreed with the SHPO's comment regarding concerns about the level of variation among stones in the mockup and the degree of angled veining, noting that the specifications would need to be tightened to have better consistency. Similar to St. Claire Limestone, it has technical disadvantages because of the building's light steel frame with no masonry backup.

Echo Lake Granite

1. The swirly pattern is too busy and contradicts the simplicity of the building form.
2. It lacks the horizontal pattern, and it does not complement the horizontal stone panel size.

3. The color changes considerable when is wet, it looks light pink when dry, but when is wet it turns dark brown and the pattern is very noticeable and dramatic, unlike anything else on the Mall.
4. It has the potential to appear dated.

Ultra-High Performance Concrete

1. Recycling the existing stone has environmental benefits, but in a large facade, this material will be too flat.
2. It does not look timeless or appropriate for the mall. It lacks character, and does not have a noticeable pattern.
3. The panels seem to be receding in the mockup installation, there are some issues with the joints.

The submission package indicates that 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 durability, high density, and customizable color and tone. However, this material is relatively new with and its 100-year longevity has not been proven. Further, the replacement of the existing stone cladding with a manufactured material had historic preservation concerns, and may not be compatible with the National Mall.

Colonial Rose Granite

During the site visit staff noted that Colonial Rose Granite appeared too monochromatic and would result in monolithic facades if selected. The stone cladding needs variety to subtly articulate the facades. The SI recently installed additional mock-up panels of Colonial Rose granite. The new stones show the wider range of color and veining available.

Additional Technical Performance Analysis

Since the Commission saw the mockup, the Smithsonian has concluded an additional technical performance analysis. The Smithsonian found that although the development of the wall assembly details could 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.

According to the submission materials, three-inch thick limestone or two-inch thick granite on a wall assembly with masonry backup provides the desired balance of strength and weight, while offering an enclosure system expected to meet the 100-year lifespan requirements. Unfortunately, the introduction of a masonry backup is cost-prohibitive due to the need for extensive reinforcement of the existing structural frame and foundation, as the NASM was originally designed for the light steel cladding support. There are no successful examples of limestone on a wall assembly without a masonry backup. Furthermore, limestones are generally less resistant to pollutants, surface mold and algae growth; and require additional cleaning which can lead to surface damage. Granite, on the other hand, is a much more dense and durable material that is

easier to maintain. It also has a proven track record of long-term performance and therefore became the Smithsonian's preferred type of stone. Of all the granites analyzed, the tone of Colonial Rose most closely resembles Tennessee Pink Marble.

Therefore staff recommends that the Commission:

Notes that the Smithsonian analyzed over eighty different stones, and several manufactured materials over the last two years, which resulted in a shortlist of five cladding options most compatible with the original design of the building. Selection criteria included aesthetic, historic preservation, technical performance, procurement, and risk.

Notes the shortlisted options included: Tennessee Pink Marble (Limestone), St. Clair Limestone, Echo Lake Granite, Colonial Rose Granite and Ultra High Performance Concrete.

Notes that since the shortlist was developed, the Smithsonian has conducted additional analysis regarding the technical performance of each option and has arrived at the following findings:

- Tennessee Pink Marble (limestone) has technical performance issues both because of the building's metal frame and issues with the stone itself; and therefore, it is not a long-term solution.
- Limestones have durability and maintenance challenges. Limestones are generally less resistant to pollutants, surface mold and algae growth; and require additional cleaning which can lead to surface damage.
- While a thicker panel of Tennessee Pink Marble (Limestone) or another limestone could address the issues associated with technical performance, there is no example of a successful long-term performance application of limestone on a light steel frame without masonry backup.
- Granite is more durable for a light steel frame application without masonry backup and provides a better long-term solution. Granite is also resistant to pollutants, surface mold and algae growth; and allows a more aggressive cleaning process.

Notes that the Smithsonian has selected Colonial Rose Granite as their preferred stone because they have found it provides the best overall value considering all the criteria.

Finds that while Colonial Rose Granite has a warm pink color comparable to the existing cladding, and is durable; it is also a very homogenous stone, lacking the wide range of color variation and horizontal striations that characterize Tennessee Pink Marble (limestone) and make the museum's façade interesting.

Upon consideration of the Smithsonian's findings, supports Colonial Rose as the preferred cladding alternative and strongly encourages increasing the percentage of stone panels with color variation and horizontal pattern in the design specifications to avoid a monolithic facade. If uniform panels must be used, disperse and minimize its use, increase tonal variation and avoid juxtaposing similar panels to achieve the randomness of the original façade.

Supports the sandblasted finish because it provides a timeless effect similar to the existing building.

Requests that the Smithsonian continue to consult with NCPC staff on any future mockup of Colonial Rose to test different combinations of color pattern and veining, as well as the glazing mockup.

CONFORMANCE TO EXISTING PLANS, POLICIES AND RELATED GUIDANCE

Comprehensive Plan for the National Capital

As noted above, this project meets basic goals of the Comprehensive Plan. In particular, the project is consistent with the policies included in the Urban Design; Federal Environment; Historic Preservation; and Visitors and Commemoration Elements. The Urban Design Element includes policies that encourage the federal government to adhere to high aesthetic standards already established by the planning and design legacy of the nation's capital; and visually reinforce the preeminence of the U.S. Capitol, and Washington Monument by protecting the visual frame around them. The cladding replacement will be constructed with quality, durable materials to protect the public investment and reflect the National Capital Region's image. The color of the cladding will be warm in keeping with the National Mall palette and contrasting with the pale cladding of the US Capitol. The Federal Environment includes policies to optimize the efficiency of heating, ventilation, and cooling systems to reduce energy. The project will maintain a safe, comfortable and pleasant environment consistent with the Visitors and Commemoration Element. Lastly, the design intent is to select a cladding that is compatible with the qualities and character of existing building and its settings, and maintain eligibility of the museum for listing National Register of Historic Places, which is consistent with the Historic Preservation Element.

National Historic Preservation Act

The NASM is a contributing element of the National Mall Historic District, which is listed in the National Register of Historic Places. The NASM is not currently listed on the National Register of Historic Places or the District of Columbia Inventory of Historic Sites and is currently 41 years old. For purposes of Section 106 review, the District of Columbia State Historic Preservation Officer (DC SHPO), SI, and NCPC have agreed that the building is individually eligible for listing in the National Register, and shall be treated as such to maintain its existing character.

Both the Smithsonian and NCPC have an independent responsibility to satisfy the requirements of Section 106 of the National Historic Preservation Act (NHPA). NCPC's approval of the plans is an undertaking under Section 106 of the National Historic Preservation Act. The Smithsonian's construction of the project is an undertaking as well. The Smithsonian formally initiated consultation with the DC SHPO in September 3, 2014. On September 5, 2014, the SI followed up with a second initiation letter that included the security screening vestibules. The SHPO responded by letter dated October 3, 2014, and commented that alternative materials such as granite, metal

or synthetic panels would likely result in adverse effects on the museum and the surrounding historic district.

According to the assessment of effects on historic properties prepared as part of the Section 106 process, the overall project components will change the character of the building and result in cumulative adverse effects on the building and the National Mall Historic District. Adverse effects will result by altering the exterior stone cladding, which is one of the most notable character defining features of the museum and an element that establishes a strong visual connection to the similarly clad National Gallery of Art. In addition, adverse effects will result from changing several other features of the property's setting that contribute to its historic significance, including alteration to terraces, relocating sculptures and introducing new vestibules.

On a letter dated June 14, 2017, the DC SHPO expressed concerns about the Section 106 process and SI's final determination to clad the building with Colonial Rose granite rather than Tennessee Pink Marble limestone without sharing the technical basis for the selection with the SHPO and consulting parties prior to the final determination. The SHPO indicated that cladding the museum in Colonial Rose granite would diminish the museum's integrity of design and materials and constitute a very significant adverse effect on the historic property. Further, the use of Colonial Rose would compromise the integrity of the museum to such degree that it would render the building ineligible for individual listing in the National Register of Historic Places. As a result, the SI has circulated the cladding technical reports to the SHPO and NCPC staff for review and additional Section 106 consultation is ongoing. An agencies consultation meeting with SI, the Advisory Council on Historic Preservation (ACHP), NCPC and SHPO took place on June 29, 2017 to discuss the technical report. An additional consulting party meeting will take place in the future to focus on mitigation measures.

NCPC staff will continue to participate in the consultation process, which must be completed prior to the Commission's final action. The SI, NCPC and SHPO will seek to execute a Memorandum of Agreement prior to the submission of the proposal to the Commission for final review. Three consulting parties meeting and two cladding review opportunities have been conducted to date. Refer to *Table 3* below for a summary of consulting parties meetings and cladding mockup review opportunities.

National Environmental Policy Act

NCPC in cooperation with SI prepared the Revitalization of the National Air and Space Museum Draft Environmental Assessment (EA) to fulfill its obligation under the National Environmental Policy Act (NEPA). NCPC has an independent NEPA obligation resulting from its approval authority over the project, and is the lead responsible federal agency for NEPA compliance. The SI, a trust instrumentality of the United States, is the project owner.

The Draft EA analyzed the potential environmental impacts of a no action and three action alternatives for the revitalization of the NASM, including replacement of the deteriorating Tennessee Pink Marble (limestone) cladding on the facade, skylights and curtain wall, building systems, vestibules, revitalization of the terrace and landscaping. The cladding alternatives under

consideration included 1) Tennessee Pink Marble in-kind replacement; 2) other natural stones with similar appearance to original cladding such as granite and limestone; and 3) a manufactured material, such as ultra-high performance concrete (UHPC). The Draft EA analyzed each of the alternatives for impacts to the following environmental topic areas: historic resources; visual resources; visitor experience; circulation; planning policies; sustainability; air quality; noise levels; vegetation; stormwater management; floodplains; topography; solid waste; hazardous materials and wastes; and climate change and carbon footprint.

NCPC solicited public input on the scope and content of the Draft EA byway of a public meeting and its website. The Draft EA was available for a 30-day public comment period from March 31 to May 1, 2017. Following review and consideration of the comments received, NCPC and SI will issue a Finding of No Significant Impact (FONSI) prior to the submission of the proposal to the Commission for preliminary review. SI and NCPC have held the following NEPA/Consulting parties meetings and mockup review opportunities:

Consultation Meetings and Cladding Mockup Review Opportunities	Date
Joint NEPA/Section 106 Public Scoping Meeting #1	November 12, 2014
Section 106 Consulting's Party Meeting #2 (Vestibules and Terraces)	February 22, 2016
Joint NEPA/Section 106 Public Meeting #3 (EA Discussion and Cladding Mockup Review Opportunity of four cladding options)	April 7, 2017
Additional Cladding Mockup Review Opportunity of four cladding options	April 6, 2017
Joint NEPA/Section 106 Follow-up (Cladding Mockup Review Opportunity of an additional stone - Colonial Rose)	June 8, 2017

Table 3: Summary of public meetings and mockup review opportunities (as of July 6, 2017)

CONSULTATION

Coordinating Committee

The Coordinating Committee reviewed the proposal at its June 21, 2017 meeting. Without objection, the Committee forwarded the proposed comments on revised concept design to the Commission with the statement that the proposal has been coordinated with all participating agencies. The participating agencies were: NCPC; the District of Columbia Office of Planning (DCOP); the District Department of Transportation (DDOT); the District of Columbia State Historic Preservation Office (DCSHPO); the District Department of Energy and Environment (DOEE); the General Services Administration (GSA); and the Washington Metropolitan Area Transit Authority (WMATA).

The SHPO noted that their coordination is conditioned upon satisfactory completion of the Section 106 review process, including the execution of Memoranda of Agreement, as applicable. DDOT requested information about the property line on Independence Avenue to determine the extent of public space and suggested that the paving along the public space/sidewalk should follow DDOT standards. The Smithsonian indicated that the paving material will be part of the future preliminary submission, which will address DDOT's paving comments.

U.S. Commission of Fine Arts

As part of the broader review of modifications to the NASM building and its grounds, the Commission of Fine Arts (CFA) has reviewed the project three times. An initial concept review of the overall project took place on June 18, 2015; a revised concept focusing on the terraces and visitor screening pavilions was held on June 16, 2016; and more recently, CFA reviewed options for the replacement of the exterior stone cladding of the Smithsonian Institution's NASM on June 15, 2017.

In its meeting of June 15, 2017, CFA was pleased to inspect on-site samples and mockups of the exterior cladding options during two visits to the museum, and approved the Smithsonian's preferred choice of "Colonial Rose" granite in a sandblasted finish. CFA expressed appreciation for the thorough analysis of the multiple cladding options proposed for this prominent museum on the National Mall. While accepting the use of stone as a replacement for the existing "Tennessee Pink" limestone, they expressed regret that a more innovative or technologically advanced material, consistent with the museum's mission, would not be used. In endorsing the proposed option of "Colonial Rose," they commented favorably on its durability and its visual compatibility with the nearby National Gallery of Art. Noting that this type of granite is usually selected because of its predominantly uniform pattern and flat appearance, they advised the careful specification of the stone, with varied tonal qualities and pronounced horizontal veining, to ensure a suitable level of visual modulation on the building's facades. CFA looks forward to reviewing the results of the architectural and technical performance mockups, as well as documentation of the selection process, in addition to the further review of the overall project for the rehabilitation of the museum and site.

ONLINE REFERENCE

The following supporting documents for this project are available online:

- Submission Package

Prepared by Vivian Lee
07/06/2017

POWERPOINT (ATTACHED)

National Capital Planning Commission

NCPC File # 7585
Smithsonian National Air and Space Museum Building Exterior, Vestibules and Site Improvements - Cladding Replacement

Independence Avenue at 6th Street, SW
Washington, DC 20560

Smithsonian Institution

Revised Concept

National Capital Planning Commission

Site Location

National Mall Building Envelope and HVAC Revitalization - Development Timeline

National Mall Building Envelope and HVAC Revitalization

1960 1970 1980 1990 2000 2010 2020

INITIAL DEVELOPMENT AND CONSTRUCTION

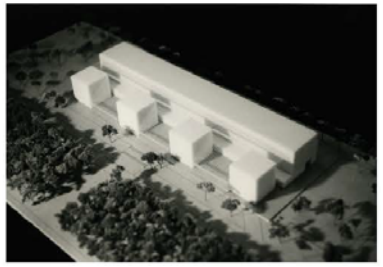
- 1958 Congress authorized preparation of plans and specs for the National Air Museum (NAM) on The National Mall
- 1962 Feasibility study completed by Harbeson, Hough, Livingston, and Larson
- 1963 Hellmuth, Obata and Kassabaum (HOK) selected to design the NAM
- 1964 HOK design completed and approved by review agencies
- 1966 Congress authorized construction but deferred funding due to the cost of the Vietnam War
- 1972 Congress authorized funding for redesign to reduce cost to $40m budget for construction completion by 1976 Bicentennial
- 1972 Museum design approved by CFA and NCPC
- 1972 Museum groundbreaking
- 1975 Museum construction completed
- 1976 Exhibit installation completed and museum opened to the public on July 1

ISOLATED REPAIRS AND RENOVATIONS

- 1978 Removal of collapsible revolving doors due to concerns with emergency egress.
- 1985 Façade repaired along the parapet and skylights due to water ingress
- 1986 Terrace renovated with the replacement of precast-concrete pavers and steps with granite pavers
- 1988 Restaurant addition and associated site modifications constructed
- 1988 Emergency exit doors rehabilitated
- 1990 Roofs replaced
- 1991 Exterior ramps installed and exterior stairs renovated
- 1992 Snow melter repaired
- 1995 Stone façade restored with widened joints and the installation of plastic weep holes and new sealant assemblies
- 2001 Skylights and curtain wall replaced
- 2004 Perimeter security installed

REVITALIZATION

- 2018 NASM Envelope and HVAC Revitalization construction targeted commencement
- 2024 NASM Envelope and HVAC Revitalization targeted completion

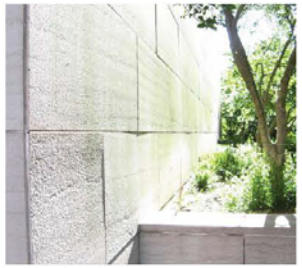


Early Proposal to Review Agencies in 1972

Grand Opening 1976

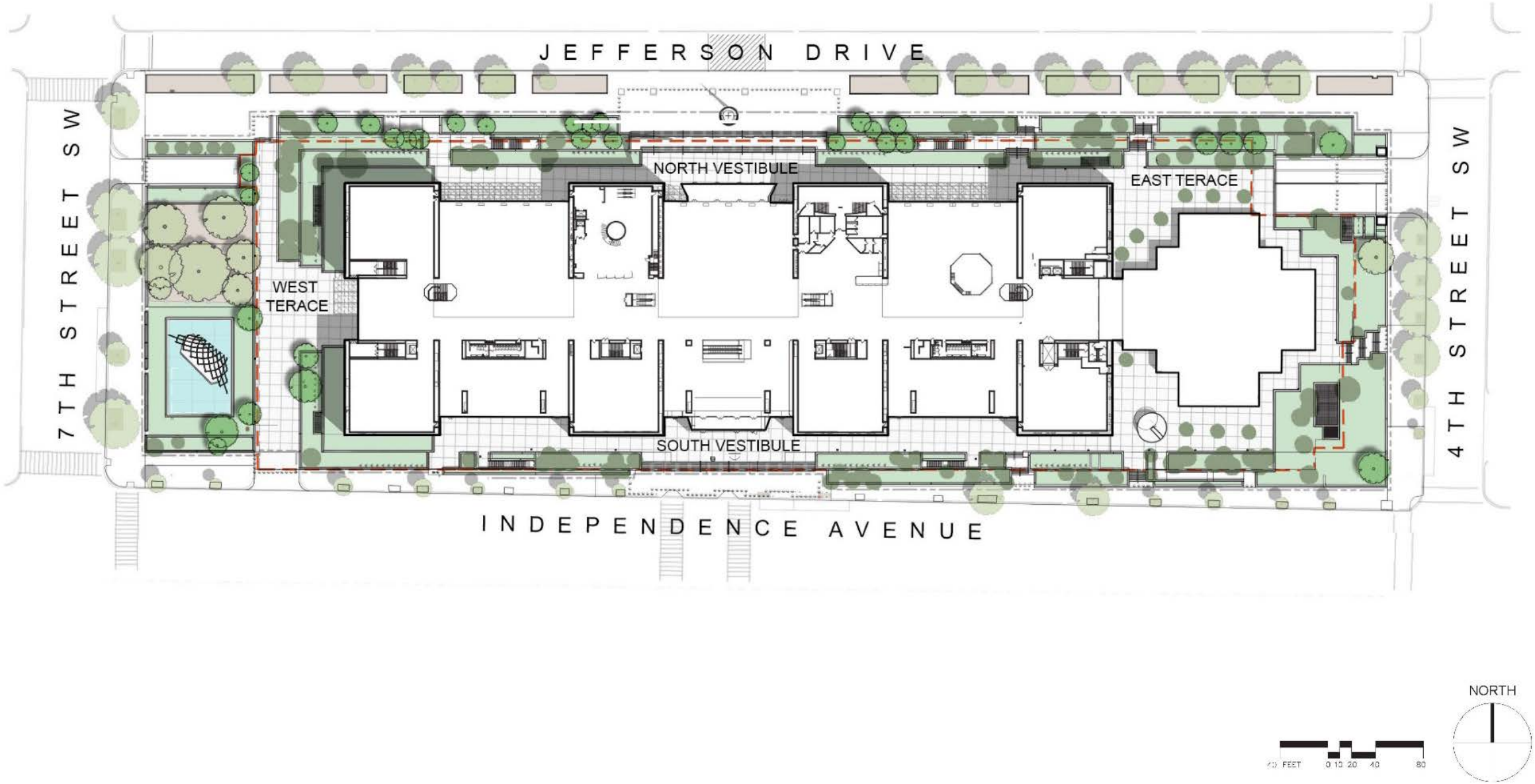
Restaurant Addition 1988

Perimeter Security 2004

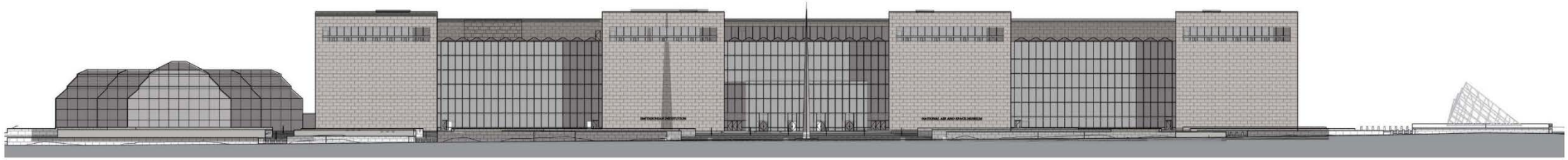


Proposed Revitalization 2024

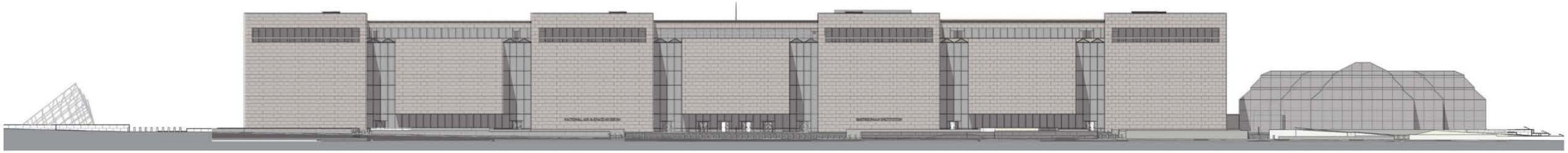
Existing Site Plan



Existing Elevations



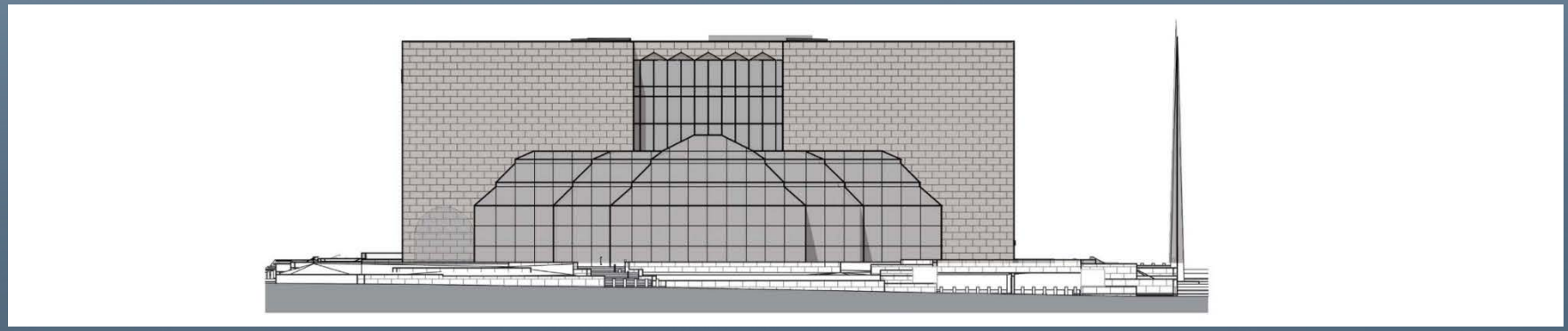
North Elevation



South Elevation

Existing Elevations

East Elevation



West Elevation

Cladding Selection Criteria Matrix

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)		Similar (Tone and Some Texture)
Color Range (Panel to Panel)		Good		Limited		Some		Some
Texture / Banding		Striations		Striations		Variegated with Large Dark Swirls		Variegated with Fine Specks and Limited Banding
Tonal Warmth		Yes		Limited		Yes		Yes
Finish		Bush Hammered (one step)		Light Water Jet / Sand Blast (two step)		Sand Rubbed (one step)		Textured (two step: washed and sand rubbed)
Technical								
Full Fabrication Infrastructure (in place as of today)		No		Yes		Yes		Yes
Ability to Meet Project Schedule / Construction Rate		No		Yes		Yes		Yes
Recovery Rate (% Yield) Anticipated		10-25%		25-30%		20-25%		30-35%
Quality Control (QC) of Panel Materials		Significant Additional QC Required		Least Complicated		Some Complication (Tighter Range Required)		Least Complicated
Quarry Site Lay-Down* Area Available		No		Yes		Yes		Yes
Procurement								
Location of Quarry (within/beyond 500 miles)		Within (Friendsville, TN)		Beyond (Marble City, OK)		Beyond (Ely, MN)		Beyond (Lac Du Bonnet, Manitoba)
Location of Production (within/beyond 500 miles)		Within (Friendsville, TN)		Beyond (Tate, GA)		Beyond (Cold Spring, MN)		Beyond (Cold Spring, MN)
Risk								
Schedule Impacts (QC / Yield / Constructability)		High		Low		Low		Low
Availability of Acceptable Material & Range		Uncertain		Certain		Uncertain		Certain
Durability (100 year material lifespan)		Good**		Good**		Good		Good
Available for Future Selective Replacement		Fair		Good		Fair		Good
Analysis								
Acceptable	8		9		7		11	
Requires Further Consideration	2		5		8		5	
Not Ideal	6		2		1		0	
General Notes								

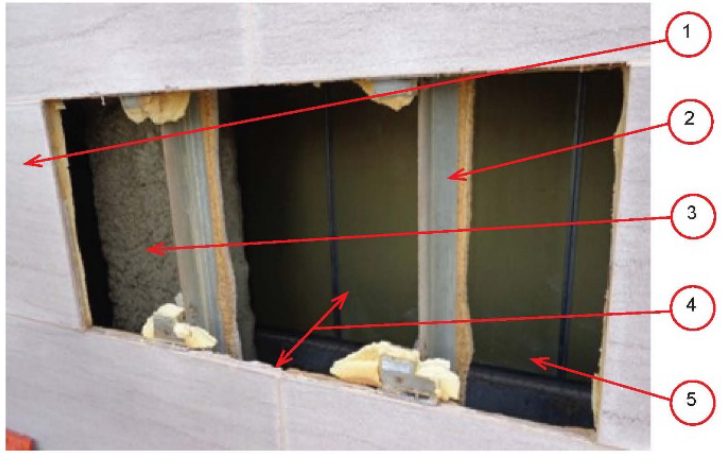
Capacity assumed good at all quarries. Available variation to be confirmed through further analysis of stones other than Tennessee Marble; this impacts recovery rate.

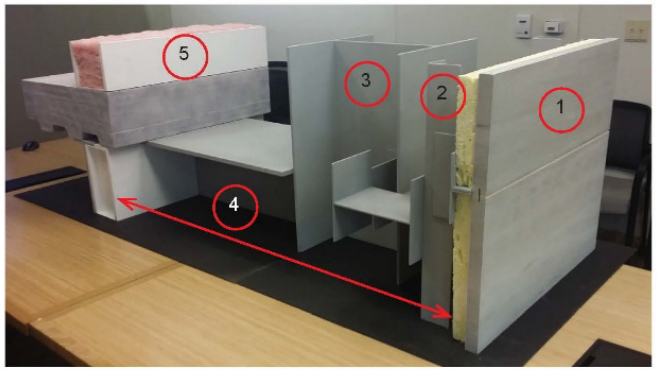
* Lay-down area refers to controlled space at the quarry that is large enough to assemble one entire NASM stone facade bay.

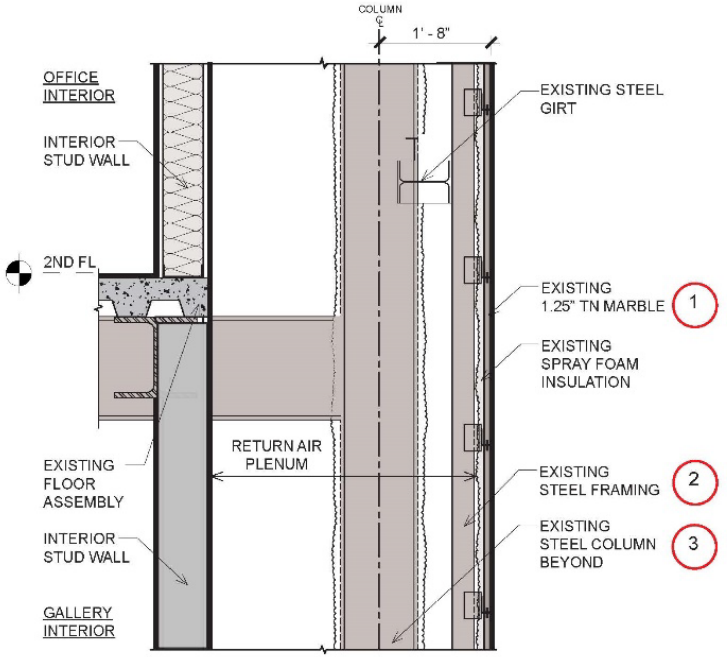
** No long-term precedent of these materials in a rain-screen, steel frame construction installation in a similar climate.

National Capital Planning Commission

Existing and Proposed Stone Cladding Replacement Details



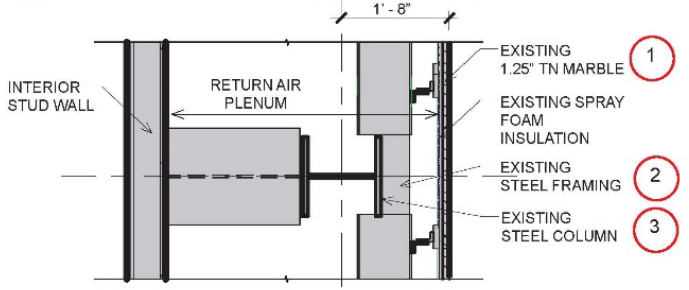




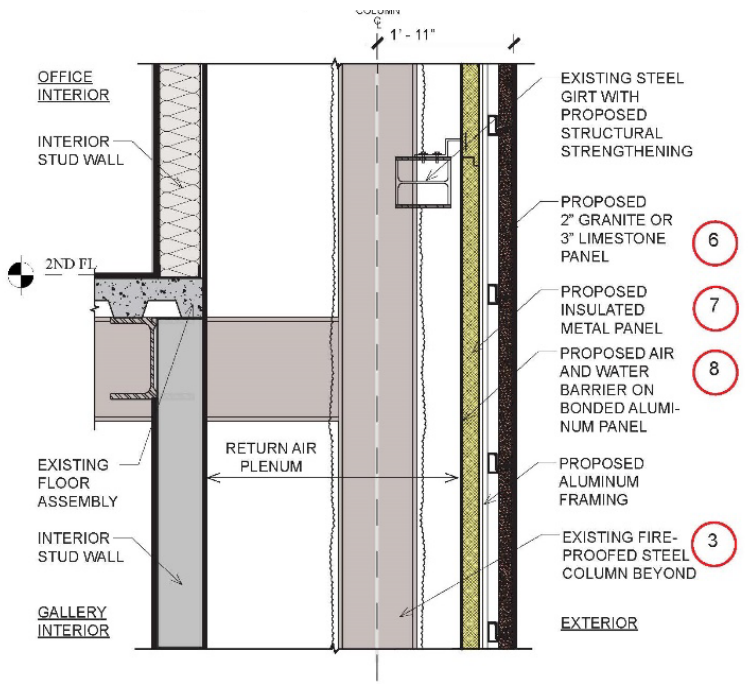
Existing Wall Section

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



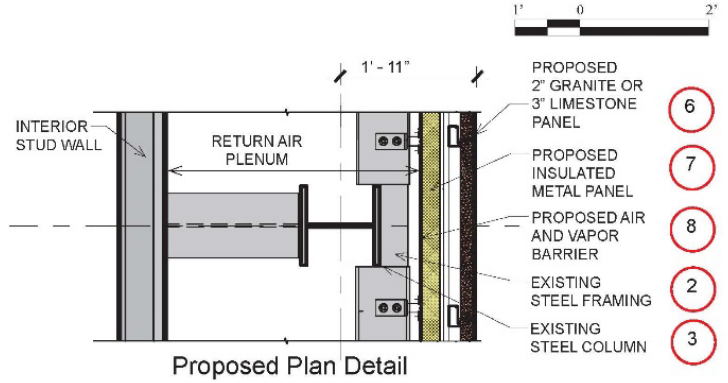
Existing Plan Detail



Proposed Wall Section

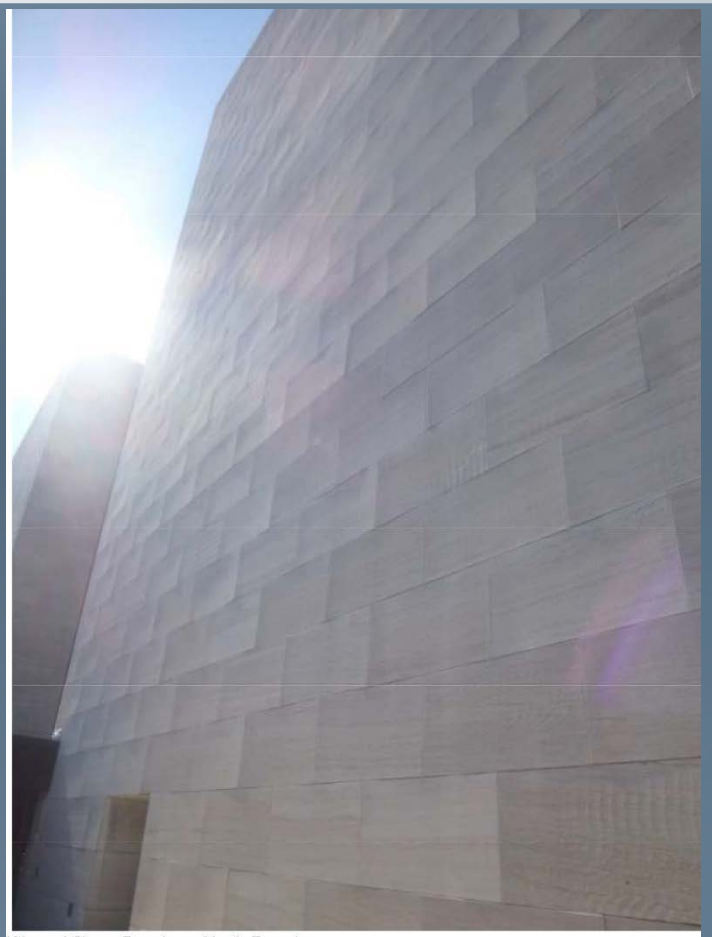
Proposed new wall construction consists of the following upgrades from exterior to interior:

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 Cladding Alternatives



Warped Stone Panels on North Facade

Warped Stone Panels on West Facade

Tennessee Pink Marble

Alternate Stone

Titanium

Ultra High Performance Concrete

Cladding Replacement Options: Tennessee Pink Marble (Limestone)

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:

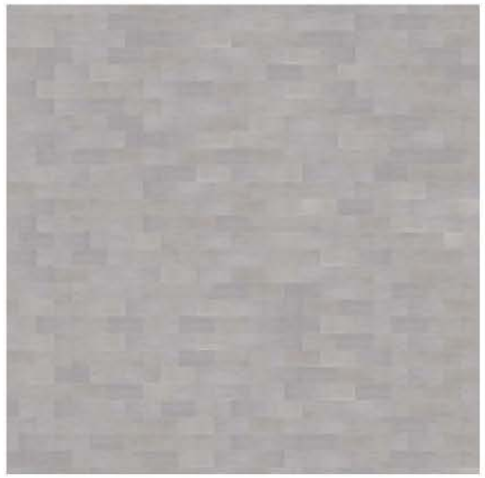
- Procurement will include time for quarry start-up and longer fabrication schedule
- Broad color range requires more extensive quality control
- Requires less aggressive cleaning process to avoid surface damage
- Less resistant to pollutants, and surface mold and algae growth
- Fabrication facility 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

Cladding Replacement Options: Saint Clair Limestone

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:

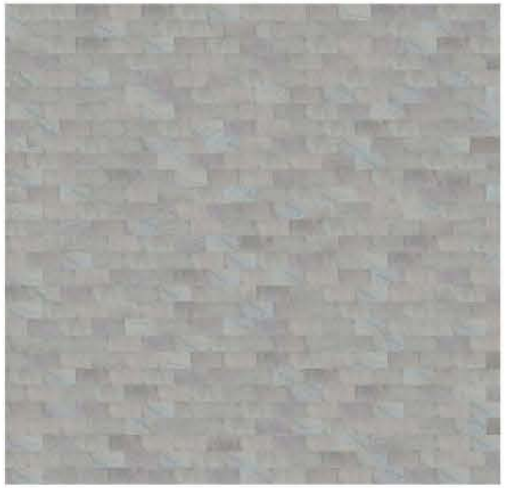
- Light grey color tone is too grey and not appealing for the large areas of stone involved on the NASM exterior facade
- Less resistant to pollutants, and surface mold and algae growth
- Requires less aggressive cleaning process to avoid surface damage

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

St Clair Quarry in Marble City, Oklahoma

Cladding Replacement Options: Echo Lake Granite

Echo Lake Sample



Echo Lake Photomontage

Advantages:

- Warm tone (when dry) comparable to Tennessee marble
- High density, durable granite (100+ year stone longevity)
- Production time feasible
- 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:

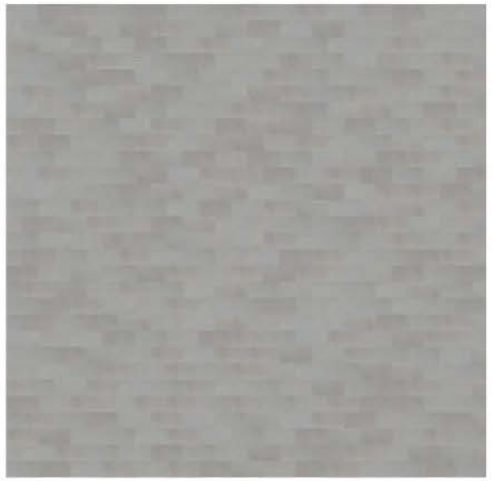
- Fine, linear veining pattern not present (busy swirling texture that is less compatible with interior Tennessee Pink)
- Broad range of color and pattern requires more extensive quality control
- Darkens considerably when wet

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

Echo Lake Quarry in Ely, Minnesota

Cladding Replacement Options: Colonial Rose (Lac Du Bonnet) Granite

Colonial Rose Panel, National Japanese American Memorial



Colonial Rose Photomontage

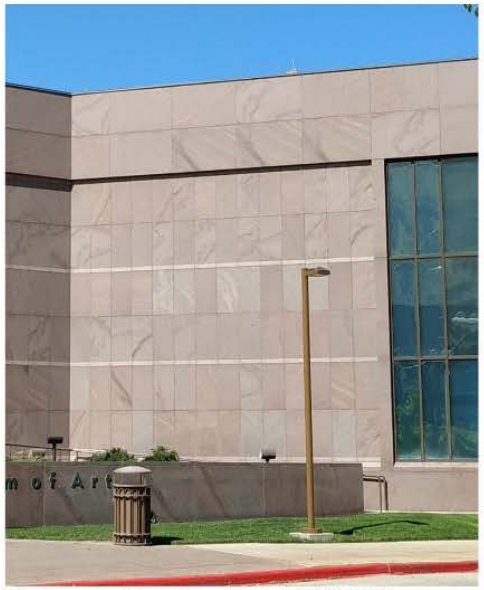
Advantages:

- 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
- Production time feasible
- 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

Proposed Cladding: Colonial Rose Granite

South Elevation

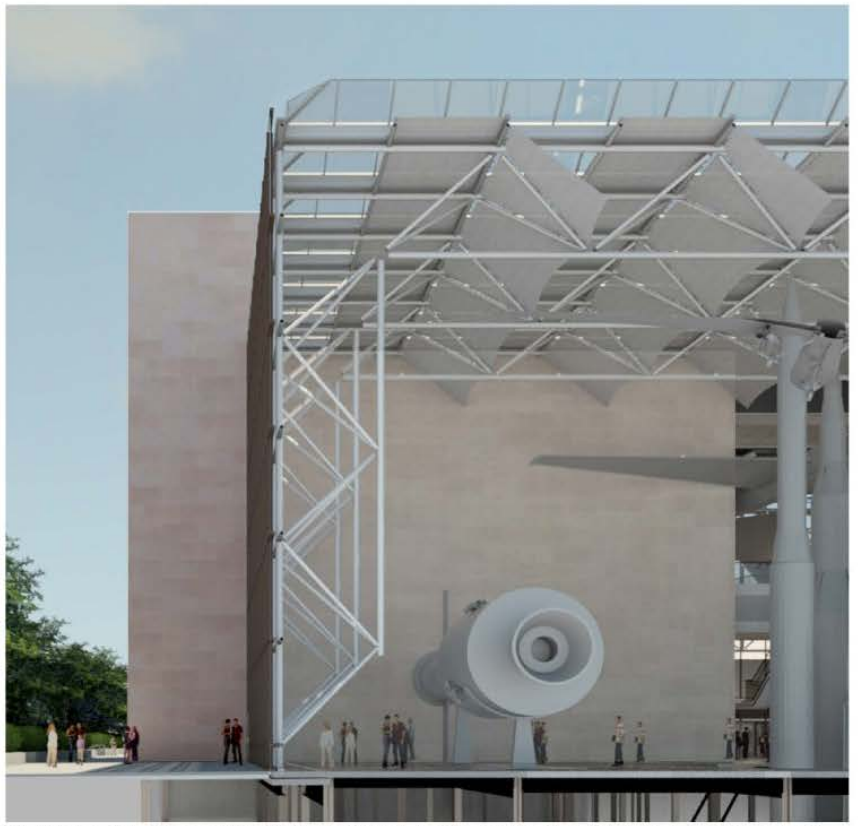
Proposed Cladding: Colonial Rose Granite

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 Exterior Renderings

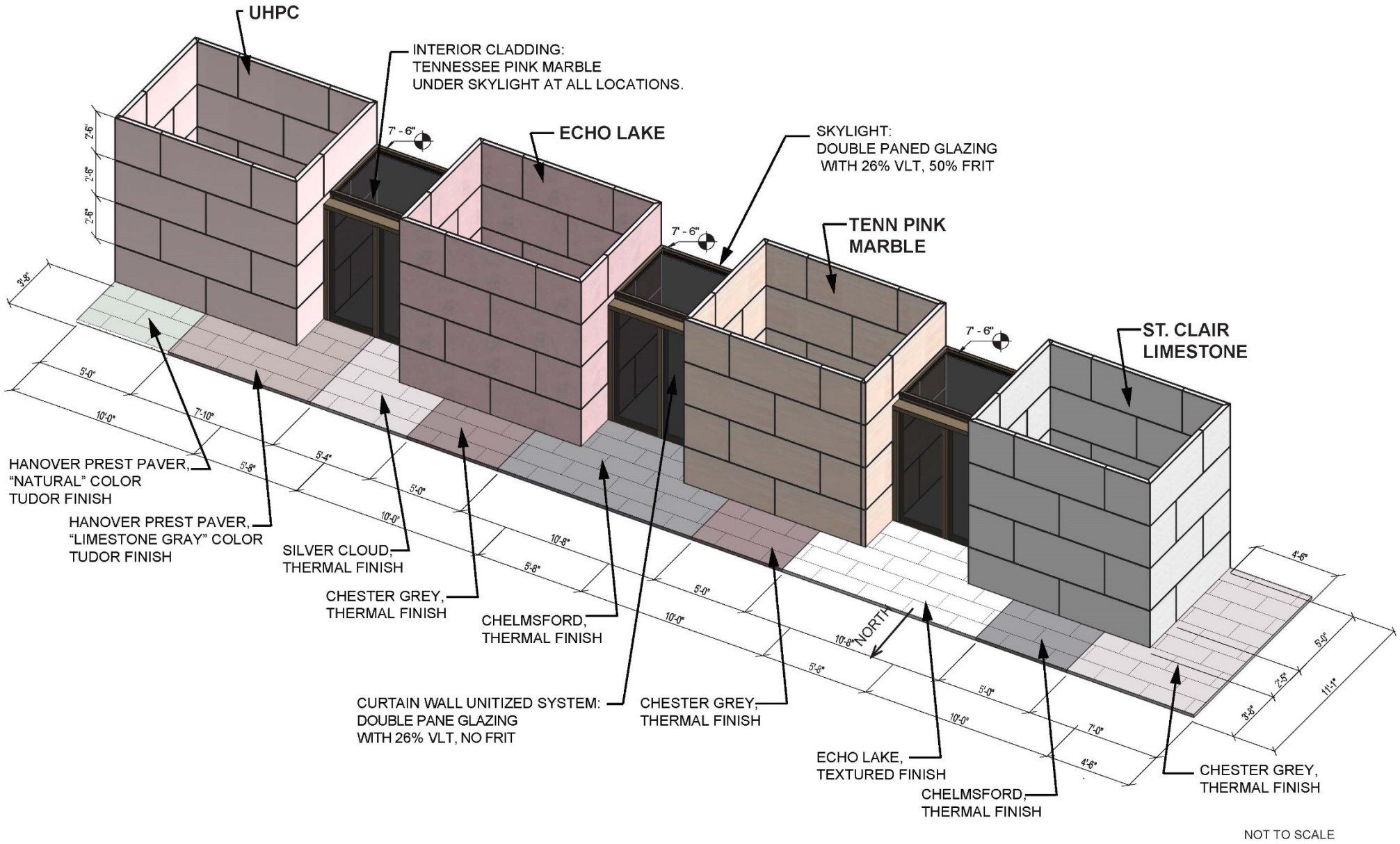
Partial North Elevation with North Vestibule Option



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

Cladding Aesthetic Mockup Isometric



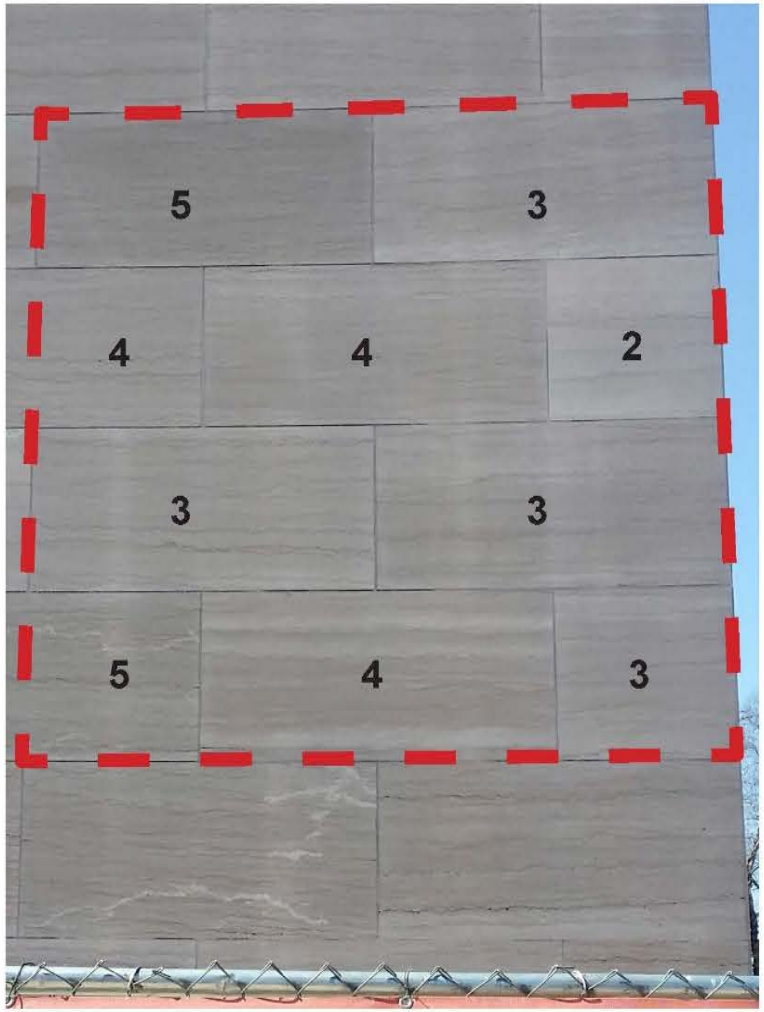
Cladding and Paving Aesthetic Mockup Photo

photo taken in overcast light,
stone retaining some moisture

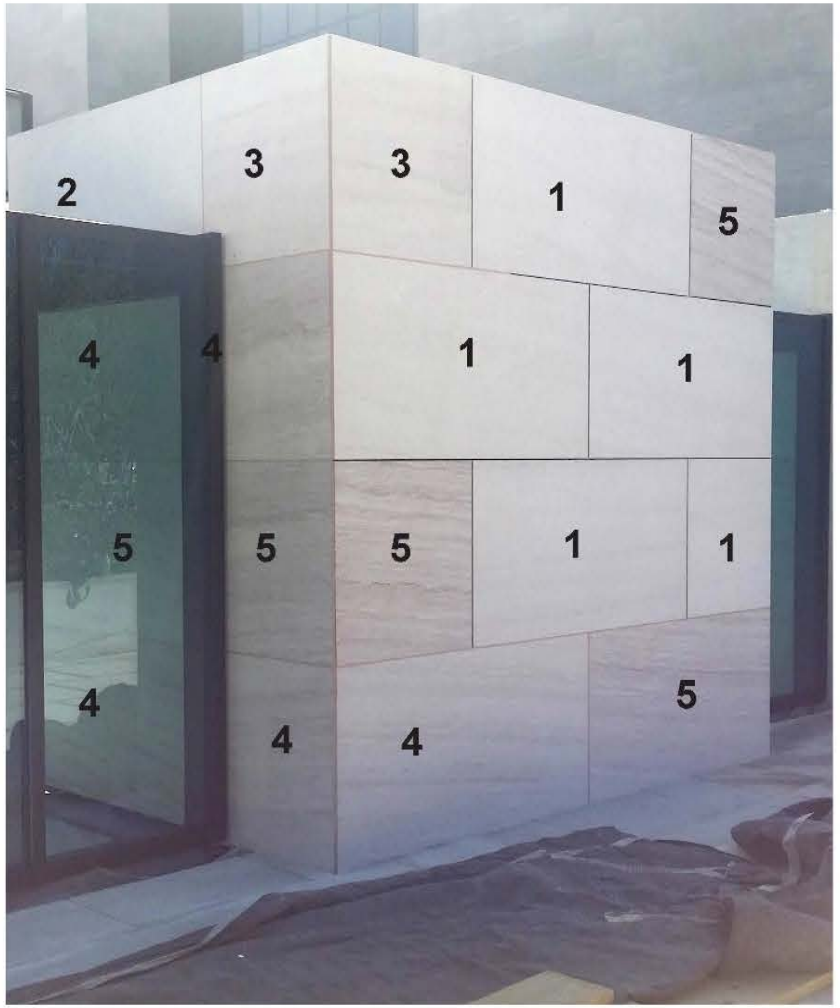
National Capital Planning Commission

Tennessee Marble Existing Cladding and Mockup

Existing Tennessee Marble
East Elevation



Tennessee Marble Mockup
North & East Elevations



Tennessee Marble Mockup
South & West Elevations

TENNESSEE MARBLE COLOR RANGE KEY

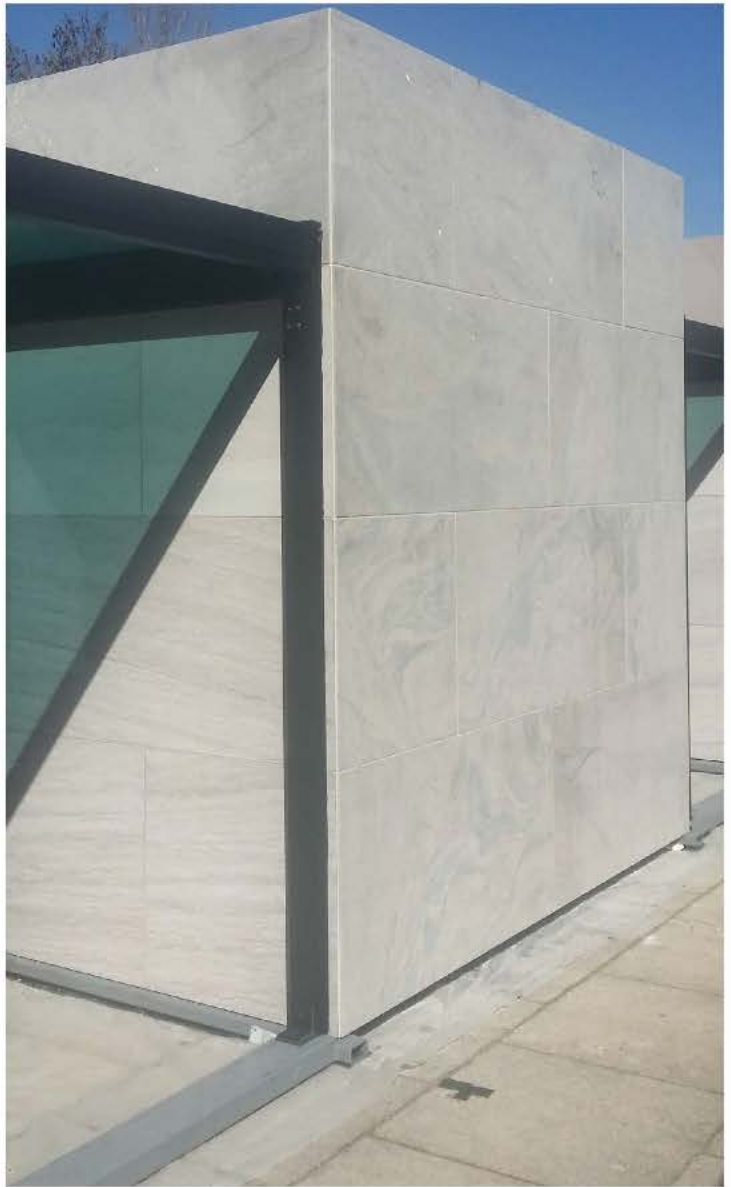
1. Light Pink
2. Medium Pink
3. Dark Pink
4. Light Cedar
5. Medium Cedar

National Capital Planning Commission

St Clair, Echo Lake, and UHPC Mockups

St Clair Mockup
South & East Elevations

Echo Lake Mockup
South & West Elevations



UHPC Mockup
South & West Elevations

Echo Lake and Colonial Rose Supplemental Mockups

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 fleuri 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.

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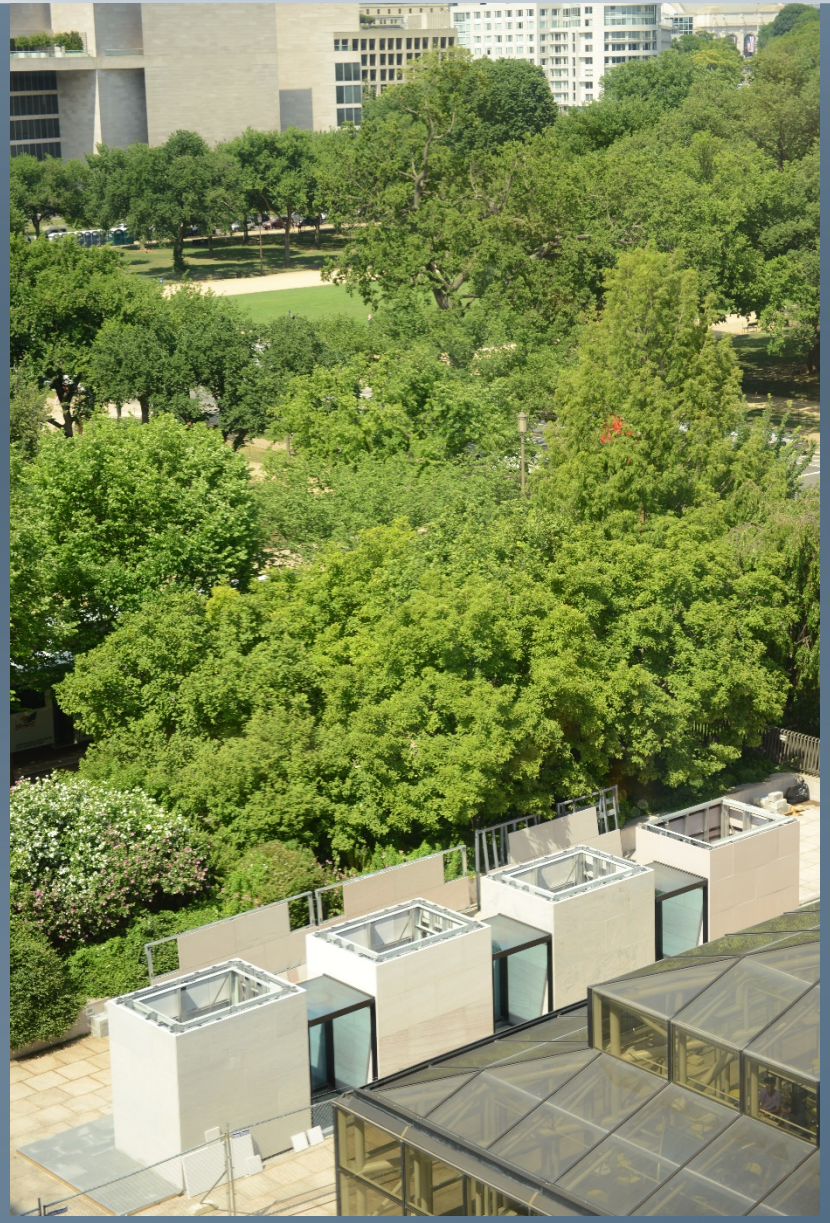
Colonial Rose Supplemental Mockups



Looking northeast from the NASM 3rd floor cafeteria toward the cladding mockup and NGA east building

View Looking west

View Looking east

Colonial Rose Supplemental Mockups – Surface Finishes

Thermal (flamed) – Rough Finish

This finish is used primarily for exteriors applications where slip-resistance is extremely important.

Sandblasted– Smooth Finish

This treatment produces a smooth abrasion, leaving the material with a slightly scratched (but not rugged) surface.

The color tones and the veins are slightly dulled.

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Cladding Matrix

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
DURABILTIY 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	CHALLEGING	CHALLEGING	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_2 (lbs CO_2) %	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

National Capital Planning Commission

Global Stone Research 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

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 Travernelle	Travertine	Vetter Stone Company
Missouri Red	Granite	Granites of America
Missouri Red	Granite	Keystone Granite
Montana Travertine	Travertine	Idaho travertine

Global Stone Research 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

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
Tennesse 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 Research List and Stone Filtering Matrix

Stone Name	Type	Source
Valders Grey Vein	Vein	Valders Stone and Marble
Variegated Indiana Limestone	Limestone	Indiana Limestone Company
Vegas Rock	Quarzite	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