Quantifying Visitor Impact and Material Degradation at George Washington's Mount Vernon

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QUANTIFYING VISITOR IMPACT AND MATERIAL DEGRADATION
AT GEORGE WASHINGTON’S MOUNT VERNON

A Thesis
Presented to
the Graduate Schools of
Clemson University and the College of Charleston

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Historic Preservation

by
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Accepted by:
Dr. Carter L. Hudgins, Committee Chair
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ABSTRACT

Over one million visitors per year traverse the visitor path through George Washington's home at Mount Vernon. Increased visitation has tested the limits of the architectural materials and created the single most threatening source of degradation. While the history of Mount Vernon is dotted with attempts to mitigate damage caused by visitors, scientific analysis of the dynamic impacts to the historic fabric is needed to preserve the integrity of the preeminent national house museum. The following thesis presents a holistic analysis of visitor impact and material degradation occurring at Mount Vernon.

Visitor impact issues are acknowledged at historic sites around the world; however, comprehensive study and measurement of direct wear and tear are rare. Analyzing the patterns of abrasion, material build-up, and microclimatic conditions, this thesis creates standards to quantify material degradation. These tests developed can easily be replicated and applied at any house museum. The findings in this thesis are only the beginning of attempts to better understand visitor impact and further illustrate the need for future research on material loss and decay. As house museums age, material loss is inevitable. Responsible managers can mitigate the detrimental effects of well-meaning, but often harmful, visitors by better understanding the rate at which damage occurs.
ACKNOWLEDGEMENTS

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CHAPTER ONE
INTRODUCTION

Surface wear and debris build-up on architectural fabric and finishes are visible, and oftentimes unavoidable, consequences of pedestrian traffic in historic house museums. The wear and tear caused by the great number of visitors to Mount Vernon provides an extreme case of accelerated material degradation. Over one million visitors a year equates to one million bodies dispersing dust and dirt, two million feet eroding the wooden thresholds, and ten million fingers touching the handrails, chair rails, plaster walls, and door openings. This thesis is an attempt to document and quantify the material degradation occurring at Mount Vernon.

Visitor impact has been a constant issue at Mount Vernon since George Washington’s time and accounts of damage are numerous. However, most responses to damage to the mansion were reactionary rather than proactive and there has been little effort to quantify the rate of wear. As a holistic approach to measuring visitor impact, this study examines the history of visitors, current areas of material deterioration, comparative issues at similar historic sites, mitigation efforts, visitor experience, and preservation ethics. Understanding the rate at which degradation occurs and the long term impact to the lifespan of the structure are pivotal to the management and practical application of proper preservation and mitigation strategies.

The methods employed to measure visitor impact are varied because the types of wear at Mount Vernon are dissimilar. Finish loss to faux graining, dirt and oil-build up on walls, loss of wooden material on thresholds, and temperature and relative humidity fluctuations are just some of the issues of concern. Chapter Two of this thesis discusses the
methodology employed for each attempt to quantify material degradation. The results of the studies are found in Chapter Seven.

Placing visitor impact in context with the larger history of Mount Vernon, Chapter Three examines the various roles visitors have held. During the time of George Washington, visitors were guests. Following his death they became mourners and pilgrims. And today, visitors are tourists. Each role affected the mansion in different ways – financially during Washington’s time, patriotically during the mourning period, and aesthetically today.

Chapter Five further defines and identifies the current areas of damage to Washington’s mansion. Identified areas of damage are compared in Chapter Six to damage found at Thomas Jefferson’s Monticello and Colonial Williamsburg. The purpose is to determine if the wear present at Mount Vernon is similar in type and degree to that experienced at other historic sites. Monticello and Colonial Williamsburg were chosen because both experience high volumes of visitors and are located in a similar climate. To further validate the current issues at Mount Vernon, studies were conducted at historic house museums in Charleston, South Carolina measuring wear on similar materials vulnerable to visitor impact. These studies included the creation of a plaster touch panel, the measurement of wooden stair tread degradations, and the calculation of temperature and relative humidity fluctuations. The results of these studies are found in Chapter Eight.

Recommendations on mitigation are also proposed including programmatic solutions, physical installations, and further studies. Programmatic solutions discuss alterations of administrative policies, procedures, and training guidelines to limit visitor impact. Physical installations look at practical applications such as the placement of stanchions and Plexiglas barriers along the visitor path. Further studies advocate additional
research on surface coatings and varnishes that are removable, yet protect vulnerable surfaces.

A holistic study of visitor impact at Mount Vernon has never been completed. Studies that quantify visitor wear are limited and come primarily from European research. Visitor impact is a problem faced by historic sites all around the world from the Caves at Lascaux to Westminster Abbey. As visitation continues on an upward trend, understanding wear patterns becomes increasingly important for all sites. Being cognizant of patterns of wear not only assists in protecting future losses but can lead to a better understanding of how to best preserve a site while still making it accessible to the public.

What this thesis achieves through the holistic study of visitor impact, is an understanding of the rate of material deterioration in historic house museums. Variables including, but not limited to, material type, the number of visitors, and existing maintenance efforts will always be present and must be taken into account. However, the standards developed for the quantification of wear provide material-specific tests that can be used by any historic site.

The role of Mount Vernon in the American historic preservation culture is one that is wrapped in patriotism and progress. As the home of George Washington, it serves a symbolic role in the American national identity. As a restored historic site, it is a marker for the beginning of the historic preservation field. While wear and tear issues continue to be problematic, the discussion and attention drawn to them with this thesis is not to admonish visitors to Mount Vernon but merely to identify the undue effects of an abundance of visitors to this historic site.
CHAPTER TWO

METHODOLOGY

A multi-faceted approach to quantify material degradation was employed to address the numerous visitor impact issues at Mount Vernon. The methods selected to quantify wear depended on the type of material that was being tested and its location. Calculating wear and tear that occurred along the visitor path allowed visitor impact to be separated from wear caused by previous residential use of the structure, staff use, environmental factors, and inherent material failures. The direct impacts that were measured included: the expansion of dirt and oil build-up on plaster wall surfaces, loss of finish material on faux-grained doorway architraves, loss of material on wooden thresholds and stair treads, and fluctuations in temperature and relative humidity levels.

Quantifying Wear at Mount Vernon

The first part of the process to quantify visitor impact was to identify the visitor path through the mansion and the areas most susceptible to wear. To accomplish this, a regular mansion tour was taken on July 10, 2012 at 1:30pm. Each stop on the tour, including areas where visitors lagged while waiting to proceed to the next segment, was noted. The tour served a dual purpose to identify current locations of wear but also to understand visitor behavior including what visitors touch and lean against. Several independent physical inspections were also completed to document and measure the wear and tear along the visitor path.

Faux Graining Wear

The faux graining on the second floor landing of the Central Passage is subject to heavy finish loss from visitor impact. The architraves of six doors adjacent to the landing are faux grained. These architraves are significantly worn due to the confined space of the
landing and its place as a stopping point along the mansion tour. Because of the continued wear the faux graining is re-applied every January.

To quantify the finish’s rate of degradation, initial measurements and photographs were taken in July 2012. Measurements were taken again in December 2013, prior to re-graining, to calculate the average amount of finish loss over a six and twelve month period. The beginning vertical location of the wear, relative to the floor, and its maximum vertical height along with its width, were recorded. The vertical expansion of the area of finish loss measured in December is expressed as a percentage of the area of finish loss measured in July to determine a six month rate of wear.

*Dirt and Oil Expansion on Plaster Walls*

The inspection of the mansion also identified dirt and material build-up on the plaster walls as a primary issue of concern. The wall surfaces that were not purposefully blocked by ropes, Plexiglas, or some other restrictive barrier were subject to pedestrian impact. Visitors traveling through the mansion touch the walls with their hands and lean against them with their bodies. Coats, book bags, purses, and other objects carried by visitors impact the wall surface as well, transferring debris or causing scrapes and abrasions. For the purposes of this thesis, the surface area of the dirt and oil build-up on the walls is referred to as the dirt field.

Three separate locations in the mansion were studied to quantify the rate of horizontal and vertical expansion of dirt and oil build-up on the plaster walls. These locations included the Servant’s Hall, the Central Staircase Landing, and the Rear Staircase Landing. The measureable data was collected between July 9, 2012 and August 10, 2012. The maximum and minimum height of the dirt field as well as its width was calculated using a standard tape measure. Photographs were taken to quantify the time it took for the dirt
field to appear and expand on clean surfaces. Using a Nikon D5000 DSLR camera, the locations were photographed three times per week between 7:00am and 8:30am. Two photographs were taken on the automatic setting, one with a flash and one without, to account for any variation in daylight. Measurements, photographs, and daily observations are located in Appendix A of this thesis.

Servants’ Hall – East Wall near the South Door

While not connected to the mansion, the east wall in the Servant’s Hall was chosen because it is the beginning of the mansion tour. It is also a narrow space and vulnerable to visitor contact. The camera was set on an adjustable tripod at a static height of 23”. The front leg of the tripod was placed 22” to the south and 62.5” to the west of the east wall. The tripod was set at a height lower than that in the Central and Rear Staircase Landings to avoid the obstruction of a wooden railing.

![Figure 2.1 – Tripod setup for the east wall in the Servants’ Hall. (Photograph by author.)](image)
Central Staircase Landing – East Wall

The east wall of the second floor Central Staircase Landing was studied for two reasons. First, this landing is one of the most confined spaces in the mansion. It has many exposed surfaces including architraves, walls, baseboards, and the staircase banister. The only barriers are Plexiglas shields in the doorways of the adjacent rooms. Second, the east wall of the landing is one of the largest continuous surfaces in the space, allowing measurements to be easily obtained.

The camera was set at a static height of 35” with the front leg of the tripod placed 35” to the south and 65” to the west of the east wall. The tripod was set at a static height of 35” because of the proximity of the Central Staircase banister. The camera was situated at the farthest location to the west in order to obtain the largest surface area of the east wall in the photograph. At this location, an automatic timer was used to avoid background shadows due to back lighting from the central stairway window to the west.
**Rear Staircase Landing - East & South Walls**

The walls of the Rear Staircase Landing are adjacent to George Washington's Bedchamber. This is one of the most popular locations on the mansion tour as it is where Washington passed away. It has been decorated to reflect the furnishings present during his lifetime, with many of his personal possessions on display as well. Visitors clamor for the chance to peer into the room, and the narrow passageway does little to aid in reducing contact with the walls. Both the east and south walls are adjacent to the rear staircase and as visitors make the turn in the hallway to head downstairs, they often make contact with the wall surfaces.

The camera was set on the tripod at a static height of 48”. The front leg of the tripod was placed 28” to the west and 3.5” to the south of the southwest edge of the stair railing. The right leg of the tripod rested against the baseboard of the west wall. In addition to the standard photographs, one picture was also taken focusing on the southeast corner and one taken farther to the west to capture both the east and south walls in the same photograph.

*Figure 2.3 – Tripod setup for the east and south walls in the Rear Staircase Landing. (Photograph by author.)*
Wooden Threshold Degradation

The wooden thresholds of the mansion doorways were also identified as areas subjected to constant visitor traffic and heavy wear. The amount of material loss on the thresholds was measured to determine an average rate of wear. Four thresholds were measured: the northwest entry door, the southwest exit door, the northeast exit door, and the east Central Passage entry door. The data collection for wooden degradation was restricted to thresholds because the flooring and staircases along the visitor path are covered by a high-traffic carpet and measurements were not possible.

Measurements were completed using a 4’ metal level and metal compass. The level was placed horizontally across the top of the thresholds to rest upon the unworn outer edges. The compass was then used to measure the gap in the middle of the thresholds where the loss occurred. Using a Pacific brand architect’s scale, the distance on the compass was measured to determine the amount of material loss. The classification of the wooden material and its original date of installation were also noted for analysis. The results of all three Mount Vernon quantitative wear studies are listed in Chapter Seven of this thesis.
Quantifying Wear on a Micro-Scale

The second segment of obtaining quantitative visitor impact data was obtained in historic house museums that serve less than sixty thousand visitors per year. To allow the data obtained at Mount Vernon to be useful at other locations, it is important to understand how the impacts occurring at these smaller museums relate with those at Mount Vernon. Studies conducted at the Aiken Rhett House, the Nathaniel Russell House, and the Joseph Manigault House in Charleston, South Carolina further tested the materials previously identified as vulnerable. The principle purposes of these studies were to validate the visitor impact at Mount Vernon and to better understand the type of wear occurring there. Three studies conducted include the use of a plaster touch panel to test material build-up on finished surfaces, the measurement of wooden stair tread degradation, and temperature and humidity monitoring.

Touch Panel Study

A plaster touch panel was constructed to continue the study of dirt, dust and biological oil build-up on surfaces. The touch panel served as a representation of a plaster wall section. It was painted with three of the surface finishes found along the visitor path at Mount Vernon. The purpose of the panel was to encourage visitors to physically touch the painted surfaces with their hands. This illustrated not only the effect of hands on historic materials but also provided data on the rate of material build-up and the interaction of the build-up with the finished surfaces. Three sections of the finishes were exposed, while three were protected by a Plexiglas cover, allowing for a control.

Fine Paints of Europe’s Hollandlac Satin paint is found on the baseboards, some chair rails and several architraves along Mount Vernon’s visitor path. Previously, these surfaces were painted with Duron’s Supreme Kote interior flat latex paint. In recent years,
many of the surfaces painted with Duron were refinished with Fine Paints of Europe. Because some of the exposed surfaces, such as the cupola steps, still feature Duron paint, both brands were included in the study. Additionally, the plaster walls along the visitor path are finished with Old Village 1601 Simulated Whitewash. This was included as well.

The Duron paint was not available for use on the touch panel. The brand merged with Sherwin Williams and, as a result, the Supreme Interior flat latex is no longer available for purchase. After consulting with both Sherwin Williams and Duron representatives, Sherwin Williams Super Paint flat latex was confirmed to be equivalent to the Duron Supreme Kote and was used on the touch panel in substitution.\(^1\)

**Panel Construction**

The touch panel was constructed to be 36” in width by 24” in height. This provided sufficient space for the three painted surfaces to be tested. The base of the touch panel was a cement board. This was essential to prevent the panel from being too heavy and to also provide a surface for the plaster basecoat. Various materials degrade at different and distinct rates; therefore, the plaster base was necessary to replicate the current conditions at Mount Vernon and provide a similar surface for wear.

The panel consisted of three equally divided vertical sections. The middle and left sections contained three horizontal panels, each of which were painted with the Fine Paints of Europe, Old Village, and Sherwin Williams finishes, respectively. A Plexiglas cover was installed over the middle section to serve as the control for the experiment and to protect

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\(^1\) The Fine Paints of Europe used was the Hollandlac Satin eggshell enamel interior and exterior paint. The color was Palladian White MV108. It was primed with Fine Paints of Europe oil primer/undercoat also in Palladian White MV108. The Old Village 1601 Simulated Whitewash was water-based exterior/interior acrylic latex. It was primed with Old Village over and under acrylic primer in white 1738. The Sherwin Williams Super Paint was a flat interior acrylic latex in color Extra White. It was primed with Sherwin Williams Multi-Purpose Zero VOC-Latex primer. All finishes were applied per manufacturer guidelines.
the painted surfaces from dirt and oil build-up. The third section consisted of a text box explaining the purpose of the touch panel. The extent of the panel was enclosed within a wooden frame. Figure 2.5 illustrates the touch panel after final construction.

Panel Installation

The Aiken Rhett House was chosen as the location for the installation of the touch panel for several reasons. The house has a large cellar area at the beginning of the visitor path which provided ample space for the panel to be displayed on a stand. The size of the space also prevented the panel from being knocked over with any potential overcrowding. Additionally, because the house is in a state of preservation, the panel served to educate visitors about their influence on historic materials.

Figure 2.5 – The completed touch panel. (Photograph by author.)
Data Gathering and Analysis

The touch panel was installed from November 23, 2012 through February 1, 2013. Weekly photographs of the touch panel and any resultant dirt build-up were taken using a Sony Cyber-shot digital camera. Following the removal of the touch panel from the Aiken Rhett House on February 1, 2013, the panel was deconstructed to allow a cross-sectional analysis of the finish material, the plaster, and the cement board. Samples were taken using a surgical scalpel with a #15 blade and tweezers. The Fine Paints of Europe sample fractured during retrieval. The top layer of the finish coat separated from the primer layer. A secondary sample was taken in the same vicinity of the first sample. Figure 2.6 indicates the areas where samples were taken.

The samples were placed into small ice cube trays that were previously prepared with a layer of Bio-plast resin. Each section of resin was labeled with its coordinating sample number. The samples were then covered with a top layer of resin and placed under a fume hood to solidify and prepare for further analysis. Once the samples solidified, they were hand-polished with sandpaper and micro-mesh polishing cloths. New pieces of each were cut to avoid any cross contamination. Pieces of 180, 400, and 600-b grit sandpaper and 1500, 1800, 2400, 4000, 6000, 8000, and 12,000 grit micro-mesh were used.

Once polished, the cross-sections were examined with a Nikon Eclipse 80i radiant light microscope. They were examined under basic visible light as well as under ultraviolet light. Results and observations are listed in Chapter Eight of this thesis.
Figure 2.6 – Locations of samples taken for analysis are highlighted by the blue circles. (Photograph by author).
**Wooden Stair Tread Degradation**

Serving as the micro-scale counterpart to the wooden threshold measurements at Mount Vernon, the wooden stair treads of the three previously mentioned Charleston house museums were measured to determine the amount of material loss due to visitor traffic. All three locations chosen have an original and publically accessible staircase that extends from a first floor to a second floor. The third floors of these museums are not accessible to visitors. Measurements of material erosion of each tread were taken on the publically accessible flights of stairs and as well on the inaccessible third-floor flights. This allowed visitor loss to be separated from wear that occurred from the previous residential use of each structure. Measurements from multiple house museums also allowed comparisons to be made between variations in visitation levels at each museum and the time each was opened to the public. This also prevented any discrepancy found at one location from skewing the results.

Measurements of each tread were taken using a 4’ metal level and Pacific brand architect’s scale to determine the amount of material loss. The level was placed horizontally across the top of the thresholds to rest upon the unworn outer edges. The architect’s scale was then used to measure the largest gap between the level and the top of tread. The classification of the wooden material was also noted for analysis.

**Temperature and Relative Humidity Monitoring**

The third study completed to gather quantifiable data on visitor impact was the monitoring of temperature and relative humidity levels in a historic house museum. Temperature and humidity levels, if not properly maintained, can have a negative consequence on architectural finishes and collections. Condensation can occur from the difference in humidity between the exterior and the interior of a structure. The value of this
experiment lies in quantifying an increase, if any, in temperature and relative humidity levels caused by visitors. Additionally, increased awareness generated by the data can lead to the responsible use and management of HVAC systems to counteract visitor influence.

The Nathaniel Russell House was monitored for fluctuations in temperature and relative humidity. Due to the restrained and defined visitor path at the Nathaniel Russell House, it is the location most similar to Mount Vernon. Most importantly it had rooms that were restricted from visitor entry. This allowed for a control room to be monitored.

An Onset HOBO® data logger was placed in the small office on the first floor as a control. Two additional data loggers were positioned in the adjacent dining room. The first of these two data loggers was placed at the far end of the room away from visitor entry to monitor the conditions of the room, absent of visitor impact. It also provided a comparison to the control room to ensure similar environmental conditions. The second data logger was positioned at the opposite end of the dining room, nearest where visitors stand during the tour. Both rooms were chosen because they are both on the south side of the museum.

Temperature and relative humidity readings at all three locations were recorded. The data was collected between November 23, 2012 and January 16, 2013. Using Onset software the data was exported to a spreadsheet format and analyzed. The highest and lowest daily temperature at each location was noted for every day. The average daily maximum and minimum temperatures, including the average daily change, were determined for each location. Relative humidity levels were treated in the same manner. This data is listed in Appendix B and the results and analysis are listed in Chapter Eight of this thesis.
Figure 2.7 – Data logger (MSHP 2 & MSHP 3) locations in the Nathaniel Russell Dining Room. (Photograph by author with permission of Historic Charleston Foundation.)

Figure 2.8 – Data logger (MSHP 1) location in the Nathaniel Russell Office. (Photograph by author with permission of Historic Charleston Foundation.)
CHAPTER THREE
DEFINING VISITOR IMPACT

Visitor impact, as it pertains to this thesis, is direct or indirect human interaction with architectural materials that results in erosion, degradation, or aesthetic alteration. However, conservation attempts to measure wear have been minimal and at Mount Vernon non-existent. The study of visitor impact and wear and tear supported by real data is necessary for three key reasons: to understand the effects visitors have on historic sites, to identify susceptible locations and materials, and to provide insight for new mitigation strategies that best protect the structure without degrading visitor experience.

It does not take the expertise of a conservator to see the impact visitors have on historic sites and the issues caused by excessive visitation. Take a tour through most historic sites in the country and dirty walls, dust deposits, eroded finishes, and loose floorboards betray the effect of visitor impact. The first step toward damage prevention is recognizing the problem. Understanding wear and tear is fundamental to separate the sacrificial or expected wear from that which causes real damage. Sacrificial wear and the need for continuous repairs, however, are nonetheless important and represent the potential loss of original material. Quantifying visitor impact and the affect it has on the lifespan of a structure allows a balance to be made between increased heritage tourism, acceptable risks, and proper mitigation.

Direct vs. Indirect Impact

The primary causes of material degradation to architectural fabric are abrasion, vandalism, weight and force loads, vibrations from foot traffic, humidity, temperature, dirt, and dust. Visitor impact at Mount Vernon and other historic house museums can be categorized as either direct or indirect. A direct impact is damage attributed directly to
visitor actions and caused by visitor travel through, and interaction with, architectural materials. Dirt and oil build-up on walls, loads and forces exerted on the staircases, and the physical removal or damage to pieces of the architectural fabric fall in this category. Direct impacts can be further subdivided into unanticipated events, illness for example, and sudden events such as spills and falls.

Indirect impacts occur from adjustments that have to be made to accommodate visitors such as the installation of an HVAC system and compliance with the Americans with Disabilities Act. Visitors do not physically cause these impacts. Rather they are secondhand responses due to increased visitation. Damages to collections can be categorized as direct impacts. However, for the purposes of this thesis they are not considered because collections are not permanently attached to the structure and do not have as large of an impact on material degradation.

Evidence of Wear and Tear

Increased visitation to historic sites has led to many conservation problems around the world. Wear at European sites such as Stonehenge, the Parthenon, the Cathedral of Notre Dame and Westminster Abbey and American sites such as Mount Vernon, Monticello and Colonial Williamsburg has increased significantly in the last century due to a rising number of visitors. While Mount Vernon records over one million annual visitors, many locations throughout Europe consistently see two and three million per year. Historian David Lowenthal stated, "popularity speeds the past’s destruction." While this may be a bit extreme, it is certainly not untrue. There is a danger to popularity, and attempts to mitigate visitor damages affect the original architectural elements. Impact is unavoidable. Whether it is caused by visitors or by the actions of the management taken to protect a site, visitation

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provokes a change to the historic fabric. Ironically, as Lowenthal has stated, “Preservation sets in train the extensive remodeling of the very past it aims to protect.”

The caves at Lascaux provide a jarring example of how visitation to a historic location has led to detrimental alteration of irreplaceable material and threatens potential loss. In 1940, the accidental discovery of Paleolithic cave paintings in southwest France set in motion their very deterioration. Shortly after their discovery, the pathways in the caves were created to accommodate visitors and improve access. Visitors to the prehistoric site introduced a biological fungus that began to erode and deteriorate the cave paintings. Since the discovery of the organism responsible for the deterioration, conservators and scientists have been working to halt further loss of the cave paintings. Visitation to the caves is now restricted. Sections of the caves are blocked off completely and barriers have been erected to protect the fragile paintings.

While not under microbiological attacks, the Cathedral of Notre Dame, Westminster Abbey, and Canterbury Castle share other issues related to visitors. Footsteps of visitors eroded away ledger stones to the point of illegibility. The rubbing of tomb inscriptions caused delicate carvings to become indecipherable. Dirt and oil build-up on walls has also presented other conservation issues including increased cleaning and replacement of materials.

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2 Lowenthal, *The Past is a Foreign Country*, 278.
In the United States, visitors subject historic house museums to similar wear and tear. Compliance with the Americans with Disabilities Act requires modifications to historic structures to make them accessible to disabled persons. As a result, wheelchairs cause indirect visitor damage to the wooden doors and walls at Monticello. The sandstone steps of Colonial Williamsburg’s prized Capital building erode from the passage of numerous visitors. And the Nathaniel Russell House in Charleston, South Carolina has been forced to prohibit visitors from climbing its famous spiral staircase due to wear and concerns about structural issues. Similar stories of wear can be found at nearly every historic site in the world.

As heritage tourism grows, there is increased attention to manage visitor impact through restrictions and limitations. Many European sites such as Westminster Abbey and Stonehenge reach visitation levels in excess of several million per year. This is more than the average American historic house museum; sixty percent welcome fewer than ten thousand annual visitors. While these sites receive far fewer visitors, they are nonetheless susceptible to damages from visitor wear.

Although many restrictions control what areas visitors have access to at sites and limit when they are allowed to access them, house museums and historic locations continue to make changes to accommodate visitors. At Mount Vernon visitors cannot see Washington’s entire house, but the addition of an education center, museum, gift shop, pioneer farm, and varied tours provide alternate experiences for guests. More importantly, these additional attractions disperse visitors across the estate and reduce the concentration in the mansion.

More than Just Cosmetic

Visitors impart two types of wear to historic houses: structural damage and cosmetic damage. Structural damage is the most physically detrimental to the material and the house, but cosmetic deterioration influences visitor experience and can mask underlying structural issues. For example, the Central Passage staircase at Mount Vernon was retrofitted with structural supports to correct sagging issues derived from visitor loads and the removal of a load-bearing partition wall in the eighteenth century.

Cosmetic damage includes build-up of dirt and oils on architectural surfaces, dust deposits, abrasion of floor boards, and wear on painted surfaces. Continuous housekeeping and cleaning maintenance can be costly. And although cosmetic damage is not directly affecting the structural stability of historic houses, it is nonetheless important. Noted preservationist James Marston Fitch stressed the relationship between the appearance of a historic structure with the quality of a visitor's experience. He declared that, “the sense of sight is of primordial significance in visiting a historic building.”

Fitch proposed that in cases such as Mount Vernon where the house is representative of elite architecture, cosmetic damage is significant. To trivialize wear and tear as a housekeeping concern diminishes the seriousness of the issue. It is essential to address cosmetic damage when assessing visitor impact because cosmetic damages fundamentally change the way the house was meant to be displayed. Furthermore, the quality of visitor experience diminishes when the house is marred by cosmetic wear and not showcased at its finest.

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Mount Vernon is a symbol of George Washington’s wealth and influence. It represents Washington as a prosperous landowner, military hero, and president. Washington paid close attention to all aspects of his surroundings and wanted Mount Vernon to appear new and opulent. For example, his stewardship of the property extended to his planned return in 1759. Washington directed to “have the House very well cleand...(and that)...the Stair case ought to be polishd in order to make it look well.”

The mansion, farm, and fields were extensions of Washington’s fastidious nature. They projected his attention to detail as they still do today.

When considering the purpose of treating or addressing these cosmetic issues, conservators must take into consideration the owner, including the standards of display, etiquette and propriety. Windsor Castle and the Palace of Versailles, like Mount Vernon, were constructed under the assumption that they would be well-maintained. They were representative of the elite households that resided there. Allowing pedestrian abrasions and surface dirt and debris to build up on the walls is not representative of what George Washington intended for Mount Vernon. As the homestead of the first President of the United States, Mount Vernon was meant to be seen by Washington’s contemporaries and to be a model for the Nation.

From a conservation standpoint, cosmetic damages can also cover up underlying issues or architectural features. When painting or other conservation repairs are necessary, cleaning of the surface of architectural materials is required first. And the removal of the damage can lead to the loss of historic material. For example, when handrails of staircases

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are cleaned, despite the use of the least abrasive methods, the top layer of material or varnish will be lost. Additionally, byproducts of tobacco smoke, while not as common today in many American historic houses, can attach to surfaces and build up in layers that could obscure frescos, wallpaper patterns, or other surface materials.

**The Evolution of Wear and Tear Studies**

Active promotion by the heritage tourism industry in the 1960s brought mass visitation to historic sites around the world. Affordable air transportation and the Tourism Act of 1969, passed by British Parliament for the purpose of promoting tourism, propelled travel to Europe. In the United States, the centennial anniversary of the Mount Vernon Ladies’ Association’s rescue of Mount Vernon, the passage of the 1966 National Historic Preservation Act, and the pending National bi-centennial of 1976 ignited increased patriotism and heritage tourism. Although the growth of tourism was beneficial to local economies, by the 1970s and 1980s this increased traffic was proving detrimental to many historic sites.

In 1976, concern over the growth in tourism led the International Council on Monuments and Sites to pass the Cultural Tourism Charter. The framers of the act understood the economic and cultural importance of tourism but passed the act to encourage its responsible management. The passage of the act validated worldwide preservation activities, taking into consideration the need for increased measures to protect historic sites and prolong their preservation.11

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The fear of loss of cultural sites and the danger posed by heritage tourists was also a primary instigator for professional attention to wear and tear issues in the 1980s. Jane Fawcett’s “The Impact of Visitors on the Medieval Cathedrals and Abbeys of England” (1987) was one of the first studies to look holistically at visitor impacts on a specific site. She argued that the influx of tourists due to the promotion of overseas tourism was dangerous and led to increased damage to ledger stones, paving stones, and furnishings. And she strongly suggested the majority of damage was resultant of vandalism. Fawcett proposed solutions including installing protective panels and roping off areas. Although this was one of the earliest studies on wear and tear, Fawcett’s study did not attempt to quantify wear or the rate of deterioration. Her study only identified the problem and attempted to institute mitigation strategies.\(^\text{12}\)

One of the earliest efforts to draw global attention to the consequences of visitor impact was a conference entitled Tourist Wear and Tear on Monuments and Sites held in London by ICOMOS UK and English Heritage in May of 1989. Conference papers focused on wear at cathedrals and outdoor sites, highlighting the impact of visitors at Canterbury Cathedral, St. George’s Chapel, and Westminster Abbey. These papers included some of the earliest attempts to gauge visitor wear by measuring the erosion of material. Following the seminar the attention to wear and tear issues continued to increase in England and around Europe.\(^\text{13}\)

The publication of many housekeeping manuals in the 1990s and 2000s followed the emergence of conservation studies in the 1970s and 1980s and the professionalization


of preservation and housekeeping standards. The majority of conservation and housekeeping manuals briefly mentioned wear caused by visitors but primarily focused on collections. Aside from the manuals published by English Heritage and England’s National Trust, most addressed the roles that visitors played on wear and tear in only a few paragraphs. However, many of the works did remark on the inability of preservation professionals to imbue upon visitors their impact on historic houses.

Perhaps the most insightful resource in understanding the management of wear and tear issues was The National Trust Manual of Housekeeping: The Care of Collections in Historic Houses Open to the Public (2006) by the National Trust. It was written as a technical manual for preservation and maintenance. This was the most comprehensive manual written on wear and tear, mitigation efforts, and visitor education. The key difference between the National Trust’s manual and other works is it also delved into conservation ethics and discussed the notion of making sure the house was interpreted correctly, correct period materials were used, the historic context was maintained, and that professional conservators were consulted when needed.

American publications by professional conservators and the National Trust for Historic Preservation reiterated that house museums were being managed by people who lacked the technical knowledge and training to properly conduct conservation and

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16 National Trust, Manual of Housekeeping, 36.
preservation work. Preservation guides assisted staff in maintenance rather than in conservation. Small sections alluded to vandalism and theft and the defacing of objects but lacked in solutions, only proposing the addition of security guards, locked doors, and barriers. Some appealed to a broader audience and attempted to cover the universal problems for all sites by offering practical approaches to increase professionalism and close the gap between management and visitor. Many also suggested that the majority of house museums and caretakers were cognizant of wear and influence by pedestrian traffic but lacked appropriately sized visitor paths to accommodate the large amount of pedestrians. However, again, the protection of collections was the primary focus and many did not address the problem of pedestrian wear and tear on the architectural fabric directly, only as an afterthought and failed to suggest any preventative measures.

The Lack of Quantifying Wear and Tear

Few studies have measured visitor wear and tear. One study that attempted to quantify visitor impact on the architectural fabric of historic houses was “The Impact of Overvisiting: Methods of Assessing the Sustainable Capacity of Historic Houses” in Preventative Conservation Practice, Theory and Research (1994) by Helen Lloyd and Tim Mullany. It provided an outline for the assessment of properties and assessed damage from abrasion, vibration, and overcrowding. One limitation was that the study was

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completed looking at all National Trust properties for overall statistics and not just one specific house.\textsuperscript{20}

A conservator for England’s National Trust, Helen Lloyd, and a small group of English conservators, also wrote several other reports, the majority of which relate to the impact of dust and dirt in historic houses.\textsuperscript{21} The studies showed the distribution of dust related to visitor traffic as well as the cost of maintenance. In each study, these conservators reference their previous works as resources for each subsequent piece of literature. This is not a drawback on the quality of the literature but rather illustrates the lack of alternative wear and tear resources.

English conservator David Honeyborne also attempted to deduce the effects of visitor impact on the fabric of buildings in the article “Effect of Large Numbers of Visitors on Historic Buildings” in Conservation of Building and Decorative Stone (1990).\textsuperscript{22} Honeyborne investigated material damage from oils on visitor’s hands, tobacco smoke, and increased humidity levels. However, his study discussed the effects visitors have on materials in general and lacked in quantifying wear for one specific location.

More recently, The Getty Trust completed “Our Lord in the Attic: A Case Study” that focused on the visitor impact and quantifiable material degradation at a house museum in

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\textsuperscript{20} The main limitation for comparison of this study with the wear at Mount Vernon is the number of visitors. While the most visited of the Trust’s properties received 100,000 visitors per year, Mount Vernon is in excess of one million.


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Amsterdam. This included the holistic recording of wear in the structure measuring the amount of material degradation on stair treads, visitor management, climactic conditions, and a collections assessment. While the total amount of quantifiable data is limited, it is still one of the first holistic studies in recent years. The study is only further demonstrative of the need for increased literature on quantifiable material degradation and visit impact.\(^\text{23}\)

Other available sources relate to sustainable tourism and best management practices to reduce visitor impact. Richard W. Benfield’s article “‘Good Things Come to Those Who Wait’: Sustainable Tourism and Timed Entry at Sissinghurst Castle Gardens, Kent” in *Tourism Geographies* 3, (2001), discussed the management of the increased influx of visitors, specifically focusing on carrying capacity and solutions for managed timed entry.\(^\text{24}\) The drawback to this study was that it was primarily focused on garden tourism and not related to architectural degradation. Timed entry is a solution that has proven effective at Mount Vernon in reducing wait time for entry into the mansion. While any reduction in architectural wear and tear has yet to be confirmed it is an interesting and non-evasive solution that works for exterior locations.

In the preservation and conservation fields, visitor impact and material degradation are still relatively limited subjects. English Heritage and the English National Trust are the World’s leading proponents of wear and tear studies. Their continued work demonstrates a scientific approach to quantify visitor wear of architectural fabric and highlights the lack of such in the United States. Despite growing concern about visitor impact, the lack of


American literature and conservation studies that quantify the rate of material degradation is a significant gap in the field of historic preservation. There are few holistic studies at American historic sites to measure and quantify visitor impact. The National Park Service has drawn attention to wear and tear issues at Mesa Verde National Park, the Washington Mall, and Lehman Caves; however, the focus is primarily on erosion of land and deterioration of historic vistas and landscapes.25

**Why Mount Vernon Matters**

In 1976, Ernest Allen Connally of the National Park Service, writing in response to preservationists James Marston Fitch and Sheldon Keck’s articles on visitor impact, recounted his experience of visiting Mount Vernon. He described the “visitation situation” as “critical.” He also commented that “going through the house can be a ghastly experience.”26 Following his tour, he recommended control of visitor admittance. Tours then only allowed visitors to “get in line and keep moving” without “taking the time to really see - and appreciate - anything.”27

Connally’s harsh view of the visitor experience at Mount Vernon echoes an issue still present at Mount Vernon nearly four decades after his observation. Mount Vernon still has a moving line. There is little time for questions. Visitors pass from one interpreter to another.

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27 Connally, “Commentary,” 344.
The time of the tour is approximately thirty minutes, nearly one half of that offered at Thomas Jefferson’s Monticello. And the confined spaces on the second floor landings of the Central Passage and the rear hall create uncomfortable, crowded conditions. But this is the way that one million plus visitors have to be accommodated at Mount Vernon. Mount Vernon does not have the luxury of a drawn out tour that caters to sixty thousand annual visitors like many smaller house museums – or does it?

SUNY Oneonta conservation professor Sheldon Keck stated in *Preservation and Conservation: Principles and Practices* that “Of all the art created in the past, a small fraction remains, not by any grand selective design of man, but apparently because it was, for the most part, hidden from him.” The Caves of Lascaux affirm it is the influence of man on the historic structure that will lead to the structure’s ultimate demise. The same thinking applies to secluding visitors from Mount Vernon or other historic sites for that matter.

People come to Mount Vernon for numerous reasons: curiosity, patriotism, an affinity for architecture, and a love for history among many others. In here lies the dilemma. If the visitors are kept away from Mount Vernon, does the house still serve a purpose? This is an existential debate of ethics and theory that could lead far astray and beyond the bounds of visitor impact. However, it is a necessary thought to consider when reviewing potential conservation treatments, the significance of a location, and its ultimate mortality. Perhaps, there will never be a right or wrong answer for Mount Vernon, rather the correct approach is one of responsibility and awareness. Quantifying wear and tear at Mount Vernon is essential to determining the longevity of its materials, instituting proper mitigation practices, and improving visitor experience.

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There is little doubt of Mount Vernon's significance to the national identity, collective memory, and the field of historic preservation. However, research on pedestrian impact at Mount Vernon and the resulting degradation of the architectural fabric is minimal, at best, and far from completion. Current sources are only now beginning to study and quantify the effects of visitors on a historic structure rather than simply pointing out the damage. The gap in research from American structures to European structures needs to be bridged and the study of the most visited historic house in the nation with the most extreme wear will be a preeminent starting point for continued efforts to mitigate visitor impact.
CHAPTER FOUR

MOUNT VERNON: FOUR CENTURIES OF VISITORS

No single house is more ingrained in American memory, rooted in patriotic identity, and revered by the American public than George Washington’s Mount Vernon. Positioned atop a bluff overlooking the Potomac River fifteen miles south of the city named for him, Washington’s venerated house welcomed his contemporaries, his patriotic mourners, and, on more than one occasion, curious travelers. The history of Mount Vernon is the history not only of the man who called it home but the people who have walked its floors and of the organization responsible for rescuing it. It is ironic that the millions who have visited Mount Vernon have unquestionably accelerated the damage to the architectural fabric.

The history of Mount Vernon is a necessary preface to understanding the role visitors to Mount Vernon have played in its material degradation. Curiosity about Mount Vernon following Washington’s death and its subsequent transformation from private residence to shared public space is part of America’s domestic history. Historian Jean B. Lee observed that, “When people no longer could visit Mount Vernon to see the living Washington, they came to venerate his accomplishments and character and to experience – visually and tactically – his domestic world.”1 Although the estate transitioned from private residence to commercial property when the last Washington heir, John A. Washington Jr., sold to the Mount Vernon Ladies’ Association, Mount Vernon had always been a public place.

George Washington: His Guests and Mourners

George Washington may be Mount Vernon’s most famous resident, but it was his older half-brother Lawrence who, after inheriting the property from their father, Augustine, initiated the first expansion of the estate. It is debated as to what was left of Augustine’s small residence when Lawrence began his work, but the construction of the central core of the mansion is credited to Lawrence. A distinguished citizen in his own right, Lawrence served in the military and was an instrumental figure in the establishment of Alexandria, Virginia. He is also credited with giving the place and its house its well-known moniker, Mount Vernon. During his military career, Lawrence served with Admiral Edward Vernon at the Battle of Cartagena de Indias, in 1741. As an expression of his esteem for the Admiral, he
named Mount Vernon in his honor. Following Lawrence’s death, in 1752, the property passed on to Lawrence’s wife and then, through inheritance, to George.

Mount Vernon, as seen today, is the result of changes George Washington made after inheriting the residence and the surrounding plantation. Washington was the principal agent of change, and what started as the small homestead his father built tripled in size under Washington’s ownership and direction. During his tenure, Washington oversaw every detail of construction at Mount Vernon. He ordered materials from Europe and kept meticulous records of designs, measurements, and expenditures. The north and south additions, cupola, piazza, the expansion of the Central Passage stairs, and the iconic asymmetrical fenestration along the western elevation, are all George Washington’s marks.

Figure 4.2 – The western view of Mount Vernon. (Photograph by author.)

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In his letter to the Marchioness de Lafayette he described Mount Vernon as a “cottage” and told of “the plain manner in which we live.” However, his decisions at Mount Vernon were carefully calculated and the structure was anything but humble.

The first visitors to Mount Vernon came as guests of George and Martha Washington. The nation looked to Washington following the War for Independence and the founding of the Republic, and whether invited, possessing a letter of introduction, or stopping by out of mere curiosity, visitors were always welcomed and treated with the hospitality befitting a man of Washington’s character. Benson J. Lossing in *Mount Vernon and its Associations* (1883) stated that even in his retirement Washington was “too great to remain an isolated citizen” and that “men of every degree, his own countrymen and strangers, were soon seen upon pilgrimages to Mount Vernon; and the little “villa” was too small to shelter in comfort the many guests that often assembled under its roof.”

Entertaining many guests was neither an easy nor inexpensive task. Washington and his wife played host to a myriad of visitors at Mount Vernon, and guests would stay for the afternoon or up to several weeks. By the time Washington had returned in 1775, the financial situation of the estate was in decline from his absence, and the burden of feeding and accommodating guests was sometimes an inconvenience. While Washington enjoyed most of his invited guests, like Lafayette and Rochambeau, the formality of hosting others

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4 Washington, in appealing to his humble side while writing to the Marchioness de Lafayette, wrote “Come then, let me entreat you, and call my Cottage your home; for your own doors do not open to you with more readiness, than mine wou’d. You will see the plain manner in which we live; and meet the rustic civility, and you shall taste the simplicity of rural life. It will diversify the Scene and may give you a higher relish for the gaieties of the Court, when you return to Versailles.” George Washington to Adrienne, Marchioness de Lafayette, 4 April 1784, Theodore J. Crackel, ed., *The Papers of George Washington Digital Edition* (Charlottesville: University of Virginia Press, Rotunda, 2008).
5 Lossing, *Mount Vernon*, 149.
6 In addition to his guests, Washington also cared for many nieces, nephews, and two grandchildren during various times at Mount Vernon in which he provided them with housing and financial resources. Ron Chernow, *Washington: A Life* (Washington: Penguin Books, 2010), 463-470.
seemed to be an annoyance to him and it appeared that he did tire of this when it was for no official purpose. Washington wrote to James McHenry, "I rarely miss seeing strange faces, come, as they say, out of respect for me. Pray, would not the word curiosity answer as well?" However, casual visitors aside, Washington recognized the home field advantage that Mount Vernon held when meeting with his contemporaries on an estate that was remarkably unassuming, yet authoritative at the same time.

Mount Vernon is known for its material form that is in apparent opposition to other Virginia gentry homes of its time. This is not a typical Georgian masonry home. Mount Vernon has an asymmetrical fenestration, an off-center cupola and beveled siding boards designed to look like stone. Beyond the physical changes for aesthetics and comfort, Washington's role in the architectural design of Mount Vernon was an orchestration of his vision for the nation. Control, order, and attention to detail drove Washington. He had hoped for Mount Vernon to be a model for the nation so that it would lead to more orderly citizenry. The peace, solace, and hope for a new nation that Washington saw in Mount Vernon coupled with his affinity for architecture, husbandry, landscape design, and even distilling made his efforts at Mount Vernon as multi-faceted as his life had been.

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9 For further information on the architectural changes and designs at Mount Vernon as well as Washington’s role as landowner and overseer see, Dazell, “Constructing Independence,” 543-580; Robert F. Dazell and Lee Baldwin Dazell, George Washington’s Mount Vernon: At Home in Revolutionary America (New York: Oxford University Press, 1998); Wendell D. Garrett, David Larkin, and Michael Webb, American Home: An Illustrated Documentary from Colonial Simplicity to Modern Adventure (New York: Abingdon, 2001); Allan Greenburg, George Washington Architect (United States & Great Britain, 1999); Irvin Haas,
all of Washington’s progress halted in 1799, when he succumbed to illness. And when his beloved Martha passed a few short years later, the symbolic role of Mount Vernon intensified.

With Washington’s death, Mount Vernon became a pilgrimage site for individuals to mourn their venerated Father. A visit to Mount Vernon was a connection with Washington. Mourners freely helped themselves to a tour of the estate and felt a patriotic right to the property, much to the annoyance of the Washington heirs residing there. They walked through the home where he dined, slept, conducted business and led the nation. They strolled the grounds he designed and the spot where he was ultimately laid to rest. Visitor accounts, however, offer key insight into the declining conditions at Mount Vernon and the exploitation and mistreatment of the property. An 1858 edition of Harper’s Weekly portrayed the scene inside the mansion. The reporter recalled the house was “filled with noisy young women…who chattered and jabbered as they might have done at Barnum’s.”

And how the women “quarreled and fought to sit in the chair in which Washington spent many a thoughtful hour.” While the mourners gathered at Mount Vernon, patriotic interest alone was not enough to sustain the property and the plantation and mansion eventually fell into a state of decline and disrepair.

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The decades following the death of Washington were not kind to Mount Vernon. The mansion was marked with the ravages of time, and the illustrious beauty that once surrounded it faded. Periods of vacancy, palpable neglect, changing fortunes and throngs of visitors all took their toll. In the nineteenth century the property passed through several generations of the Washington family and eventually ended up in the hands of John Augustine Washington, Jr., the great grandnephew of George Washington. John would be the last Washington family member to ever occupy Mount Vernon as a resident, and in 1858, he put up the property for sale for the sum of two hundred thousand dollars.\textsuperscript{12} This single act would be the catalyst for a string of events which defined the future of Mount Vernon.

**The MVLA at Mount Vernon**

The state of disrepair, as well as the defense of it from relic hunters, suggested Mount Vernon needed to be purchased and protected by a capable organization. The near deification of Washington following his death and the desire for everything and anything associated with him was an enticing enterprise for relic hunters and vandals. Mount Vernon while private property was perceived by many to be in the public domain. Visitors often wandered about the mansion and the grounds without the permission of the owners.\textsuperscript{13}

When John A. Washington Jr. put Mount Vernon on the market, fear for the loss of the property and despondency for its dilapidated condition inspired a southern matron from South Carolina named Louisa Bird Cunningham. She imbued upon her daughter, Ann Pamela Cunningham, the importance of purchasing and rescuing Mount Vernon. Aside from George Washington, Ann Pamela Cunningham proved to be the single most pivotal figure in Mount Vernon’s history. Through her efforts she formed the Mount Vernon Ladies’

\textsuperscript{12} Lossing, *Mount Vernon*, 370.

Association of the Union (MVLA), an effort that crossed the nation’s growing sectional divide and raised the necessary funds to procure Mount Vernon. In 1859, the last installment on the purchase was made and the MVLA secured ownership. When John Augustine Washington, Jr. formally vacated the property in 1860, the MVLA took official control.14

**Mount Vernon’s Early Tourists**

When tourists first came to Mount Vernon the majority arrived via steamboat along the Potomac and made the uphill trek to the mansion. Others entered through the now closed west gate. Both approaches are far different from the modern visitors center, paved parking lot, and entry gate. While the entry portal has been upgraded, the ever present issue of pedestrian impact has changed little in the last one hundred and fifty years.

In the earliest days of Mount Vernon’s role as a historic site, the MVLA planned to open George Washington’s home to all who visited. On November 19, 1866, the MVLA established an on-site residence for the Superintendent creating a presence on the estate

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while the mansion was open to the public.\textsuperscript{15} The opening of the mansion and the introduction of paying tourists brought with it other obstacles including additional upkeep costs for which funding was not always readily available.

The MVLA Minutes of Council shed light on the issue of visitor wear and illustrate some of the first attempts to document and mitigate it. Incidents of wear including worn floorboards, soiled surfaces, vandalism, and graffiti were reported by both the Vice-Regents and former Superintendents of Mount Vernon and illustrate a continuous pattern of visitor impact to the mansion. While efforts were taken to mitigate damage, common issues and patterns in the late nineteenth and early twentieth centuries are still prevalent today. However, the majority of actions to mitigate these damages proved to be reactionary rather

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{visitor_graffiti.png}
\caption{Visitor graffiti inside the seed house at Mount Vernon, dated September 25, 1876. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)}
\end{figure}

\textsuperscript{15} Mount Vernon Ladies’ Association of the Union, ”Minutes of Council, November 19, 1866” (Washington, D.C.: 1866), 6.
than preventative.

One of the major issues Mount Vernon dealt with in the nineteenth century was vandalism. Relic-hunters removed sections of plaster, lath, and other architectural materials to obtain a piece of George Washington. Mount Vernon's first resident Superintendent, J. McH. Hollingsworth, reported in 1878, on the ability of the staff to address this issue, “Through their watchfulness much vandalism is prevented and I can remember but one instance during the year of damage done by the relic-hunter.” However, Superintendent Hollingsworth’s praise was short-lived as the continued impact of visitors led to a regular increase of rules.

In 1879, the MVLA directed the superintendent “to obtain a sufficient number of printed posters, forbidding visitors to eat their lunch within the mansion, to place these posters in conspicuous positions, and to thoroughly enforce this rule.” One can only imagine the bold visitor who picnicked in the dining room of the mansion forcing the implementation of this rule. Further requests that now seem commonplace were made over the years including a presentation in 1885 by the Vice-Regent for Georgia to prohibit smoking in the mansion. While the prohibitions against food and smoking are still in force today and are posted in the Servant's hall before visitors enter into the mansion, these were the first examples of such restrictions coming before the Council.

Other issues of concern were vandalism by souvenir hunters, weight and force loads on the central staircase, and wear on floorboards and the grounds. Mount Vernon's second

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16 Mount Vernon Ladies’ Association of the Union, “Minutes of Council, 1878” (Bridgeport, Conn: Farmer Office Steam Presses, Corner Wall & Water Streets, 1878).
Superintendent, Harrison H. Dodge, noted the damage to the cupola, “by the depredations of relic hunters, who had torn away the plaster to get at the laths.”\(^\text{19}\) He continued on to describe the “shockingly disreputable condition” of the attic walls, doors, and wood-work due to vandalism, “being literally covered with pencil marks.”\(^\text{20}\) After cleaning and repainting the vandalized areas, Dodge attempted to limit any further issues by again posting notices to prohibit vandalism. This appeared to solve the problem as Dodge stated, “I have only had occasion to impose a fine upon one party since the establishment of the above order.”\(^\text{21}\) It is unknown what the penalty was for causing such damage or its enforceability, but this was the first such occasion mentioned where guests were admonished for damaging the architectural fabric of Mount Vernon.

The 1876 *Visitors Guide to Mount Vernon*, contains perhaps the most uninhibited descriptions of visitor wear. The guidebook told the story of relic-hunters and the damage they caused to the Carrara mantelpiece in the Large Dining Room by referring to them as “Land Pirates.”\(^\text{22}\) The guide traced the travel of the mantelpiece from Italy and its mid-shipment capture by French pirates. The pirates subsequently released it upon learning it was meant for George Washington. However, the civility of the pirates was unmatched by Mount Vernon’s visitors. The *Visitors Guide* declared that the mantelpiece, “has received less respectful treatment from unknown Land Pirates, for its delicately-carved figures and ornaments have been mutilated and broken by relic-hunters.”\(^\text{23}\)

The “Land Pirates” or relic hunters were not the only parties responsible for material loss in the mansion. The 1929 Minutes of Council tell of a story that came to light

during the search to locate the possible original wallpaper of George Washington’s Bedchamber. The minutes tell of a child that visited Mount Vernon following the Civil War and upon being disappointed with tour of the mansion, an interpreter gave her a piece of fabric from the wall. The interpreter stated, “Little Miss, that is what is left of the wallpaper the General had here. If you won’t tell on me, I will give it to you for a keepsake.” The validity of the story and the actions of the interpreter are open to interpretation, but it was reported that the fabric was returned many years later.

Another cause for concern was the material wear developing in the mansion. Superintendent Dodge’s 1885 report to the Council made reference to this ongoing issue and his efforts to address the damage. He stated that, “Four of the doors, those leading to the library and banquet hall, stood greatly in need of attention, the old paint having worn off completely... (the door was) treat(ed) with oil, putty, and paint.” Five years later, the 1890 report mentioned again the continued state of wear and tear on the estate “occasioned by the throngs of visitors on board walks, steps, and floors.”

Following reports on increasing wear, the Ladies’ Association and the staff made additional efforts to mitigate the impact caused by visitors to Mount Vernon. Mitigation efforts continued with a focus on the material degradation that had occurred on the stair treads both on the interior of the mansion as well as on the exterior. In 1901, the stairs in the mansion were covered in corrugated rubber. And during times of heavy pedestrian

26 MVLA, “Minutes of Council, May 27, 1885,” 6
27 Mount Vernon Ladies’ Association of the Union, “Minutes of Council, May 1890” (New Haven, CT: Tuttle, Morehouse, & Taylor, Printers, 1890), 47.
traffic the exterior stone steps were boarded over.28 Superintendent Dodge voiced his concern about the wear on the exterior sandstone steps of the portico that were imported by Washington. Dodge stated, “It is only a question of how much longer they can resist the severe effect of so much travel before they be permanently covered or entirely replaced.”29 At this point in time, Mount Vernon had only been open to visitors for approximately forty years, but visitors in that short time had already caused material disintegration of the steps.

The growing number of visitors to Mount Vernon in the twentieth century also brought additional problems of wear. After World War I, the 1919 Minutes of Council mansion report highlighted the resulting wear on the mansion from servicemen visiting Mount Vernon and the challenge of how to address it. The report stated that the “almost incessant trampling by soldiers wearing hobnail shoes has left its evidence upon floors and stairs, while finger marks on the walls and doorways soiled both painted and papered surfaces.”30

Council notes throughout the twentieth century continue to make mention of ongoing issues within the mansion due to visitor traffic. And while vandalism issues prevail today, they are sporadic in occurrence. However, despite the due diligence of the MVLA to protect the Mount Vernon from relic hunters and “land pirates,” worn and soiled surfaces continue to be problematic to the mansion.

Mount Vernon in the Twenty-First Century

Today, Mount Vernon is a National Historic Landmark and is the most visited historic site in the nation with an annual visitation in excess of one million. A growing staff of professionals including preservationists, archaeologists, horticulturalists, historians, librarians, curators, and an executive administration have transformed Mount Vernon into a well-run estate and corporate enterprise that adheres to the MVLA’s mission to “preserve and restore the historic structures” and ensures that “visitors to Mount Vernon experience the property much as it was during George Washington’s ownership.”

Admission revenue is an important aspect of Mount Vernon’s annual budget with an adult admission price of $17.00. However, discounted admission is offered for seniors and children, including the Colonial Days program at Mount Vernon, which provides reduced and free admission for school children and teachers. In 2011, Mount Vernon had 1,058,000 visitors, 303,000 of them were students. Total visitation resulted in $11,762,249 in revenue from admission sales.

A tour through George Washington’s residence is included in the price of admission to the estate. The hours of operation for the mansion are dependent upon the time of year. Generally, the mansion is open for tours from 8:00am to 5:00pm during the summer months and 9:00am to 4:00pm during the winter. The mansion and estate grounds are open to visitors 365 days a year including holidays. The continuous open schedule allows a steady stream of visitors to the site with minimal downtime for repairs or restoration to be completed out of visitor view.

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Traversing Washington’s Path

The pathway for visitors in any historic site is pivotal to control traffic flow and the length of tours, to protect delicate collections, to prohibit entry to particular rooms and most importantly to serve as a traceable pattern of visitor wear. Like most house museums, visitors to Mount Vernon are guided through the mansion on a predetermined pathway. The tour is led by several interpreters each assigned to a location or stop through the mansion. The term visitor path, as it will be used for the purpose of this thesis, refers to the physical walking path through the mansion as well as the architectural fabric within physical reach of visitors.

There are also additional tours and special events that take place throughout the year and in the evenings beyond normal business hours which account for additional visitors and increased traffic to areas that are not part of the standard visitor path. The visitor paths for those events and tours are altered from the daily tour path through the mansion and include additional areas not generally accessible, including the basement. Those areas are briefly covered in Chapter Five as they are not exposed to the amount of continuous wear that the daily visitor path is exposed to. Some of the additional events include the National Treasure Tour, the Fall Wine Festival & Sunset Tour, and Mount Vernon by Candlelight. There are also additional dinner and whiskey tasting events. While all of these events do not specifically add increased traffic through the mansion itself, they do account for increased traffic to the estate.

These special events and tours account for approximately 35,000 additional visitors to the site. According to staff at Mount Vernon there are around fifteen to twenty private and after-hours events per month. On average, approximately half of the private evening events include tours of the mansion or events on the piazza. Other private and after-hours
events include, but are not limited to, weddings, receptions, candlelight tours, photo shoots, lectures, media events, film events, and private retreats or meetings.

During normal business hours, a typical tour through the mansion is approximately twenty minutes from entry into the Servants' hall until exit at the kitchen. There are nine stopping points along the tour. The visitor path begins with entry into the Servants' Hall through the south entry door and passes through a small walkway into a larger room to the east where the first stop occurs. The tour then exits through the east door onto the colonnade walkway with rubber matting and a raised platform which connects the hyphenated Servant's Hall with a front platform on the northwest side of the mansion. While not a scheduled stop or room on the tour, the platform does serve as the second stopping point for entry into the mansion. The backlog while waiting for the proceeding tours to move on causes visitor lag at this point for one to two minutes.

Figure 4.4 – The first floor plan of Mount Vernon, excluding the Servants' Hall. The orange arrows highlight the visitor path. Not to scale. (Drawn by author.)
The tour enters the mansion through the north entry door on the western side into the Large Dining Room for the third stop. The narrow visitor path runs west to east through the room. Carpet lines the path, and ropes and stanchions border the carpet on either side preventing visitors from stepping onto the uncovered hardwood flooring. The exit to the room is through the east door onto the piazza. The piazza serves as the fourth stop and waiting area for reentry in the mansion through the southernmost door on the east side into the central hall. The stone floor of the piazza is covered with a rubber mat and the path is narrow and blocked on the east side by a connected row of Windsor chairs.

The tour reenters the mansion through the central door on the west side into the Central Passage for the fifth stop. The large, carpeted space allows visitors to spread out and view four adjacent rooms. The landing under the stairs, the West Parlor and Little Parlor to the north, and the Small Dining Room and Downstairs Bedchamber to the east are visible from the Central Passage but are inaccessible to visitor entry and blocked off by Plexiglas barriers and stanchions.

From the Central Passage visitors continue up the central hall staircase onto the second floor landing and stop for a sixth time. The staircase is covered in carpet and the left third of the stairs is blocked off with stanchions and ropes. On the narrow landing, visitors were observed leaning against the north and east plaster walls while listening to the interpreter. Six rooms are visible from the landing. Every room but one is blocked off by Plexiglas barriers. The non-barricaded room to the southeast is referred to as the Yellow Bedchamber. The room serves as a pass-through to the next stop, the back hall and stairs. Again, the pathway is covered by a strip of carpet with rope and post barriers on either side.
As visitors travel through the Yellow Bedchamber, they stop for a seventh time in the rear hall at the top of the rear stairway near George Washington’s Bedchamber. Visitors use the chair rail along the western wall as a hand rail while walking through the hallway and lean against the east, south, and west plaster walls in the rear hall. Due to the confined space, the rear hall is the most crowded point on the tour.

Passing down the stairs and through the vestibule at the bottom of the rear stairwell, the tour enters into the study for its penultimate stop. This is not a very wide path. The north side of the carpeted path is adjacent to the north wall of the Study with no protection for the wall. The south side is blocked by ropes and stanchions. The tour exits through the western vestibule and through the southern door on the west side of the mansion onto the colonnade walkway with rubber matting and a raised platform on the southwest side. The tour ends in the kitchen building with stone floors that lack any protective covering.
Understanding the location of the visitor path is crucial to identifying the areas that are most susceptible to wear and to separate out what could be deemed as sacrificial wear from wear that is causing actual deterioration and loss of historic material. Additionally, Mount Vernon’s history of visitation and the jingoism of the materials written on it draw attention to visitor to wear and impact even prior to the mansion becoming a historic site. Stories of extreme visitor wear are numerous, but what is evident is that the same issues of wear and tear at Mount Vernon that are seen today have been in play for many centuries. These sources are valuable and essential in putting Mount Vernon in context with the shift and change in use from private residence to public space.

Mount Vernon is a nationally significant historic site. Continued awareness to the loss of architectural fabric is pivotal to Mount Vernon’s prolonged preservation. It is given that certain finishes are going to show deterioration. Wear is unavoidable; however, understanding that materials are going to be subjected to constant traffic can lead to better management plans and the promotion of responsible visitation. We should be happy that people want to come to historic sites, for without them what is the purpose other than a grave marker to a bygone era?
CHAPTER FIVE
CURRENT VISITOR WEAR AT MOUNT VERNON

A review of the Mount Vernon Historic Structure Report completed by Mesick, Cohen, and Waite Architects in February of 1993 indicated that many of the areas of wear from visitor traffic through the mansion are still the most frequently worn areas nearly twenty years later. The architectural investigation defined the locations where original materials were located as well as provided a point in time reference for the current state of the mansion.¹ The current damage to the architectural fabric is heavily concentrated along the visitor path and is mainly the result of anticipated abrasions from a large number of people moving through small areas. Other causes of wear are the result of the physical interaction of visitors along the path such as visitors leaning up against walls, touching the architecture with their hands, and the physical removal of pieces of the architectural fabric, including wallpaper and wooden finishes.

Instances of current wear as of July 2012 and material build-up were identified at each area along the visitor path. The areas of wear were noted to provide a current assessment of the visitor impact as well as to serve as a baseline for comparison to future inspections. Some areas of frequent wear have been cleaned, repainted, or re-grained more often than others. All areas of wear that have been addressed by Mount Vernon’s Restoration Department during the inspection period have been mentioned as such. The following details the significant areas.

Servants’ Hall

- The east wall in the western room was cleaned on July 2, 2012 using a citric acid wash. Also, the chair rail along this wall was also repainted on July 3, 2012. A more detailed description of the citric acid mixture and cleaning procedure is found in Chapter Nine of this thesis. As of July 20, 2012 there were some small scuff marks along the wall.

- The south wall in the eastern room was heavily soiled from visitor traffic. The field of debris began at the baseboard and extended to approximate heights of 43” and 52” at various locations along the wall.

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2 The principle focus of the study at Mount Vernon is on the material wear and impact within the mansion. While the Servant’s Hall is considered an exterior building, it is included because it serves as the start of the tour and the entry point into the mansion.
West Exterior Elevation of the Mansion

- **First floor, north most window on the western façade** Along the lower right edge of the wooden window casing, a small hole was pulled away at by visitors. Initial pictures taken on June 7, 2012 showed the damage before it was repaired. Repairs were made during the week of July 9th, 2012 and photographs taken on July 12, 2012 show the repaired section prior to repainting.

Large Dining Room

- **West Interior Elevation:** A small section of wallpaper border to the west of the entry door and above the chair rail showed signs of wear, and there were two sections of peeling paint along the lower panel just below the chair rail to the east side of the door. The damage appeared to be where sections of the peeling paint were removed. There was visible dirt and oil build-up along the east architrave of entry door that began at 26” in height from the floor and extended to 50”. The wear continued along the adjacent
door stile at 35" from the floor to a maximum height of 56". Additionally, the baseboards on both sides of the entry door were heavily scuffed and marked approximately 1.5" on either side. Deterioration is less on the east side of the door likely because the entry door swings opens to the right on the interior, the east side of the door is blocked by ropes, and visitors are made to file to the end of the room.

**Figure 5.4** – Torn wallpaper and heavily soiled door architrave on the Large Dining Room east interior wall. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)

- **East Interior Elevation:** To the left of the east exit door there is a 2” missing section of wallpaper border above the chair rail. Paint on the chair rail, directly below the missing wallpaper, was rubbed off. The wallpaper border to the right of the exit door was torn and missing in sections. The architrave to the right of the door was missing paint in some sections and was heavily soiled with dirt and oils. The right stile on the exit door had a portion of the finish worn off near the architrave to the right.
Flooring: Markings on floor extended outwards from the carpet edge to the south. They appeared to be marks from where the carpet was placed previously.

**Piazza and East Exterior Elevation**

- The rusticated finish on the piazza's beveled siding boards was worn off in several spots along the path between the northeast door and the southeast door. This was documented on June 7, 2012. Since this time, the rustication process, which is done to make the clapboard appear like stone, was completed on the exterior elevation along the piazza. There were no visible signs of wear due to the restoration.

![Figure 5.5 – Rustication process on the east exterior and piazza. (Photograph by author.)](image)
Central Passage

- There was dust on the wood paneling throughout the entry way. Although cleaned daily, the continuous opening and closing of four entry/exit doors makes this a continuous problem. There was some visible dust on the panels along the side of the Central Passage stairway and behind the visitor ropes near the staircase, but it is less apparent than the dust on the walls in the passageway where visitors have access.

- East Entry Door: There were abrasions along the lower right corner of the south door where it meets the baseboard. The baseboard was worn from contact with the door. Some wear on the finish was present on the north door at the right edge approximately 10-12” above the door lock.

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3 The first floor side parlors are situated to the east and west and run adjacent to the north wall of the Central Passage while the Small Dining Room and Downstairs Bedchamber sit along the south wall. These four rooms are open to visitor view but blocked from entry. For the purposes of this thesis the interiors of these rooms are not considered part of the visitor path due to the prohibition of entry by the visitors. Also excluded is the landing space beneath the Central Passage stairs. This area is blocked from visitor entry by ropes and stanchions. The wood paneling does, however, receive dust and debris due to foot traffic and the constant opening of the east door in the Central Passage. The dust is visible in the sunlight; however, due to the darkened color of the paneling and the daily cleaning of the central passage the measurement of the spread of debris, dirt, and oils along the paneling would be difficult and not possible to gauge accurate readings.
• Small Dining Room Architrave: The area of wear to the faux graining on the right side of the architrave was approximately 23” in length. The graining on the left side was worn in a similar fashion on both the interior and exterior of the architrave. The lower section of the wood paneling between the dining room and small bedroom room door had a crack that extended most of the width of the panel. It does not appear that the crack itself is the result of visitor impact.

• Downstairs Bedchamber Architrave: The graining on the right side was worn slightly along the exterior edge near the chair rail. Also, along the interior closest to the inside of the bedroom there was a chip in the graining that began at approximately 4’ – 5” above the floor and was approximately 1.5” in length. The graining on the left side is more heavily impacted than the right side and was worn on both the interior and the exterior of the architrave, including where it met the chair rail and on the chair rail itself. The baseboards in this area showed abrasions and scuff markings on both side of the architrave.

• Little Parlor Architrave: There no visible wear on the architrave. There was some minor wear to the faux graining on the chair rail to the right of the architrave.

• West Parlor Architrave: There was very minor wearing on the right exterior of the architrave at the chair rail. A small chip in the graining on the interior was present.

Central Staircase and Second Floor Landing

• Stair Rail and Balusters: The railing had heavy oil build-up from continuous use. The balusters were scratched and many had evidence of prior repairs. The stair rail baseboard extending from the south wall on the second floor landing was heavily worn.
There was dirt and oil build-up on the plaster wall surfaces to the north, south, and east. The east wall was cleaned on June 26th, 2012 with a citric-acid cleaning solution.

Blue Bedchamber Architrave: The wood graining on the left interior was worn from approximately 39” above the floor and extended to 52”. There was similar wear along the exterior of the architrave. The varnish from the wood-graining on the architrave transferred onto the plaster wall surface adjacent to the left architrave. The synthetic whitewash finish was also worn in sections which exposed the plaster wall material. The wood graining on the chair rail adjacent to the left architrave was worn as well.

Lafayette Bedchamber Architrave: The exterior edge of the left architrave was heavily worn along the graining approximately 32” from the floor and extended to 58” in height. The left architrave showed slight wear from approximately 43” at the lowest to 54” at the maximum.

Figure 5.7 – Central Passage Staircase with oil build-up on the railing and evidence of prior repairs. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)
• Garret Stair Passage Architrave: The faux graining of the left architrave had abrasions that began at approximately 34.5” and extended to 48” high. The plaster wall adjacent to the left side of the architrave showed some slight wear from the transfer of varnish from the architrave to the wall. The right side of the architrave showed very little wear. Only slight portions of the graining were missing at intermittent locations between 44” and 51” high. The faux graining on the east wall chair rail between the Garret Stair Hall architrave and East Bedroom architrave had finish loss in multiple locations.

• Small Bedchamber Architrave: The left side of the architrave showed heavy wear on the exterior that began at 33.5” and continued to a height of 56” with a maximum width of approximately 0.75”. There was slight wear on the interior of the left architrave along the exterior but at intermittent locations. There was a negligible amount of wear along the right architrave. The plaster wall adjacent to the left side of the architrave showed some slight wear from the transfer of varnish from the architrave to the wall.

• Yellow Bedchamber Architrave: The graining on the interior of the left architrave was worn at approximately 28” high and extended to approximately 53”. The graining along the interior of the left architrave, inside the Yellow Bedchamber, was worn at a height that began approximately at 26” and extended to 53.5” while the interior of the right architrave showed abrasions at 29” high that extended to approximately 52”. The exterior of the architrave was worn in a similar fashion and began at approximately 26.5” high and extended to approximately 58”.

• Nellie Custis Bedchamber Architrave: The graining on the left exterior architrave showed abrasions that began at 38” high and extended to 52”. The left interior architrave showed very minor abrasions in similar locations to the exterior. The right side of the architrave had a negligible amount of wear.
Figure 5.8 – Blue Bedchamber– Abrasions to left architrave with varnish transfer to the plaster wall. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)

Figure 5.9 – Small Bedchamber architrave – Heavy abrasions to the faux graining and varnish transfer. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)
Yellow Bedchamber

- North Elevation: Paint was missing from the interior of the door right architrave along the from an approximate height of 27” to approximately 47.5”. The wallpaper border on the wall to the left of the north wall door was torn and removed in several sections near the chair rail and left architrave. On the wall to the right of the north wall door, the wallpaper border had a 3” tear above the chair rail. The wallpaper itself had visible build-up of dirt and oils, similar to the plaster walls in the rest of the mansion from human contact. The build-up was also the likely result of dust and dirt in the air drawn up by daily pedestrian traffic through the room. There was dirt and oil build-up and abrasions on the painted chair rail to the right of the door architrave that extended horizontally approximately 14”.

- South Elevation: The wallpaper to the left of the door architrave was previously torn as of June 7, 2012 and was replaced at the time of this survey. There is no current damage. The wallpaper to the right of the architrave showed very minor wear and no large tears.
The wall itself was heavily soiled with dirt and oils. Although this wall is blocked by stanchions, it is still within reach of visitor path. The left architrave on the south door was worn at a height of approximately 33.5” and extended to approximately 48”. The painted finish on the right side of the architrave was worn in a larger section that began at approximately 29” high and extended to approximately 52.5”.

- East Elevation: This is not accessible to visitors. There are not any direct impacts other than dust build-up on the walls.
- West Elevation: There was build-up of dust, dirt, and oils on the section of wallpaper closest to the north entry door.

**Rear Hallway and Stair Landing**

- There was dirt and oil build-up on all four walls. All walls were cleaned between July 13 and July 20, 2012. Photographs were taken before and after cleaning. Prior to cleaning the south, west, and east walls had material build-up that began at the baseboard and extended to approximately 57” in height. The build-up ran the entire width of the south and west walls. Along the east wall the build-up was approximately 52” wide and sloped at a downward angle from right to left.
- Multiple scratches and scuff marks were visible along the lengths of the baseboards on all four walls.
- East Closet in the Rear Hallway Entry: The painted edge on the right side was worn at an approximate height of 37” and continued to approximately 56”.
- The chair rail on the west wall of the hallway had abrasions that extended approximately 20” along its length.
- George Washington’s Bedchamber Architrave: The painted finish on the left exterior architrave displayed abrasions that began at approximately 34” in height and extended
to 55”. The interior of the left architrave was worn from a height of 38” and extended to approximately 53”. The painted finish on the right exterior architrave displayed wear that began at approximately 32” in height and extended to 53”. The interior was worn from a beginning height of approximately 40” and extended to 58”.

Figure 5.11 – Abrasions to the right edge of the east closet in the rear hallway. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)

Rear Stairwell

- There was heavy build-up of dirt and oils along both the east and west walls on the side of the rear stair passageway. The dirt and oils were cleaned with a citric-acid solution on July 20, 2012. The ceiling area above the stairwell was also heavily soiled with dirt and oil build-up. This area was cleaned on July 20, 2012 using the citric-acid solution as well. Photographs show the area before cleaning.
The painted molding that borders the stairwell ceiling was worn from constant contact as visitors travel down the stairways touching it with their hands or heads. The area of wear was approximately 7” in length.

The paint on the southeast window architrave was worn near the stair handrail on the east wall.

**Southeast Vestibule**

There was dirt and oil build-up on the plaster surface of the south wall. The painted wood surfaces of the north wall showed little signs of wear. There was also little to no visible wear along the door to the east and its architraves.

**Downstairs Bedchamber Architrave:** The right exterior architrave showed minor visible build-up of dirt and oils but few abrasions. The interior portion of the architrave, inside the door jamb, was extensively worn along its finish. The paint was cracked, chipped, and gouged to the wood in some locations. The wear began at a height of approximately 5'.
7” and extended to approximately 46” high. It extended in some locations across the entire width of the jamb. The left exterior side of the architrave shared the same wear pattern along the section inside the door jamb but stopped at a height of approximately 40”. Some of the wear closest to the interior of the small bedroom appeared to be impact related rather than worn off by friction as was seen on the majority of the architraves in the mansion. There was no visible wear along the exterior portion of the left architrave because the door to the small bedroom protects it from visitor wear and influence.

- The Downstairs Bedchamber door showed some minor wear of the graining along the edge that faced the vestibule.

- Study Architrave: The left side of the architrave displayed heavy wear on the interior section. The wear began at a height of approximately 28” and extended to approximately 60” with varying degrees of thickness. The interior portion of the architrave in the door jamb also showed some slight wear along the same height as the outside of the architrave but at intermittent locations. The painted finish on the right side was worn slightly and began at approximately 31” and extended to approximately 44” high.
Study

- **East Door:** The door swings open into the Study and protects the interior of the door architrave. The door showed some moderate wear along the edge including some large gouges of an approximate length of 4”.
- **The east elevation was blocked by stanchions and showed little impact from visitors.**
- **Fireplace Graining:** There were small, minor abrasions in several locations along the right and left side of the mantle edges with heavier abrasions along the left side.
- **Fireplace:** The lower left side baseboard showed abrasions along the corner and some loss of material.
- **North Elevation Paneling:** There was minor wear along the chair rail at a height of 35” and at intermittent locations along its length.
- **West Door and Architrave:** There was very slight wear along the edge of the door. The left exterior architrave showed moderate wear at a height that began at approximately 44” high and extended to approximately 51.5”. The interior of the left architrave had heavy abrasions of the graining at a height that began at approximately 26” and extended to approximately 56”. The painted finish along the left interior door jamb portion of the architrave showed heavy wear that began at 32” in height and extended to 61”. The most concentrated wear was between 38” and 50” in height and extended across the width of the door jamb. There was little to no visible wear along the right side of the architrave because it is blocked by the west door that opens toward the interior of the Study.
• West Elevation: There was heavy wear of the faux-grained finish on the chair rail closest to the doorway architrave that extended approximately 12-14” along the west wall. This section was partially blocked by the stanchion and could be the result of visitors leaning against the wall. However, this area is also where the interpreter stands during the mansion tour and the damage could potentially be from the interpreter. The baseboard to the left of the door also showed scuffs and scratches as well as some loss of paint.

Southwest Vestibule/Exit Hallway

• Pantry Architrave: The painted finish along the right architrave was worn at a height that began at approximately at 40” and extended to approximately 52.5”. The left architrave showed very minor marks on the painted finish.

• West/Exit Door and Architrave: The left architrave showed a build-up of dirt and oils from visitors hands when they opened the exit door. The painted finish was rubbed off along the interior closest to the door and began at approximately 29” high and extended to 55”. The middle rail of the exit door showed some chipped paint.
Third Floor & Basement

- These areas are not part of the regular visitor path; however, they are accessible to visitors at certain times of the year or on specific private evening tours. The third floor of the residence is accessible to the general public on President's Day and during the private tours. Upon inspection, the third floor of the mansion displayed some visible wear and tear with dirt and oil debris present on the plaster stairwell walls. The build-up was not extreme enough to get an accurate measurement of height, but markings from impact and visible dirt and oils were present. Each of the four rooms directly off the third floor landing had apparent damage from condensation that dripped from the air conditioning return vents installed in the ceiling. There was a small square of water damage approximately 12” by 12” in area on the wood flooring in each room directly below the openings.

- The National Treasure tour, among other private evening tours, allows passage to the basement. Due to the limited visitor traffic, the basement did not show any visible signs that were directly attributable to pedestrian impact at this time.

Flooring

- The wear on the flooring varies throughout the mansion. The Study is the only room on the first floor with original wood flooring from George Washington’s era. The wood flooring on the entire second floor is original to the eighteenth century. To protect the flooring and reduce wear, the entire visitor path through the mansion is covered with industrial carpet. The carpet was last replaced in February 2012.
Figure 5.15 – Air conditioning return vent on the third floor. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)

Figure 5.16 – Water stains on the wood flooring directly below the vent in Figure 5.15. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)
Weaknesses

The type and degree of visitor impact to the architectural finishes varies within the mansion. Areas where visitors are spatially limited such as the second floor landing of the Central Passage staircase, demonstrate the most highly concentrated amount of damage to the architectural fabric. Baseboards, plaster walls, the handrails on the stairways, and the door architraves and thresholds are most vulnerable to wear and material loss. Other damage is caused by efforts to seclude visitors from entry into particular rooms. Damage is caused from Plexiglas shields inadvertently bumping into the walls, visitors leaning on ropes to get a better view of the rooms, and damage from the ropes themselves being moved back and forth to block the entry way.

An additional area of weakness is the area near the east exit door in the Large Dining Room. The room has a rope and post barrier that is positioned approximately 1’ – 6” from the wall leaving the area susceptible to visitor influence and damage. The exit door opens to the left on the interior, and this area is protected when the door is opened, but while it is closed during the tours the area is vulnerable. Additionally, there is a ½” to 1” gap at the bottom of the Large Dining Room entry and exit doors. This allows dust, dirt, and water to get in even when the door is closed. While this opening is not directly caused by visitors, visitor traffic on the exterior footpaths stirs up dust which enters the mansion through the door gaps. Although the wear and tear issues at Mount Vernon are numerous, the following chapter compares these issues with those present at Monticello and Colonial Williamsburg to determine if Mount Vernon's wear is proportional to its visitors or if it is a case of accelerated degradation.
CHAPTER SIX
THE VIRGINIA THREE: MOUNT VERNON, MONTICELLO AND COLONIAL WILLIAMSBURG

George Washington entertained many guests at Mount Vernon, but it is doubtful that even during the most prosperous and flourishing times that he would have been able to keep up with the millions that now journey to his estate. In terms of annual visitors to a singular historic site, Mount Vernon is in a league of its own, but similar wear and tear patterns also occur at sites with fewer visitors. While this thesis is an attempt to take a comprehensive and holistic look at the visitor impact to the mansion at Mount Vernon it is also necessary to understand how Mount Vernon’s wear relates to that at similar historic locations.

A comparative study was conducted at historic sites with like visitation numbers and visitor patterns to determine if the wear at Mount Vernon is proportional to the number of visitors it receives or if it is excessive. However, wear patterns and levels can be affected by other variables including the location of the visitor path, the architectural materials present, and maintenance and mitigation efforts. All things considered, a historic house museum with lesser visitation should not show the same amount of wear as Mount Vernon does. Thomas Jefferson’s Monticello and Colonial Williamsburg were chosen as comparable sites to Mount Vernon based on annual visitation numbers, proximity to Mount Vernon, similar architectural eras and materials, and because of the ongoing preservation and restoration efforts at both locations. The comparison of the wear at these sites is paramount to the credibility of the visitor impact at Mount Vernon. In order for the results of this thesis to be replicable and applicable to other historic sites, the visitor impact at Mount Vernon cannot function as an anomaly.
Monticello

Home to the Nation's third President, Thomas Jefferson, Monticello is located in Charlottesville, Virginia approximately one hundred and twenty miles southwest of Washington, DC. Like Mount Vernon, Monticello is as much revered for the man who lived there as it is for its architectural merit. Designed and constructed by Jefferson from 1769 until 1809, the house is a two-story, twenty-one room, neoclassical brick structure with Doric columns dominating the east and west façades and a distinctive dome emblazoning its roofline.¹ While Jefferson and Washington were polar opposites in the political arena, the attention that each man gave to their residence is what made their homes the lasting icons they are today.

Jefferson designed Monticello and unlike Mount Vernon, there was no preexisting structure that he inherited and expanded. From the beginning, Monticello was his own creation. Jefferson chose the location, drafted the design, picked out the materials, and oversaw the construction. While Washington wanted Mount Vernon to be a model for the nation as well as his home, Jefferson added elaborate details within his classically constrained design including ox heads and archaeological imagery in the molding entablature. From his home, Thomas Jefferson led a nation, supervised the construction of the University of Virginia, and of course, welcomed and entertained guests and many wearied travelers possessing letters of introduction.²

Like Washington, Jefferson himself was inundated with visitors on a regular basis. Although many quests were often uninvited and unexpected, they were always welcomed and accommodated. Monticello served as a stopping point for many travelers on their way to and from Washington, DC and guests would stay days or weeks at a time. Jefferson often went to his retreat at Poplar Forest to escape the numerous visitors. And like Washington and Mount Vernon, the mourners and relic hunters came to Monticello after Jefferson’s death, and they too took their toll on the deteriorating property.

Following Jefferson’s death in 1826, the Monticello estate was bankrupt and nearly $107,000 in debt. Jefferson’s remaining possessions and Monticello itself were sold at auction by his daughter, Martha Jefferson Randolph, to pay creditors. The last family to

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occupy Monticello as a private residence was the Levy’s, who had held the property since 1834. The Levy’s understood the architectural, historical, and political importance of the house and its association with Jefferson and much like he did, welcomed visitors to the estate and allowed tours of the house.\textsuperscript{6} In 1923, Monticello was procured from the Levy family by the Thomas Jefferson Memorial Foundation and opened to the public.\textsuperscript{7}

Similar to the founding of the Mount Vernon Ladies’ Association, the Thomas Jefferson Memorial Foundation was established for the purpose of preserving Monticello and Thomas Jefferson’s legacy.\textsuperscript{8} The Foundation set forth with the task of restoring Monticello, but the majority of the restoration began nearly fifteen years after the purchase was made with early efforts led by art historian and architect Fiske Kimball. Initial restoration focused on stabilization and included first the replacement of the roof. Later work included structural renovations and stabilization of floor joists, installation of a heating and cooling system, and restoration of the southeast dependencies. Restoration efforts continued through the twentieth century and included ongoing preservation efforts to return the house to Jefferson’s pre-presidential era and maintain its status as an American architectural icon.\textsuperscript{9}

\textit{Touring Monticello}

With the exception of Christmas day, Monticello is open every day of the year, like Mount Vernon this allows for a daily stream of visitors to the house. Visitation to Monticello increased gradually through the twentieth century but declined after America’s bicentennial in 1976. In 1924, the first year that Monticello was publicly opened, 20,091 tickets were

\textsuperscript{6} Jefferson Foundation, \textit{Thomas Jefferson’s Monticello}, 74.
\textsuperscript{7} Monticello.org, “Monticello (House) FAQ,” \textit{House and Gardens}.
\textsuperscript{8} Monticello.org, “Thomas Jefferson Foundation Chronology.”
sold at fifty cents per person. Visitation exceeded 200,000 people in 1948, and by 1969 totaled 383,692. Forty five years after it opened to the public the cost of admission doubled to $1.00. At its peak, in 1976, 671,487 visitors came to Monticello.10

A typical day pass to Monticello includes three guided tours including Jefferson’s house, a slavery tour, and a garden tour, as well access to the visitor’s center and other exhibitions. A daily tour pass is $18.00 or $24.00 depending on the time of the year. The basic day tour to Monticello provides access to the first floor and basement levels of the house, is approximately one hour long and limited to twenty-five persons at a time. Additional special tours are offered each day that include access to the second floor. Monticello also hosts special events including, but not limited to, a Wine Festival, Garden Week, summer camps, private tours, and weddings. In 2011, admission fees totaled $7,257,957 for 445,000 visitors, about half of the number to Mount Vernon.11

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10 Monticello.org, “Thomas Jefferson Foundation Chronology.”
Figure 6.2 – Monticello First Floor Plan. Not to scale. (Drawn by author.)
**Current Visitor Wear**

There are several issues present at Monticello: abrasions to painted surfaces, impact damage to doors, architraves, baseboards, and chair rails, dirt and oil build-up the second floor stair handrail, chewing gum deposits on the stone entry steps, and faded flooring. Wear is heavily concentrated along the visitor path with minimal instances present along the second floor and the basement. The majority of the wear is directly caused by visitors, but there are instances of indirect wear.

Visitors enter the house through the eastern portico. Before entering, visitors are asked to dispose of any gum or food into terracotta rubbish bins. Bins are located approximately one foot from both the north and south sides of the portico entry steps. Multiple visitors missed the bin when disposing of their gum resulting in unsightly deposits on the sandstone steps. This is a relatively minor impact, but it can lead to discoloration and potentially minor deterioration of the steps.

*Figure 6.3 – Eastern portico steps with gum deposits. (Photograph by author.)*
Abrasions to the architectural fabric are the most frequent occurrences at Monticello. The painted surfaces of the door architraves throughout the first floor including those protected with aluminum covers are marred by the impact of visitors. This is most likely due to guests passing through the doorway rather than leaning against it as the majority of wear tends to be to the interior or on the corners of the architraves. Abrasions in some locations extend upward from the floor to about one and a half feet. This appears to be from the passage of wheelchairs in the space as the first floor tour has been made handicapped accessible.

The door entryways from the north passage into both the dining room and the north octagon are particularly narrow. The bottoms of these doors have been covered with Plexiglas shields to protect them from wheel chair damage and accidental foot impacts.
However, because the doors still need to function and close, the Plexiglas does not wrap around the interior edges of the doors. These edges are exposed when opened and are marred and show minor material loss.

![Image of a door with impact abrasions](Figure 6.6 – Impact abrasions to the dining room door in the north passage. (Photograph by author with permission of the Thomas Jefferson Foundation.)

Heavy material build-up on the architectural finishes is minimal at Monticello. With the exception of scuff marks on the wall surface encasing the second floor staircase and oil build-up on the handrail, they are very minor throughout the rest of the house. The staircase leading to the second floor is very narrow and can explain the appearance of the wall marks. Unlike Mount Vernon, these marks are not from visitors leaning against the wall surface while listening to an interpreter, but rather occur from passing through the narrow space. Additionally, the build-up on the handrail presents a problem in terms of visitor impact. Since the house was occupied as recent as the early twentieth century and visitor tours were limited, it is difficult to state that visitors are solely responsible for this.
Figure 6.7 – Oil build-up on the staircase handrail visible from the second floor. (Photograph by author with permission of the Thomas Jefferson Foundation.)

Figure 6.8 – Dirt and scuff marks on the staircase sidewall leading to the second floor. (Photograph by author with permission of the Thomas Jefferson Foundation.)
Indirect wear at Monticello includes the fading of the parquet flooring and damage from display cases in the parlor. The flooring is covered with modern carpet to protect it from visitor damage. Similar to most houses with carpeted flooring, sun damage faded the uncovered portion while the area protected by the carpeting retained the darker color. The parlor also has several display cases which contain personal items that belonged to Thomas Jefferson. One of the display cases impacted the chair rail behind it multiple times. This could potentially be from movement by staff members or accidental collisions from visitors. While these are not directly caused by visitors they are unintended consequences of having to make accommodations for visitors while protecting the historic fabric.

There are different patterns of wear and variables between Monticello and Mount Vernon that make the type of wear found and its frequency slightly different. For example at Monticello, the chair rails are more heavily abraded than the wall surfaces. The chair rail protrudes further out into the room than the chair rail at Mount Vernon, thus protecting the wall surface and taking the brunt of the wear. Maintenance and mitigation efforts taken by Monticello’s restoration department have also limited visitor impact. These efforts will be further discussed in Chapter Nine of this thesis.

Abrasions and basic wear and tear from normal use are to be expected in a historic house just as they would in a private residence. The current visitor impact at Monticello appears to be relatively proportional to the number of annual visitors it receives. The wear and tear is confined to the visitor path, does not detract from the aesthetic aspect of the tour, and does not appear to be excessive or causing serious loss of material, material failure, or finish transfer. At this time, the wear does not give the impression that it is causing any structural issues as many non-visitor induced structural issues were addressed
during Monticello’s restoration in the mid-twentieth century. However, any visitor related structural issues would need to be verified with a structural engineer.

Figure 6.9 – Damage to the parlor chair rail from a display case. (Photograph by author with permission of the Thomas Jefferson Foundation.)

Figure 6.10 – Fading on the parquet flooring in the parlor indicated by the orange arrow. (Photograph by author with permission of the Thomas Jefferson Foundation.)
Colonial Williamsburg

A former capital of Virginia, Williamsburg is rooted in the settlement and founding of early America and has associations with some of the most prominent Founding Fathers including George Washington, Thomas Jefferson, and Patrick Henry. Within greater Williamsburg, Colonial Williamsburg sits on the site of the original colonial city center. The site is a three hundred acre, restored and reconstructed, outdoor living history museum. Colonial Williamsburg is located approximately one hundred and fifty miles southeast of Washington, DC and hosts over 800,000 annual visitors. With its proximity to many other historic colonial locations including Jamestown and Yorktown and tourist destinations such as Virginia Beach and Richmond, its annual visitation is slightly higher than that of Monticello.

Settled in 1633 on the site of Middle Plantation, Williamsburg rose to prominence in 1699, when, under British rule, it became the capital of Virginia. The statehouse in nearby Jamestown was burned and the decision was made to move the capital to Williamsburg for better military protection, fertile land, and access to navigable creeks. Williamsburg quickly developed into the political center of the nation and hosted patriots and leaders of the American Revolution. It also included the nation’s second oldest university, the College of William and Mary, and flourished under tobacco production. In 1780, the Virginia capital was moved to Richmond and the city reverted back to its quiet ways.

As the nineteenth and early twentieth centuries passed, change and progress were ultimately responsible for the loss of many of Williamsburg’s early colonial structures. Many

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original structures had been destroyed by neglect and fire or demolished in the way of progress. In 1926, Reverend W.A.R. Goodwin of Williamsburg’s most famous church, Bruton Parish, proposed the idea to restore Williamsburg to philanthropist John D. Rockefeller, Jr. With Rockefeller’s financial backing, the restoration of Williamsburg included the tearing down of 442 modern buildings, the relocation of 18 structures, and the restoration and preservation of hundreds more.14

The restored area is managed by the Colonial Williamsburg Foundation and is an expansive site encompassing 618 structures, eighty eight of which are original with many more that include eighteenth century materials. Since it is part of the actual city, the colonial-era streets are open to the public and many of the houses are occupied by private residents and Colonial Williamsburg staff.

Figure 6.11 – Duke of Gloucester Street in Colonial Williamsburg. (Photograph by author.)

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Touring Williamsburg

There are a variety of admission options for visitors including day, multi-day, annual, and multi-site tickets. A one day adult admission is $24.95 and includes access to select houses, public buildings, exhibits, and three museums. Hotels, restaurants, and shops are also part of the site. In 2010, Colonial Williamsburg received $20,483,588 in revenue from admissions; this is excluding revenue from food services and restaurants, special programs, and rentals.15

Visitors can enter Colonial Williamsburg from a variety of locations and have the option to tour the property themselves, take a guided tour or follow a predetermined pathway. The visitor path for this location is not comparable to Mount Vernon as multiple routes are possible. However, the pathways inside accessible houses, such as the Peyton Randolph house, are guided by interpreters on a specified visitor path.

Current Visitor Wear

The instances of wear were not assessed for every property at Colonial Williamsburg but rather evaluated on a general basis from the physical inspection of the most popular and prominent structures. Although it is difficult to draw conclusions about how the patterns of wear in a singular structure directly compare with those at Mount Vernon, the assessment is useful to determine if the type of wear is similar and displays the same deterioration issues. While the flooring at Mount Vernon may be subjected to one million pairs of feet per year, every visitor to Colonial Williamsburg may not enter every open structure on the property leading to a disproportionate amount of wear in comparison with the number of annual visitors. Additionally, Colonial Williamsburg’s annual pass allows

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guests to visit multiple times but only count once in annual visitation totals. Not only does this skew the number of annual visitors, but houses may be subjected to repeated wear by the same person and only be counted once. While visitor wear patterns are seen in several of Williamsburg’s structures, it is difficult to accurately determine the specific number of visitors that are responsible for these issues.

There is various evidence of direct visitor impact to structures at Colonial Williamsburg. These include abrasions to painted surfaces, worn steps and thresholds, dirt and oil build-up on entry doors and walls, worn or missing hardware, and vandalism. Indirect damage consists of ADA compliance accommodations, condensation from air conditioning units, and installation of decorations for periodic programming.

One of the most prominent structures on the site is the Capital. While it is a twentieth century reconstruction of the original building, it was extensively researched and built of similar materials. The Capital’s steps are constructed from sandstone, a relatively popular and widely available stone in the Tidewater region during the eighteenth and nineteenth centuries. The sandstone has concave wear patterns along the steps and also in the doorway thresholds. The wear to the sandstone is not uncommon and does not necessarily suggest excessive wear as it is known for its soft qualities and material deficiencies. However, the visible patterns of wear are significant to note given the structure is less than one hundred years old. Increased wear on modern thresholds, both stone and timber, compared to historic ones is a continuous problem at Colonial Williamsburg and one that can also be related to the quality and lack of historic materials, such as old growth wood.
Abrasion to painted surfaces and dirt and oil build-up are also common issues. At the Court House there are visible impact marks as well as dirt on the left exterior side of the entry door. The Peyton Randolph House also has multiple marks and visible dirt along the wall surfaces of the staircase leading from the first floor to the second. The second floor is part of the regular tour so unlike Monticello, these stairs are used frequently. The painted surfaces on several door architraves on the second floor also show wear from continuous contact.

Additionally, there are greater opportunities for vandalism at Colonial Williamsburg than at Mount Vernon or Monticello as it not a secluded historic site and the streets are accessible just as in any town. Since it is a living community with actual residents, entry gates cannot be closed and visitors cannot be removed from the location at night. The properties that require admission are closed at 5pm so generally only the exterior is susceptible. While exterior vandalism is rare, historic structures have at times been spray painted with graffiti.
Figure 6.13 – Worn steps at the Capital. (Photograph by author.)

Figure 6.14 – Worn threshold at the Capital. (Photograph by author.)
Figure 6.15 – Dirt build-up at the Court House. (Photograph by author.)

Figure 6.16 – Abrasions to the painted architrave at the Peyton Randolph House. (Photograph by author.)

Figure 6.17 – Dirt build-up and scratch marks on the staircase wall at the Peyton Randolph House. (Photograph by author.)
The majority of visitor impact is direct, but there are some instances of indirect impact from accommodations or changes made that result in damage to historic fabric. Ramps and swinging sills have been installed to allow handicapped access, changing the historic character of some sites. Some of the properties have been outfitted with air conditioning for visitor comfort and protection of interior collections. In the summer of 2012, issues arose from condensation on conduit piping within the walls of some structures. Condensation issues also occur in the modern hotel properties on site. Lastly, for special programming during the Christmas Season nails are put into the wood paneling of some structures to hang decorations. While these instances are relatively minor, it is still important to understand that they occur indirectly because of visitation.

Figure 6.18 – Sill modified with swinging hinge to allow wheelchair access. (Photograph by author.)
Like Monticello and Mount Vernon, the abrasions and basic wear and tear from normal use are expected at Colonial Williamsburg. Disparities exist because of Colonial Williamsburg's size, but the types of wear at each location are similar. Visitor impact is reduced because visitors are more spread out over the site. Wear and tear is more evident at, and primarily confined to, popular structures, such as the Peyton Randolph House, the Capital, and the Palace. While dirt and oil build-up does detract from the aesthetic aspect of the tour in the Peyton Randolph House, it does not appear to be excessive or causing serious loss of material, material failure, or finish transfer.

**Drawing Comparisons to Mount Vernon**

The wear at Mount Vernon is a combination of several factors including confined spaces, visitor exposure to materials, tour policies, reactive mitigation strategies, and high visitation. Abrasions, worn surfaces, dirt and oil build-up, vandalism, temperature and humidity issues, and ADA compliance regulations at Monticello and Colonial Williamsburg parallel the type of wear at Mount Vernon and illustrate that it is a common occurrence. The wear is concentrated in similar locations and is of a similar type but the key difference is variation in degree and intensity.

Monticello's wear is due in part to its reduced annual visitation, a varied floor path, a guided tour group, and perhaps different materials, but also due to mitigation strategies employed by the conservation and preservation staff. The details of which will be further discussed in Chapter Nine of this thesis. With Colonial Williamsburg the damage is not as extreme as Mount Vernon because it is not concentrated in one location, rather spread out over an entire site. Additionally, Colonial Williamsburg works within a cyclical maintenance schedule to attend to every one of its 618 structures, so damage is readily assessed. Like Monticello's efforts, these will also be elaborated further in Chapter Nine.
The greatest factor in Mount Vernon’s increased wear is its high level of visitation. Several additional factors add to an increase in Mount Vernon’s visitation: its proximity to Washington, DC, its association with America’s first President, and its role as the first privately owned house museum in the country. Mount Vernon has also been open to the public nearly sixty years longer than Monticello and Colonial Williamsburg.

There is no recognized scale for measuring the degree of visitor impact. Each site has its own variables. And measurements can be subjective. Comparison of similar sites and the consideration of several factors such as the loss of material, its location, material failure, finish transfer, and detraction from overall tour experience, however, can assist evaluation of visitor impact. The subsequent chapter will discuss the material degradation at Mount Vernon to aid in analysis of the excessiveness of its visitor impact.
CHAPTER SEVEN

QUANTIFYING MATERIAL LOSS

Degradation of restored interior finishes at Mount Vernon is identical to the type of wear observed at Monticello and Colonial Williamsburg’s historic buildings. Identifying the wear was the first step in gauging its level of severity and effects on architectural materials, as well as determining best mitigation strategies. This chapter discusses the results of several tests undertaken to calculate the rate of wear to architectural fabric at Mount Vernon by measuring the expansion of wear patterns and material loss. Also discussed are several areas that were identified as being vulnerable to visitor impact, but where independent tests were not able to be conducted. Variables, such as visitation numbers, history of use, and material differences all inhibit the creation of a standard rate of wear as each historic house is unique as is the threat posed at each house. However, the tests and methods of calculation implemented in this study can be used in other historic house museums.

Faux Graining Wear

Many architectural surfaces along Mount Vernon’s visitor path are within the reach of visitors and susceptible to accidental or intentional damage. A major area of concern is the faux graining on the second floor landing of the Central Passage. The graining is located on the architraves of the six doors connected to the landing. This graining is susceptible to continuous wear and material loss. Two factors contribute to the wear: crowded spaces and exposed finishes. The area of the landing is approximately 115.73sq feet and can often have in excess of twenty-five people including a docent in the space. Additionally, there are no protective barriers covering the door architraves. While Plexiglas barriers are in the door openings, visitors often place their hands on the architraves to brace themselves as they
peer over the barriers. As a result, the varnish coat and the top layer of graining are worn away in several locations.

The amount of wear varies from slight abrasions to heavy loss of finish material. The loss of paint has also revealed the primer and substrate in some areas. Aside from wear directly to the architraves, the varnished top coat is also transferring onto the plaster wall near the architraves. Due to the heavy wear, the faux graining is refinished every January. Measurements of the lowest starting point of the wear, the maximum height, and the width, where possible, were taken in July and December of 2012 as benchmarks for annual wear. For the purposes of this thesis, the area of finish loss to the architraves is referred to as the Material Degradation Area, abbreviated as MDA.

Figure 7.1 – The central passage landing on the second floor. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)

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1 Mount Vernon mansion maintenance records from the re-graining efforts in January 2005 indicate that the faux graining was covered with two coats of McCloskey's Oil-Based Satin Heirloom varnish.
The majority of the MDAs begin at 39” above the floor and extend to 58” in height. This is approximately waist to shoulder height for an average adult. Aside from visitors placing their hands on the architraves, finish loss is likely caused by visitors leaning against the architraves with their backs and shoulders. Potential finish loss also comes from book bags or purses carried by visitors which strike and rub against the architrave.

The areas with the maximum measurable loss of finish were architraves of three rooms on the second floor: the Yellow Bedchamber, Blue Bedchamber, and Small Bedchamber. Initial measurements in July 2012 of the Yellow Bedchamber indicated that the MDA of the left architrave closest to the interior of doorway was 27.5” in height. In December, the MDA increased vertically by 4.5” or approximately 16%. In July, the Blue Bedchamber’s MDA on the left architrave closest to the wall was 16.5” in height and by December it increased to 18.5”. Its 2.5” vertical growth from to July to December is nearly a 15% increase, while the MDA closest to the doorway increased by approximately 15.4%. Lastly, the Small Bedchamber displayed heavy finish loss in July. Measurements taken in December indicated the MDA on the left architrave closest to the wall was 22.5” in height. In December, the MDA expanded vertically 3.5” which is a 15.4% increase from July.

From July to December, the majority of finish loss increased minimally in vertical height but changed in severity, expanding from minor and slight abrasions to moderate or heavier patterns along the width. In addition, there was greater exposure of the primer material and loss of the finished surface. The surface area of the MDA is noticeable through visible inspection, but is not as easily interpreted in measurements as its width varies.

Measurements show that the maximum height of the MDA during the period of analysis increased an average of two to four inches in some locations, but the width varied on each architrave. This is a 15 to 16% increase over a six month period. It is interesting to
note that the heaviest patterns of wear occurred on the left architraves of most of the doors with the exception of the Yellow Bedchamber. Its wear increased on both the left and right architraves along the interior nearest to the door. The wear pattern is likely heavier at this location because the Yellow Bedchamber serves as a transitional space to the rear hall on the visitor tour.

The paneling in the Study is also finished with a faux grain. Finish loss along the north wall chair rail increased from 4” in length in July to approximately 8” in December. While the length of the MDA increased nearly 50%, the intensity or degree of finish loss is slight in comparison with that on the second floor landing. However, it still demonstrates a noticeable increase in exposure of primer material and loss of top coating and varnish. Additionally, although measurements were not taken, the greatest visible finish loss to the faux-grained wood remained near the location where an interpreter is stationed in the room. Figures 7.2 through 7.6 illustrate the wear to the Small Bedroom architrave and the paneling in the study over six and twelve months respectively.

At this time, it was possible to determine and describe a specific rate of MDA vertical expansion of the faux graining that occurs over a six month period. However, the variations in the degree of the finish loss make it difficult to ascertain a replicable rate of wear or expansion that could be applied to subsequent years. The wear patterns likely vary from year to year depending on use or visitation, differences in material (such as pine which is more susceptible to damage because it is a softwood compared with that of some hardwoods like oak), and maintenance. Therefore, the analysis could not determine a precise rate of wear for this material. However, testing methods that conform to the standards of the American Society for Testing and Materials (ASTM) are available to quantify finish loss and abrasions to surfaces and can be used to more accurately identify a
rate of wear specific to the material. Calculating a “standard” rate specific to visitation levels is more problematic.
Figure 7.3 – Small Bedchamber left architrave in December 2012. Finish loss increased in severity along the interior and increased in vertical height along the exterior of the architrave. It is highlighted by the red boxes. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)
Figure 7.4 – Faux graining finish loss in the Study, taken in July 2012. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)

Figure 7.5 – Faux graining finish loss in the Study, taken in December 2012. (Photograph by author with permission of the Mount Vernon Ladies’ Association.)
Dirt and Oil Expansion on Plaster Walls

Dirt, dust, biological oils, and surface marks readily occur on plaster wall surfaces at Mount Vernon. The wall surfaces are finished with Old Village brand acrylic latex simulated whitewash. The finish replicates historic whitewash composed of slaked lime, chalk, and water without the volatility of the lime and with a faster drying time and easier application process. The whitewashed finishes were previously identified as areas susceptible to visitor impact and wear. The four week study to quantify the vertical and horizontal expansion of dirt and oils on the surface of the whitewashed walls, described in the methodology section of this thesis, revealed that it takes only a few days for dirt and oil build-up to appear on clean wall surfaces and that material build-up does not occur in a continuous thick layer, but rather in a sporadic pattern. What follows are the statistics and analysis of the data gathered during the study.

Servants’ Hall – East Wall

The Servant’s Hall is not a part of the mansion, but it was considered for the study because of its role as the starting point to the visitor tour of the house. The east wall was cleaned with a citric acid wash on July 2, 2012, removing any dirt or material build-up. The citric acid wash is a liquid solution comprised of citric acid, ammonium hydroxide, and de-ionized water. It took approximately sixteen days for visible and measurable dirt to accumulate on the cleaned surface.

Initial photographs on July 10, 2012 did not show any visible accumulation of dirt and oils along the east wall. However, there was a small amount of dirt and dust present along the top of the baseboard. On July 18, 2012, visible dirt accumulated on the lower panel approximately 9” from the floor and there was also a small blue mark about 1” wide at approximately 41” in height. It is unknown what object caused the mark. Sixteen days
later, small scratches, about one inch in length, materialized at a height of 13.5” from the
top of the floor. During this period of time the data was not strong enough to determine
a precise rate of debris build-up at this location because the horizontal and vertical
expansions of dirt and oils along the surface of the wall were sporadic in dispersion, making
it difficult to accurately gather measurements.

*Central Staircase Landing – East Wall*

The study also identified the east wall of the second floor landing of the Central
Passage staircase as another location vulnerable to surface material build-up. The plaster
surface of the east wall was cleaned on June 26, 2012 with a citric acid wash. Initial
photographs on July 10, 2012 did not show any visible accumulation of dirt and oils along
the east wall. A small abrasion mark above the chair rail that began approximately 5” south
of the north door molding and extended approximately 15” in length appeared on July 13,
2012. Five days later, a small amount of material build-up accumulated on the plaster
surface to the left of the Small Bedroom architrave and 0.5” above the top of the chair rail. It
was approximately 15sq inches in area. This appeared to be transferred varnish from the
faux graining on the left Small Bedroom architrave.

Sporadic dirt and oil build-up was present twenty-two days after the east wall was
cleaned. However, an 88sq inch evenly dispersed field of dirt build-up appeared five and a
half weeks after the wall was cleaned. It took longer for dirt to appear in the Central
Passage than in the Servants’ Hall perhaps because the Servants’ Hall location is a narrower
passage. It is also prone to dirt and dust from the exterior of the building and functions as
an entry way, while the central staircase passage is protected from the exterior elements.
Figure 7.6 – Dirt build-up on the east wall of the Central Passage Landing. (Photograph by author.)

Figure 7.7 – Dirt build-up on the south and east walls of the Rear Staircase Landing. (Photograph by author.)
Rear Staircase Landing – East & South Walls

The second floor, rear staircase landing is comparable in size and character to the Central Passage landing. Both locations are narrow passage ways that bottleneck visitor traffic and have exposed plaster wall surfaces. The visitor path makes a ninety-degree turn in the rear hallway to continue down the stairs. Both the east and south walls surrounding the staircase landing at the end of the rear hall were documented. On July 10, 2012, initial photographs showed a measureable field of dirt and oil build-up on the south wall that was approximately 35.6sq feet in area. The east wall had a field of dirt build-up that was approximately 10.3sq feet.

The south wall was cleaned with a citric acid wash on July 13, 2012. This provided a clean surface for controlled documentation and measurements. Visible dirt marks and abrasion marks appeared approximately seven days after the south wall was cleaned. Seventeen days after the wall was cleaned, a very light field of dirt build-up, approximately 32.5sq feet in size, became visible. The final observations on August 3, 2012 showed that the field of dirt and oil build-up visible on July 20, 2012 continued to increase in visibility but only in minor increments. It appears that once the dirt field is established it does not necessarily expand in horizontal and vertical size but rather in thickness which increases sporadically.

At this time, it is possible to determine the time it takes for a field of dirt build-up to appear on the plaster walls. However, the variations in the thickness of the build-up and sporadic accumulation make it difficult to ascertain rate of horizontal and vertical expansion. Similar to the MDA of the faux graining, the wear patterns likely vary from year to year depending on use or visitation, differences in materials and maintenance.
**Wooden Threshold Degradation**

Doorway thresholds at Mount Vernon bear significant visitor traffic. Additionally, because the first floor of the mansion is ADA compliant, the thresholds are susceptible to abrasions and force loads from wheelchairs. There are a total of six doorways on the west and east façades of the mansion, but only four of these doorways are part of the visitor path. The thresholds for all four doors that serve as entry and exit points for visitors on the mansion tour show visible concave material degradation and loss. Measurements taken from each threshold determined the amount of material lost due to visitor impact.

The approximate rate of threshold wear is dependent upon the type of material, the number of visitors, the number of wheel chair or mechanical abrasions, and environmental factors. The thresholds are exposed to the elements including rain, snow, and excessive heat and humidity during the summer months. These factors can potentially weaken the material and are variables in determining the rate of wear.

There are three doors along the western façade of the mansion. The north door is the main entry point for visitors on the tour. Guests enter the Large Dining Room from here, the south door is the mansion exit, and the center door is not used. The current threshold of the north door is walnut and was installed in August 2011. In one year the threshold lost two millimeters of material. The largest section of loss was near the center of the threshold. The ADA accessible entry ramp was also worn two millimeters on the left side. Similar to the north door, the south door threshold is also walnut and was installed in August 2011. As of August 2012, approximately one millimeter of material eroded.

It appears that the north entry door is wearing two times faster than the south exit door. There are several reasons for this difference. While both thresholds are walnut and were installed at the same time, the north door and its adjacent platform is a stopping point
for visitors awaiting entry into the mansion. The additional lag time allows visitors to stand and step on the threshold more often than that of the south door. The threshold also protrudes slightly beyond the door frame and is attached to the ADA ramp providing a location for visitors to stand on.

There are also three doors along the eastern elevation of the mansion. Visitors exit from the Large Dining Room onto the piazza through the north door. The center door is the Central Passage entry door that directs visitors back into the mansion. The south door is not used. The north door threshold is constructed of yellow pine. Its actual date of installation is unknown but it is presumed to be during the 1950s. It has approximately 1-1/8" of material loss. It is heavily concaved in the center and is contiguous with the concave wear pattern of the adjacent stone paving on the piazza. The Central Passage entry door threshold is constructed of two parts: the inner threshold is yellow pine and the outer is oak. It was installed in February of 2012 and has a loss of about three millimeters.

![Figure 7.8 – The threshold of the central passage door along the eastern façade. (Photograph by author.)](image)
Central Passage Staircase

Past and Present Wear Issues and Reinforcement

The stair in the Central Passage is the principle visitor pathway to the second floor of the mansion. The staircase is original to George Washington’s era and consists of three runs of stairs and two landings. Washington constructed the staircase during his major renovations of 1757-1759. The previous staircase, constructed by Lawrence Washington, was dismantled to make room for the newer and grander staircase that provided access to the new second story. Yellow pine was used primarily for the risers and treads while white oak, chestnut, and black walnut were used for details and framing.²

Originally constructed for residential use, the staircase now bears the brunt of one million annual visitors. With the transition to commercial space, the central staircase became one of the most reinforced and structurally assessed components of the mansion. While no independent measurements or tests directly related to the Central Passage staircase were conducted for this thesis, a brief history of its structural reinforcement is pivotal to understanding the issues associated with visitor induced force loads and wear on the staircase.

Problems associated with the staircase date back to the late nineteenth century. In 1885, Mount Vernon Superintendent Harrison Dodge described the deteriorating condition of the staircase along with his efforts to reinforce the structure and mitigate loss by installing an iron rod designed to raise the staircase back into position. He stated that the

stairway had “fallen away from its bearing several inches,” and he had “a heavy iron rod...securely fastened to the stanchion of the second landing, carried through the ceiling above and firmly bolted upon to the floor of the old linen closet in the attic.”

Dodge’s reinforcement provided some relief for the load carried by the central staircase, but his fix was not a permanent solution. The *Report of N.W. Halsted Committee on the Mansion* in May 1889 noted that sagging and weakness to the staircase had returned and recommended that “the upper staircase be examined to test its security, as it appears to be somewhat sunken.”

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Part of the problem with the staircase stemmed from George Washington’s renovations. During his 1757-1759 work he removed a load-bearing partition wall in the Central Passage. This critical support wall transferred the load from the second floor and the staircase to the first floor. This compromised the structural stability of the second floor staircase and landing. The staircase showed signs of structural failure including sagging and separation of balusters from the railing. In 1882, an arch, previously installed to relieve a portion of the load, was removed and replaced with wooden columns and an iron girder.\textsuperscript{5}

The columns were later removed by Superintendent Dodge and replaced with an iron truss when they were determined historically inaccurate.  

The staircase was strengthened and reinforced multiple times during the early twentieth century. Unfortunately, structural issues, exaggerated by visitor use, continued. Mount Vernon Restoration Manager Steven Mallory noted in his 2009 report on the mansion staircases that, “the staircase became stressed as the second floor decking and landing sagged throughout the last half of the twentieth century.”

In 1991, Mesick, Cohen, and Waite Architects completed an examination of the staircase in preparation for structural stabilization. The report confirmed that “the treads of the first flight and the floor boards of the first landing deflected under heavy dynamic loads imposed by groups of visitors.” Structural stabilization was completed in 1992. Wooden support members were placed under the first flight of stairs to disperse the load, while a tubular steel frame supported the landing. While the staircase was reinforced from underneath, Mesick, Cohen and Waite determined that the cellar supports for the staircase were in stable condition and did not need any additional reinforcement. Their report determined there was, “no need to modify the structure in the cellar because it was sufficient enough to support any loading that could be reasonably expected on the staircase.”

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Current Issues

Despite the installation of the support members underneath the stairs, it still continues to bear heavy loads from daily visitor traffic. Mesick, Cohen, and Waite noted that “frequently there are more than forty people, representing a load of three tons, on the staircase at one time.” Fortunately, since the completion of the structural stabilization, there has been no need for major retrofitting or other major structural repairs to the staircase. Most of the structural issues have been corrected or at least stabilized. The primary cause for concern now is material erosion and degradation to the balusters, handrails, and other decorative elements. As long as high visitation occurs, the staircase will continue to show stress and wear as it remains a residential staircase retrofitted and stabilized for commercial use.

Other Structural Repairs

Aside from the Central Passage staircase, repairs undertaken at Mount Vernon to combat wear and tear and decaying materials included sandstone and plaster repairs, foundation underpinning, repairs to woodwork, and removal and reinforcement of soft and decaying brick. Underlying structural issues were addressed in the 1880s and the 1930s. Repairs in the 1880s addressed the degradation of the original sandstone piers. In the 1930s, the mansion foundation and chimneys were underpinned to provide better structural stability. Termite and water damaged timbers and those suffering from material failure were replaced with new wooden planks and steel I-beams. Despite the fact that

these early repairs serve as evidence of underlying structural and material concerns, heavy visitation remains a problem that exaggerates these issues.

**Soil Intrusion**

Dirt, dust, and other debris tracked into a historic house present numerous problems for the management and care of the house. The dust settles on collections and architectural details increasing cleaning time and maintenance costs. Additionally, small stones are abrasive to surfaces such as finished flooring, while dirt and dust cause staining and discoloration. Independent soil collection was not completed at Mount Vernon; however, the Mount Vernon Collections Department completed a study from May 2011 through July 2012 measuring the amount of debris vacuumed from the mansion.

In reviewing the data collected by the staff at Mount Vernon, only whole months were considered while partial ones were discarded. For example, May 2011 only contained ten days of data and July 2012 contained eighteen days. Both months were excluded from consideration except when totaling the amount of dirt collected during the entire experiment, which was 533.5 pounds. The heaviest amount of monthly debris measured was in May 2012 and totaled fifty six pounds. In comparison, the lowest monthly amount collected was twenty one and a half pounds in September of 2011. The average weight per day was 1.258 pounds.

The study demonstrated that while the finished floor surface is protected by carpet, significant amounts of dirt and debris are being tracked into the mansion. The study would be beneficial at other historic house museums to accurately gauge the amount of soil intrusion, but merits a more firm protocol that would include measuring the weight of debris in the filter (if one is used), vacuuming at the same time each day in the same areas,
and replacing and weighing the bag every day. Multiple areas should be vacuumed to determine the highest traffic locations.
CHAPTER EIGHT

MICRO SCALE STUDIES

The visible impact of tourists to Mount Vernon can be relatively inherent. Dirt on walls, abraded finishes, and worn thresholds are representative of continually excessive visitation. Despite this fact, visitor wear and tear presents issues at even the smallest historic houses. The Aiken Rhett House, the Heyward-Washington House, and the Joseph Manigault House in Charleston, South Carolina each serve fewer than sixty thousand visitors per year, yet they continue to be plagued with wear and tear issues.

Three studies at these historic house museums attempted to quantify visitor impact on a smaller scale. The experiments are based on visitor impact issues at Mount Vernon and include measurements of material build-up on finished surfaces, wooden stair tread degradation, and visitor-induced temperature and humidity changes. The results of these studies aid not only in further understanding the visitor impact at Mount Vernon but make its issues relatable to smaller historic houses and assist in understanding the damage that occurs.¹

**Touch Panel Study**

The Aiken Rhett House is a three-story Federal masonry structure with various Greek Revival elements, constructed in 1820. The house is currently in a state of preservation rather than a state of restoration. As such, there are various deteriorating elements present within its walls. The Charleston Museum opened the residence to limited tours in the 1970s, but it was not until its acquisition by the Historic Charleston Foundation

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¹ The terms smaller and micro-scale, as used in this thesis, refer to house museums with fewer than 60,000 annual visitors.
in the 1990s that visitor tours became more widespread. Visitation gradually increased and in 2012, there were 32,554 visitors to the house.2

The visitor path is predefined, but the tour is self-paced with few barriers separating visitors from the fragile and deteriorating architectural surfaces. The touch panel, replicating the architectural finishes found at Mount Vernon, was installed at this location to serve the dual function of quantifying visitor wear and providing an educational tool for visitors. The panel reminds visitors of their responsibility to avoid contact with the fragile surfaces in this historic house. Additional details on the design, construction, installation, documentation, and analysis of the touch panel are described in the methodology section of Chapter Two.

Approximately 4,150 visitors toured the Aiken Rhett House and potentially touched the panel during the study. It is possible that every visitor did not touch panel, but it is also possible that every visitor does not touch the walls at Mount Vernon. The wear present on the panel is rather a proportional representation of visitor wear. What follows in this chapter is analysis of data regarding the interaction of dirt and oil build-up with the architectural finishes on the panel.

*Visual Analysis*

The dirt and oil material build-up on the Fine Paints of Europe experimental section was very slight and was the least visibly soiled of all three test sections. The finish was also duller in appearance than the control section. There were some small visible dirt marks, but the build-up was more concentrated in several locations, rather than as a consistent dispersal. In comparison, the Old Village simulated whitewash was heavier and more even

dirt dispersal than the Fine Paints of Europe finish. Compared to the control section, the dirt and oil build-up was consistent across the surface of the material.

A thin layer of dirt and oil build-up on the Sherwin Williams flat latex paint was spread across the surface area of the panel, but the majority of the build-up was concentrated in several locations and was more noticeable and darker in appearance than the dirt and oil build-up on the Old Village simulated whitewash. The build-up was heavier in the middle of the panel and had defined finger marks and scrapes. This was likely the result of an over-zealous visitor, rather than evidence related to the quality of the material.

It is also important to note that material debris and build-up likely appeared in a shorter amount of time in this study because unlike the finishes in historic houses, visitors were encouraged to touch the panel.

Upon visual inspection, the Sherwin Williams flat latex paint and the Old Village synthetic whitewash were the materials most susceptible to visitor wear and material build-up. However, the dirt build-up on the Sherwin Williams paint was the heaviest and, in this study, was the most susceptible to visitor wear. Overall, the Fine Paints of Europe finish was more resistant to dirt and material build-up. This is likely because it is a higher quality, oil-based paint compared to an off-the-shelf latex paint.
Figure 8.1 – The touch panel after removal on February 1, 2013. (Photograph by author.)

Figure 8.2 – Fine Paints of Europe experimental section on February 1, 2013. (Photograph by author.)
Figure 8.3 – Old Village experimental section on February 1, 2013. (Photograph by author.)

Figure 8.4 – Sherwin Williams experimental section on February 1, 2013. (Photograph by author.)
**Microscopic Analysis**

Two cross-sectional samples were examined from each of the experimental finishes as well as from each of the control panels. All three finishes appear as smooth, thin layers on top of the plaster finish and cement board. The appearance of the finishes is consistent with that of modern paint. As noted in the visual analysis, material build-up is present on visual inspection of each of the panels, however, under microscopic analysis the material is not able to be seen. The build-up does not show under basic visible light microscopy, even with 20x magnification. Consequently, photomicrographs did not capture a visible build-up of dirt and oil debris.

Several reasons are possible for why the build-up is not seen in the microscopic analysis. First, the build-up is still on the surface level and is not absorbing into the material. Additionally, the study was conducted for slightly over two months and it is likely that due to the brevity of the experiment the material did not build-up enough to absorb into the material. Lastly, when layers of dirt are visible as a stratigraphic layer in historic paint, the layer may be a confluence of multiple factors. The paint may have been exposed for several

![Figure 8.5 – Sherwin Williams Experimental Cross Section.](Photograph by author.)
years, allowing a significant amount of dirt and material to collect. The presence of other materials from coal burning fireplaces, cigar and cigarette smoke, and other environmental factors are often part of the build-up which makes it appear darker and more prominently in stratigraphic paint analysis. Lastly, in historic paint analysis, dirt and build-up are encapsulated by layers of paint which allows the dirt layer to be more easily preserved and seen.

**Wooden Stair Tread Degradation**

*Nathaniel Russell House*

Like the Aiken Rhett House, the Nathaniel Russell House is owned and operated by Historic Charleston Foundation. Constructed in 1808, the restored three-story Federal style structure is renowned for its free-flying spiral staircase. In 1955, Historic Charleston Foundation purchased the house and opened it to the public. At its peak, the house welcomed over 80,000 visitors. Despite a decrease in visitation 52,592 visitors toured the house in 2012, making it one of the most visited homes in the city of Charleston.³

The spiral staircase inside the Nathaniel Russell House is the principle stairway for access to the second and third floors. Until February 2013, the staircase provided visitors access to the second floor and staff with access to offices on the third floor. At the completion of the house tour, visitors exit down a modern staircase in the rear of the building. Due to increasing structural concerns and efforts to preserve the staircase, it is now restricted from visitor tours. Measurements of the material loss to the stair treads prior to its closing, however, illustrate a portion of the visitor impact to this historic staircase.

The pine stair treads show significantly greater wear from the first floor to the second floor than from the second floor to the third floor. The range of material loss on the treads of the first flight of stairs is between 5 and 9.5 millimeters. The average loss is 6.44mm per stair. The wear is consistently greater on the center and the right of most of the treads. The treads from the second floor to the third floor display far less wear than the previous flight. The range of material loss on the treads is between 1 and 4.5mm. The average loss is 2.9mm per stair tread. Some of the stairs also have cracks, split treads, and evidence of prior repairs which may lead to uneven wearing.

In comparing the first flight of stairs to the second flight, the amount of wear is nearly 2.2 times greater on the first flight that visitors have access to. If it is assumed that 2.9mm of wear is from staff and the previous residential use of the house, then the difference between the wear of the two flights of stairs (6.44mm – 2.9mm) would be the average amount of loss directly caused by visitors. This equates to 3.54mm of additional visitor wear to the staircase. Since the house has been open to visitors for fifty eight years, this would be an average of approximately 0.06mm of wear to each tread per year. Again, variations in visitation levels, staff usage, and other structural issues affect this calculation.

*Aiken Rhett House*

The principle staircase at the Aiken Rhett House connects the first floor with the second and the third floors. Similar to the Nathaniel Russell House, visitors access the second floor with this principle staircase and exit from a secondary staircase. Visitors are also restricted from access to the third floor.

The flight of stairs from the first floor to the second consists of three runs of stairs and two landings. The range of material loss on these pine treads is between 0.5mm to 4mm. The average loss per tread is 2.38mm. The stairs leading from the second floor to the
third floor consist of two runs of stairs and one landing. The treads have a range of material loss between 0.5mm to 3.5mm with an average loss of 2mm per tread. Again, assuming that the wear to the restricted flight of stairs (2mm) is wear from staff and the previous residential use of the house, then the material loss that can be associated with visitors is approximately 0.38mm per tread.

However, this amount of loss may not be as drastic as that of the Nathaniel Russell House for several reasons. Carpet hooks are embedded in the risers of the stairs. These indicate that at one time the stairs were covered by carpet which could potentially explain why visitor wear is not as drastic; however it is unknown when this was installed or removed. Additionally, this house has not been open to public tours for as long as the Nathaniel Russell House has, and the Aiken Rhett House serves fewer annual visitors.

**Joseph Manigault House**

The Joseph Manigault House is owned and operated by the Charleston Museum. It is a three-story Federal style brick structure, constructed in 1803. Once a single-family residence, the use of the house changed frequently during the twentieth century. The house was converted to tenement housing in the 1920s, but by the early 1940s it was used by the United Service Organization (USO). In 1949 it was eventually opened as a historic house museum. Presently, the house entertains 30,000 annual visitors.

The house features a principle spiral staircase with pine treads that connects the first floor with the second floor. Unlike the Nathaniel Russell House, the staircase is not free-flying. A separate staircase on the east side of the building connects the second floor with the third floor. Measurements from these separate stairs are not comparable to the

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principle staircase because they are not contiguous and are not used by visitors. Additionally, at one time they were used as access to tenements on the third floor and as a result they were subjected to greater and disproportionate wear.

The principle staircase consists of two runs of stairs with one middle landing. The treads from the first floor to the second floor range in wear from 1.5 to 5mm. The average material loss is 2.78mm per tread. The majority of wear is in the center of the stairs with only a few stairs showing heavier wear to the left and right sides of the treads. Similarly to the Aiken Rhett House, small tacks along the tread indicate that a carpet that may have been once installed, which may have limited the rate of wear.

The toe or leading edge of the treads on the secondary stairs that access the third floor, while not comparable in rate of wear with the principle staircase, are heavily eroded in a concave pattern. However, the concave wear pattern on the principle staircase occurs across the top of the treads. The rear stairs show heavy wear between 6.5 and 7mm on the most of the treads and appear to be constructed of an inferior quality of pine, different from the principle staircase.

The Nathaniel Russell House has been open to the public for the longest period of time, has greater visitation, and is subjected to the greatest visitor impact of all the houses considered in this study, so it is not surprising that it displays greater material loss on its treads. On the other hand, the Aiken Rhett House and the Joseph Manigault House have similar annual visitation numbers, both staircases have evidence of prior carpeting, and both were opened as house museums later than the Russell house which makes the comparison between the two more reliable.

The Joseph Manigault House has been open longer than the Aiken Rhett House which explains why, with similar visitation numbers, the wear is greater. The Manigault
House measurements validate those from the Aiken Rhett House and the notion that wear is increasing over the lifespan of the staircase. While there are other factors that could influence wear, if the difference between the average wear on the first flight of stairs at the Manigault House is compared with that on the first flight at the Aiken Rhett House and if it is understood that the Manigault House was opened to the public for approximately thirty years longer, the rate of wear to the treads over twenty five to thirty years would be approximately 0.5mm.

**Temperature and Relative Humidity Monitoring**

Large numbers of visitors affect interior temperature and relative humidity. Each visitor radiates heat and exhales moisture. In confined spaces, this raises ambient temperature and introduces increased levels of moisture into the internal environment. The regulation of environmental levels to accommodate visitors and protect fragile collections can have additional consequences. As shown in Chapter Five, condensation damage from the sweating of Mount Vernon's air conditioning system caused water staining to the wood flooring.

Independent tests to gather temperature and humidity data were not deployed at Mount Vernon. Data was collected on temperature and relative humidity levels inside the mansion by Mount Vernon's Collections Department, but at the time of this thesis the data was not available for review. To determine visitors’ effects on temperature and relative humidity in a historic house, studies were conducted independently with the permission of the Historic Charleston Foundation at the Nathaniel Russell House in Charleston, South Carolina. More detailed information on the purpose for this location, the time frame considered for data collection, and on the placement of data loggers is found in the methodology section of Chapter Two. All data collected, along with the daily averages, is
found in the appendix to this thesis. The use of the word "daily" for the time frame of data collection refers to the hours of operation for the Nathaniel Russell House between 10:00am and 2:00pm from Monday through Saturday.

**Temperature**

The small office room on the southwest side of the house was the control location for this study. The average maximum daily temperature for this room was 63.37°F and the average minimum was 61.24°F. The average daily change in temperature was 2.12°F. The data logger at the far end of the dining room was another point of control. The average maximum daily temperature for this location was 64.64°F and the average minimum was 62°F. The average change in temperature per day is 2.64°F. This indicated a 0.52°F greater fluctuation of average temperature than the office.

The experimental location in the dining room near the visitor path had an average maximum daily temperature of 64.95°F and a minimum of 62.51°F. The average daily change in temperature was 2.8°F. This change was 0.16°F greater than the control at the far end of the dining room and 0.68°F greater than the control in the small office. Potentially, this could have been an increase because of the introduction of visitors in this area. However, the Onset HOBO® U10 temperature data logger has a margin of error of ±0.95°F. While the difference in room temperature from the experimental location to the two controls could potentially be visitor induced, it still falls within the margin of error. Additionally, the experimental location only had a greater difference in temperature fluctuation compared with the dining room control location nine out of thirty-three days or 27.3% of the time during the collection period. Again, this shows that the margin of error is

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so close that the results are not definitive enough to draw stronger conclusions about this period of time.

**Relative Humidity**

The small office room had significantly greater fluctuations in relative humidity compared with the dining room control and the experimental location. The average maximum daily relative humidity was 75.05% and the average daily low was 70.04%. The average change over the course of the day was 5.01%. The dining room control location had an average maximum relative humidity of 72.49% and an average low of 69.15%, which made the average change per day 3.34%.

The average maximum daily relative humidity of the experimental location in the dining room was 69.9% and the average minimum was 66.67%. The average change over the course of the day was 3.32%. This was less of a fluctuation than either the dining room control or the office control. This potentially means that visitors may have been in the experimental location long enough to increase temperature during the day, but not relative humidity.

Additionally, the office control showed significantly greater fluctuations in relative humidity than either of the locations but minor fluctuations in temperature. There may have been some other factor that affected this variation. The dining room, for example, is a much larger space and can disperse temperature and relative humidity fluctuations over its area more than the smaller office space can. Better fluctuations could be measured at the middle height of the room and the ceiling height as warm air and moisture tend to rise. Given that the control data logger was placed on the floor near the visitor path, it may have reported microclimatic conditions rather than the larger changes in the room.
**Data Variations**

A potential inaccuracy that may have affected the data collection was the result of human error. Data from December 12, 2012 through December 30, 2012 was not collected because the data loggers were not reset correctly after previous data was gathered. Furthermore, due to asbestos abatement and ongoing construction at the Nathaniel Russell House, the heating and cooling system was turned off to avoid debris transfer during the abatement. Because of such, the data collected was not under the climate controlled conditions that the museum would generally be subjected to.

Lastly, the conditions in the control room and the experimental room were not as similar as originally thought. The control room retained a much higher level of humidity and greater variances during the day than the experimental room. This could potentially be due to its proximity to the main tour and continuous opening of the door could influence the circulation patterns in the space.

**External Studies**

A study to test visitor induced temperature and relative humidity fluctuations completed in 1997, as part of the Pro-active management of the Impact of Cultural Tourism upon Urban Resources and Economies (PICTURE) project financed by the European Commission, Sixth Framework Programme of Research, proved that visitors do lead to significant and measurable increases in temperature and relative humidity. The study was completed inside the Knight’s Hall at Brezice Castle in Slovenia. Measurements were taken comparing the change in beginning temperature and with that collected during a concert of three hundred people. The study found that there was an increase of 2°C and 5°C in
temperature and relative humidity increases of 10% and 12%, respectively, at mid-height
and ceiling level locations within the hall as a result of visitors in the space.\textsuperscript{6}

The results from the Brezice Castle study demonstrate that measureable differences
in temperature and relative humidity caused by visitors can be quantified. While expected
results showing a definitive increase in temperate and relative humidity near the visitor
path were not obtained with this study at the Nathaniel Russell House, the study does show
that there are variations and fluctuations from location to location and merits further
research.

\textsuperscript{6} Milos Drdacky, Tomas Drdacky, and David Creighton, “Impact and Risks Generated by Large Visitor
CHAPTER NINE

RECOMMENDATIONS ON MITIGATION

Current wear to the architectural fabric and finishes at Mount Vernon is caused by a confluence of factors, chief among them confined spaces, administrative procedures, and direct visitor impact. If visitation remains at current levels, exposed faux-graining, plaster surfaces, and thresholds will continue to degrade. While this thesis focused on quantifying visitor wear, the purpose of the data is to assist Mount Vernon with designing mitigation measures. Proposed recommendations on mitigation include programmatic solutions, physical installations, and further studies. Programmatic solutions discuss alterations of administrative policies, procedures, and training guidelines. Physical installations address practical mitigation applications. And further studies advocate additional research to prevent loss of material.

As this research has shown, the visitor impact at Mount Vernon is not proportional to its annual visitation levels. Dirt an oil build-up on wall surfaces reappeared within seventeen days, the material degradation area of the faux graining increased by up to 50% in some areas within a six month period, and within a year 2mm of material was worn away from the wooden threshold of the entry door. While visitor impact cannot be stopped, a majority of the wear is preventable and with a few modifications can be lessened or at least made proportional to its annual visitation. The wear at Mount Vernon simply needs to be controlled and better managed.

Other historic sites such as Monticello and Colonial Williamsburg have taken proactive steps to mitigate visitor damage. Similar protocols would be beneficial to Mount Vernon. The recommendations that follow are addressed from the least invasive and cost
efficient to those that are more invasive and costly. Overall, solutions are generally low-cost and require only more proactive attention.

**Programmatic Changes**

The first set of recommendations for reducing visitor impact and material degradation address general operational standards and informal guidelines currently in place including hours of operation, design of the mansion tour, and control of tour size. Mount Vernon is open every day of the year, except Christmas Day and as a result the mansion is continuously open for tours. There are two options to reduce constant visitor impact: (1) limiting tour times on Sundays or the day of the week identified with the lowest daily visitation and (2) closing the estate for additional holidays including Thanksgiving and New Year’s Day. Doing so would reduce traffic through the mansion and overcrowding. Additional closures would provide more time for repairs, cleaning, and maintenance when guests are not present. While it is understood that this may lead to a decrease in annual revenue, a more detailed cost/benefit approach should be studied to determine if the loss in revenue would be offset by the reduction in maintenance and staffing costs.

Another issue of concern is overcrowding. Timed-entry tickets are given to visitors so they may wait in line for the tour of the mansion. The time assigned indicates when to enter the waiting line, not to start the mansion tour. The interpreter at the end of the line sections off visitors and directs them to the beginning of the tour in the Servants’ Hall. Mount Vernon interpreters attempt to limit the size of visitor groups to no more than twenty five persons at a time. However, if the waiting line gets too long this number is not always strictly enforced.

Rather than providing a time for waiting in line, visitors should have an assigned time for entry into the mansion. The times should be assigned in fifteen minute increments.
This would specifically control the number of visitors on the tour. Furthermore, the change would eliminate halts in the tour reducing material loss at points where visitors currently wait, such as the platform near the north entry door and along the piazza. Again, the applicability of this recommendation may be limited as it would restrict the number of daily tours and visitors through the mansion, but it may lead to an improved visitor experience.

Wear to the faux graining and dirt and debris build-up on the wall surfaces indicates overcrowding occurs in the central hall and rear staircase landings. The mansion tour groups should be restricted to a maximum of twenty people at a time. This would reduce overcrowding in the already limited spaces and improve the atmosphere of the tour for visitors as well as better managing the flow of visitors through the mansion.

A major programmatic change that could potentially reduce visitor damage throughout the mansion is to have mansion tours guided by a single interpreter. Currently, an interpreter is stationed in a passive role in each room. Rather than moving room to room with the guests, the interpreter is responsible only for one room and the revolving groups of guests that pass through it. However, there are instances where guests are left alone on the tour while waiting to proceed to the next stop. If guided by a single docent and not left alone in waiting areas, the opportunity and time for visitors to cause damage would decrease. This could prove successful in reducing damage, like that caused to the window frame on the western façade. Visitors picked the wooden material while waiting between the Servants’ Hall and the mansion.
Cyclical Maintenance

Cyclical maintenance is needed to address areas of continuous wear along the visitor path. Current efforts at Mount Vernon, Monticello, and Colonial Williamsburg address visitor damage in conjunction with routine maintenance. At Mount Vernon the faux graining is repainted every year and the carpet on the visitor path is replaced every four years. Mount Vernon currently uses a citric acid wash to remove dirt and material build-up from plaster surfaces and diluted Ivory soap and water to clean the baseboards. The citric acid wash is a mixture consisting of twenty five grams of citric acid crystals, fifteen grams of ammonium hydroxide (to act as a buffer), and five hundred milliliters of de-ionized water.

At Monticello, the wall surfaces are cleaned once per year with diluted soap, and the protective linoleum floor cloth is repainted every few years. Colonial Williamsburg has perhaps the most intensive preventative maintenance schedule. The Governor’s Palace and the Capital are shut down for two weeks every year for maintenance and painting because of their high visitation levels. Seventeen structures have annual maintenance closings per year, thirty-five have their exterior’s addressed annually, and ten structures are on an annual masonry repair list.

While Mount Vernon has taken efforts to limit visitor impact and damage, including using bio-degradable environmental cement on exterior pathways to control dust and dirt brought into the mansion, it lacks a proactive plan specifically geared toward addressing all aspects of visitor damage. A plan should be developed, separate from routine maintenance, to monitor impact issues within the mansion. Increased analysis of temperature and humidity fluctuations, continued measurements of threshold loss, monthly inspections to monitor faux graining, dirt build-up and vandalism damage are necessary to identify
vulnerabilities and mitigate material loss. The creation of a proactive plan allows damages to be addressed timely and provides the opportunity to limit wear and tear from occurring by identifying the susceptible areas before they become damaged.

![Figure 9.1 – Preparing the pathway in front of Mount Vernon for gluing. (Photograph by author.)](image)

**Training and Education**

The education of visitors and additional training of interpreters would also mitigate material loss and damage. There is currently a sign in the Servants’ Hall that reminds visitors that they are not permitted to eat, drink, smoke, take photographs or touch the architectural elements or interior collections while in the mansion. Visitors are inquisitive, and the tactile nature of humans leads us to learn through touching. Additional signs placed throughout the mansion would serve as subtle reminders of the restrictions that prohibit touching the architectural fabric while on tour. Additionally, smaller panels, similar to the touch panel, that illustrate delicate finishes, materials, and textiles found within the
mansion should be installed along the tour path to educate visitors and draw their attention to touching the permitted objects rather than the architectural surfaces.

Education should not be limited to visitors. Increased training for interpreters on the aspects of visitor wear will allow them to be more cognizant of potential damage when overcrowding is occurring. Additionally, increased training could make the interpreter more aware of their own impact on the mansion. The baseboard of the staircase near the Nellie Custis Bedchamber and the faux graining on the chair rail on the west wall in the Study are heavily abraded. Damage in these locations are where an interpreter stands in the respective rooms. Rotating the position of the interpreter in the rooms could minimize this impact.

Another option for mitigating wear through education would include the publication of informational leaflets specifically designed to inform visitors about their impact on Mount Vernon. The leaflet could be inserted in the visitors guide or handed to visitors when
they purchase their admission tickets. This helps to make visitors more cognizant of wear and tear issues and reminds them of their responsibility to mitigate their impact while touring the mansion.

**Physical Installations**

The majority of visitor impact issues at Mount Vernon can be addressed with simple and cost effective solutions to include: readdressing the placement of stanchions and the installation of Plexiglas, aluminum panels, and draft guards. Dirt and oil build-up on wall surfaces also present significant problems to the cosmetic appearance of the mansion. Close attention needs to be paid to the placement of stanchions. In the Large Dining Room for example, the stanchions near the entrance and exit doors are often not close enough to the wall surface to prevent visitor contact. This occurs for two reasons. One, they are simply out of position and closer attention paid by interpreters could solve this issue. Two, the stanchions also have a wider base with a post in the center. If the base is positioned close the wall, there is gap that occurs between the top barrier of the post and the wall edge. Additional stanchion types should be researched to locate a design that can be placed adjacent to the edges of walls and eliminate the vulnerable gap.

While it is not feasible, or desirable, to affix a large section of Plexiglas to finished architectural surfaces, the careful placement of stanchions, signs, or other objects can serve as a barrier between visitor’s and the mansion’s wall surfaces. Stanchion placement also would prevent visitors from spreading out and thus leaning against or impacting architectural materials. This may limit floor space in narrow passage ways, such as the Central Passage landing and the rear passage, but, again, the reduction in the number of visitors on the tour would solve this overcrowding issue.
Additionally, the worn thresholds and resultant gaps at the bottom of doorways entering and exiting the mansion should also be addressed. Removable draft guards placed at the base of the doors should cover the gaps and reduce water and dust infiltration. These can be positioned in the evening when the mansion is closed. A more permanent solution would include affixing a guard to the base of the door or installing a new threshold. This solution should be researched further.

Baseboards and door architraves along the visitor path are finished with Fine Paints of Europe brand paint. The architraves in both the southeastern and southwestern vestibules and those in the Study have been heavily eroded and are in need of protection. Fine Paints of Europe is a higher-quality oil-based finish, and it is costly. Time and associated costs for maintenance and materials can be lessened by the installation of aluminum panels on the baseboards and the architraves.

This proactive solution is already in place at Monticello. A thin aluminum panel is fashioned to the dimensions of the baseboards in high traffic areas, such as around corners.

Figure 9.3 – Aluminum panel on the dining room baseboard at Monticello. (Photograph by author with permission of the Thomas Jefferson Foundation.)
The panel is finished to match the color of the baseboards and affixed with 3M brand double-sided foam tape. Unlike most adhesives, the tape does not leave a residue, so the historic finish is not in danger of damage. The aluminum panels are affixed to doorway architraves as well. Many of the panels display scratches and evidence of wear, validating their effectiveness at protecting the materials they cover. This is a low-cost solution that is easily installed and effective.

In the late nineteenth and early twentieth centuries metal grates were used to restrict visitors from certain rooms. Today, Plexiglas stands are installed in the doorways of the rooms that visitors are not allowed to enter. An alarm sounds if visitors attempt to move the barrier. This is an effective solution that protects the room and finishes. However, the architraves of the doors within the mansion are still exposed, and as has been discussed, subjected to heavy wear. Plexiglas panels could be affixed over the finished architraves on the second floor landing at the heights that incur the most damage. One drawback is that small screws or nails would have to be inserted into the architraves or the surrounding plaster wall to hold the panels in place. Another option would be to affix clear Mylar sheets over the areas. It is lighter than Plexiglas and can be attached with small tacks rather than screws or nails, reducing damage to historic material. Similar to limiting visitors in the mansion, a cost/benefit analysis should be conducted comparing the installation costs of these methods with the annual expense of the re-graining.

**Further Studies**

This thesis is a holistic approach to a singular site to illustrate the issues of visitor impact on various architectural materials. To further examine the rates of abrasion and material degradation several ASTM standards are available for advanced testing that this thesis did not address. The methods conducted at Mount Vernon and in the micro-scale
studies merit further research to gain firmer data on the yearly rates of material loss. Measurements should be gathered over several years to confirm the exact rate of wear specific to Mount Vernon.

*Coatings and Varnishes*

Continual cleaning is costly, time consuming, and even leads to the loss of thin layers of historic fabric. It would be worthwhile to research material behavior and additional coatings, consolidants, and varnishes to protect the faux graining, the painted architraves, and the plaster wall surfaces. As with any installation in a historic structure, the coatings should be removable and not harm original material.

However, Mount Vernon is a restored structure, unlike the Aiken Rhett House in Charleston, South Carolina which is in a state of preservation. The Aiken Rhett House has many exposed nineteenth century materials. At Mount Vernon, a majority of the wall surfaces along the visitor path have been refinished multiple times with modern paints and materials. Because of this, advanced conservation methods to maintain material integrity that may be beneficial at places like the Aiken Rhett House may not be the most appropriate option for Mount Vernon.

*Material Build-up*

Multiple variables can affect the measurement of the rate of wear and material build-up. It would be beneficial for Mount Vernon to perform long-term specific tests analyzing the durability to abrasion, permeability, and indentation resistance of the various finish materials. Experiments are available to test these methods that meet ASTM standards and can be completed under a control environment.

Additionally, the absorption rate and interaction of dirt and oil build-up with the plaster material should be investigated. The construction of a “touch panel” was an attempt
to understand this interaction. While no dirt absorption was visible on the tested finishes over a period of two months, the experiment merits further analysis and study to determine if absorption occurs at an extended period and with greater visitation numbers. Furthermore, on cross-sectional examination, staining or other analysis could bring to light more data and information on the interaction of the build-up with the various painted surfaces. Further study should also be completed on the chemical bonds occurring between the dirt and the painted surface.

The solutions to address visitor impact and material degradation at Mount Vernon are a combination of administrative driven changes and increased visitor responsibility. The most important factor is rather than making visitors part of the problem, to make them part of the solution. The options presented for mitigation at Mount Vernon should be considered, although some may require additional research on feasibility. A full conservation assessment should be completed before any treatments are implemented. To reiterate, the purpose of this thesis was to quantify visitor wear and the rate of material loss and degradation. The proposed recommendations are a starting point meant to assist Mount Vernon with understanding the areas vulnerable to wear, what type of damage is occurring, and how quickly material degradation is happening. Ultimately, the data will aid conservators at Mount Vernon in designing their own mitigation measures and implementing additional solutions.
CHAPTER TEN

CONCLUSIONS

The development of reliable tests to quantify visitor impact and material erosion is essential to the long-term preservation of historic sites. Lack of attention to this in preservation scholarship and practice is a drawback to the implementation of proper mitigation strategies. The methods discussed in this thesis merit further study to understand the best practices to balance visitor access with the protection of vulnerable historic materials.

The loss of any historic fabric including wallpaper fragments, peeling paint and wooden material from a historic location removes a piece of the house’s history. Additionally, addressing damages caused by visitors through maintenance and restorative work can also result in the loss of historic material. As original materials are replaced, the danger of becoming an inauthentic representation increases.

Mount Vernon is different from any other historic house in the nation. As the home of our Founding Father and first president, it is rooted in patriotism and national identity. Additionally, its rescue and subsequent restoration punctuates the beginnings of historic preservation efforts in the United States. For these reasons alone, it cannot be treated as a typical house museum and its continued preservation is of the utmost importance.

This thesis addresses three pressing needs: first, increase the understanding of the affects visitors have on historic sites, second, provide techniques to identify susceptible locations and materials and third, propose new mitigation strategies that best protect historic materials without degrading visitor experience. While Mount Vernon’s wear is exaggerated by its abnormally high visitation, this research has shown that measureable
impact still occurs at house museums with as few as thirty thousand annual visitors. As long as historic sites remain open, visitor impact will continue to prove problematic.

Mitigation measures and additional solutions to address the visitor impact are the responsibility of the professional conservators and staff at Mount Vernon. Additionally, before any efforts are undertaken a full conservation assessment should be completed. Recommendations based on this research include:

- Limit tour size to twenty persons
- Limit hours and days of operation
- Implement timed mansion entry
- Lead tours with a single interpreter
- Increase cyclical maintenance
- Implement visitor education and interpreter training
- Publish informational leaflets on visitor impact
- Place additional stanchions and signs throughout the mansion
- Modify the placement of existing stanchions
- Install draft guards
- Install aluminum panels
- Attach Mylar sheets and/or Plexiglas to wall surfaces
- Continue studies on coatings, varnishes, material build-up and abrasions.

It is the duty of professional conservators, preservationists, and administrators to protect and preserve Mount Vernon. However, it is also the duty of those who visit the mansion to be responsible and respectful of the place. Although most damage is caused inadvertently and without malice, visitors must still be held accountable for the damage they inflict. The question begs to be asked, if visitors were consciously aware of their impact
would they take a more concerted effort to mitigate their own effects or without a
fundamental social change are we left with unruly masses and hordes of visitors who feel an
ordained right to behave as they choose simply because they purchased a ticket of
admission?

The attention drawn to visitor impact is not to simply admonish visitors, but rather
to identify and better understand the effects of excessive visitation. Additionally, it
supports the notion that increased education on the rates of material degradation and
visitor induced effects are essential to Mount Vernon’s continued preservation. Perhaps,
Ann Pamela Cunningham stated it best in her farewell address to the Mount Vernon Ladies’
Association when she said, “Those who go to the Home in which he lived and died wish to
see in what he lived and died!”¹ Her words emphasize the significance of retaining original
materials and reducing visitor impact.

Limiting annual visitation does not diminish Ann Pamela Cunningham’s intentions
and the MVLA’s mission to let all people experience “the home of Washington.” It is,
perhaps, a fulfillment of their duties. Nothing lasts forever. One day Mount Vernon will be
gone. But if it can be properly maintained and safeguarded against undue influences, then it
can continue for generations. Ironically, the very people for whom Mount Vernon was
rescued may be the reason for its ultimate demise. So much effort has been put forth by the
MVLA to return Mount Vernon to its appearance during George Washington’s time that it
would be a travesty to let the very reason for doing so be its undoing.

APPENDIX A:

SURVEY OF DIRT AND OIL EXPANSION AT MOUNT VERNON – JULY 2012
### Survey of Dirt and Oil Expansion at Mount Vernon - July 2012

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time of Day:</th>
<th>Location:</th>
<th>Size of Debris Field:</th>
<th>Remarks:</th>
<th>Photos:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday July 10, 2012</td>
<td>7:30am-8:30am</td>
<td>Servant's Hall - East Wall on Entry</td>
<td>No remarkable oil or dirt. A few small marks.</td>
<td>Plaster wall cleaned on with citric acid wash on July 2, 2012. The chair rail and baseboard were repainted on July 3, 2012. Tripod location = 22&quot; south of east wall door opening, 62.5&quot; west of that point to front leg of tripod. Tripod height = 23&quot;. Then raised to full height as test. Have to shoot at a lower height of 23&quot; due to the presence of a rail to the west of the entry blocking visitors from entering further into the room.</td>
<td><img src="survey_images/image1.jpg" alt="Image 1" /></td>
</tr>
<tr>
<td>Tuesday July 10, 2012</td>
<td>7:30am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>No remarkable oil or dirt.</td>
<td>Plaster wall cleaned on - June 26, 2012 (Tuesday) with a citric acid wash. Baseboards not repainted. (Tripod location = 35&quot; south of third floor door opening, 65&quot; west of that point to front leg of tripod.) Tripod height = 35&quot; (Have to shoot at this height to capture entire wall, but cannot shoot from further back due to the blockage by the central landing stair rail.</td>
<td><img src="survey_images/image2.jpg" alt="Image 2" /></td>
</tr>
<tr>
<td>Tuesday July 10, 2012</td>
<td>7:30am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>56-58&quot; high (top height average closest to the corner) x 52&quot; wide - sloping at downward angle from right to left (south-north)</td>
<td>Tripod height = 48&quot; Shooting towards the SE corner. Shooting at higher height to capture both the east wall with corner and the south wall. Visitors round this turn to exit down the rear stairs. Tripod location = 28&quot; west of southwest corner of stair rail, 3.5&quot; south of that point to front leg of tripod.</td>
<td><img src="survey_images/image3.jpg" alt="Image 3" /></td>
</tr>
<tr>
<td>Thursday July 12, 2012</td>
<td>7:30am-8:30am</td>
<td>Servant's Hall - East Wall on Entry</td>
<td>No measurements/photos taken</td>
<td>Switched to a wooden folding tape measure for better accuracy and consistency in photographs.</td>
<td><img src="survey_images/image4.jpg" alt="Image 4" /></td>
</tr>
<tr>
<td>Thursday July 12, 2012</td>
<td>7:30am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>No measurements/photos taken</td>
<td>Cleaned baseboards w/ soap and water</td>
<td><img src="survey_images/image5.jpg" alt="Image 5" /></td>
</tr>
<tr>
<td>Thursday July 12, 2012</td>
<td>7:30am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>No measurements/photos taken</td>
<td>Cleaned baseboards w/ soap and water</td>
<td><img src="survey_images/image6.jpg" alt="Image 6" /></td>
</tr>
<tr>
<td>Date:</td>
<td>Time of Day:</td>
<td>Location:</td>
<td>Size of Debris Field:</td>
<td>Remarks:</td>
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<tr>
<td>Friday July 13, 2012</td>
<td>7:00am-8:30am</td>
<td>Servant's Hall - East Wall on Entry</td>
<td>No remarkable dirt or oil</td>
<td>Tripod height = 23&quot;.</td>
<td></td>
</tr>
<tr>
<td>Friday July 13, 2012</td>
<td>7:00am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>Small mark above chair rail, beginning approximately 5 inches south of the north door molding and extending approximately 15 inches. Difficult to see in straight on photograph. Angled photo looking south east taken to attempt to capture mark. No other remarkable dirt or oil.</td>
<td>Tripod height = 35&quot;</td>
<td></td>
</tr>
<tr>
<td>Friday July 13, 2012</td>
<td>7:00am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>56-58&quot; high (top height average closest to the corner) x 52&quot; wide - sloping at downward angle from right to left (south-north)</td>
<td>Photographed before cleaning and after. Area was cleaned with a mixture of ammonia, citric acid and water. Tripod height = 48&quot; (photos taken in high key to try to capture clean wall - appears slightly over-exposed)</td>
<td></td>
</tr>
<tr>
<td>Monday July 16, 2012</td>
<td>7:15-8:30am</td>
<td>Servant's Hall - East Wall on Entry</td>
<td>No remarkable dirt or oil</td>
<td>Tripod height = 23&quot;</td>
<td></td>
</tr>
<tr>
<td>Date:</td>
<td>Time of Day:</td>
<td>Location:</td>
<td>Size of Debris Field:</td>
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<tr>
<td>Monday July 16, 2012</td>
<td>7:15-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>Small mark above chair rail at the southwest corner of the east wall. Detail photo taken. No other new dirt/oil visible on wall.</td>
<td>Tripod height of 35&quot;, shooting from same predetermined location as prior photographs.</td>
<td><img src="image1.jpg" alt="Image" /> <img src="image2.jpg" alt="Image" /> <img src="image3.jpg" alt="Image" /> <img src="image4.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Monday July 16, 2012</td>
<td>7:15-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>No remarkable dirt or oil on south wall. Still some remaining dirt/oil on east wall as this was not cleaned on 7/13.</td>
<td>Tripod height = 48&quot;</td>
<td><img src="image5.jpg" alt="Image" /> <img src="image6.jpg" alt="Image" /> <img src="image7.jpg" alt="Image" /> <img src="image8.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Wednesday July 18, 2012</td>
<td>7:30-8:30am</td>
<td>Servant's Hall - East Wall on Entry</td>
<td>Dirt on lower panel below chair rail approximately 9&quot; high. A small blue mark about 1&quot; wide and located 41&quot; up on the wall.</td>
<td>Tripod height = 23&quot;</td>
<td><img src="image9.jpg" alt="Image" /> <img src="image10.jpg" alt="Image" /> <img src="image11.jpg" alt="Image" /> <img src="image12.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Wednesday July 18, 2012</td>
<td>7:30-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>See Remarks</td>
<td>Tripod height = 35&quot;. Small build up noticed along the southwest corner of the wall. Approx 10&quot; long by 1&quot;-1.5&quot; in height and running at approx. 5&quot; along the top of the chair rail. This appears to be varnish from the faux wood graining. There is also another section of the same build up along the west side of the wall adjacent to the grained door trim. The wall has build up adjacent to wear it is worn off of the door trim.</td>
<td><img src="image13.jpg" alt="Image" /> <img src="image14.jpg" alt="Image" /> <img src="image15.jpg" alt="Image" /> <img src="image16.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Wednesday July 18, 2012</td>
<td>7:30-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>No new remarkable dirt or oil. Dirt still visible along the east wall leading to the stairway as it has not yet been cleaned.</td>
<td>Tripod height = 48&quot;</td>
<td><img src="image17.jpg" alt="Image" /> <img src="image18.jpg" alt="Image" /> <img src="image19.jpg" alt="Image" /> <img src="image20.jpg" alt="Image" /></td>
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<tr>
<td>Friday July 20, 2012</td>
<td>7:15am-8:00am</td>
<td>Servant's Hall - East Wall on Entry</td>
<td>Small scrapes on SE corner at 10&quot; and 15&quot; high, respectively. Brown smudge and drip stain on the door molding on the east side of the wall. between 33&quot; &amp; 44&quot; high.</td>
<td>Tripod height = 23&quot;</td>
<td><img src="image1" alt="Photos" /></td>
</tr>
<tr>
<td>Friday July 20, 2012</td>
<td>7:15am-8:00am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 35&quot;</td>
<td><img src="image2" alt="Photos" /></td>
</tr>
<tr>
<td>Friday July 20, 2012</td>
<td>7:15am-8:00am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>Some small dirt/marks on the southwest corner of the lower panel at heights from 20&quot; to 26&quot;.  Photos taken. Also marks along the west wall in the same location where it corners with the south wall.</td>
<td>Tripod height = 48&quot; There appears to be the beginnings of a dirt/oil build up on the south wall. Photos taken w/ flash and without. Cannot yet tell if it is just remnants left over from cleaning on 7/13. Part of the issue is shadowing in the hall as well. Will compare with next week’s photos to see if more accumulation.</td>
<td><img src="image3" alt="Photos" /></td>
</tr>
<tr>
<td>Monday July 23, 2012</td>
<td>8:00am-8:30am</td>
<td>Servant's Hall - East Wall on Entry</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 23&quot;</td>
<td><img src="image4" alt="Photos" /></td>
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<tr>
<td>Monday July 23, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 35&quot;</td>
<td><img src="image5" alt="Photos" /></td>
</tr>
<tr>
<td>Date:</td>
<td>Time of Day:</td>
<td>Location:</td>
<td>Size of Debris Field:</td>
<td>Remarks:</td>
<td>Photos:</td>
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<tr>
<td>Monday July 23, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 48”</td>
<td><img src="image1.jpg" alt="Photos" /></td>
</tr>
<tr>
<td>Wednesday July 25, 2012</td>
<td>7:30am-8:30am</td>
<td>Servant’s Hall - East Wall on Entry</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 23”</td>
<td><img src="image2.jpg" alt="Photos" /></td>
</tr>
<tr>
<td>Wednesday July 25, 2012</td>
<td>7:30am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 35”</td>
<td><img src="image3.jpg" alt="Photos" /></td>
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<tr>
<td>Wednesday July 25, 2012</td>
<td>7:30am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 48” Small pencil-like mark on the south wall at a height of approximately 47” and with a width of about 4”.</td>
<td><img src="image4.jpg" alt="Photos" /></td>
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<tr>
<td>Friday July 27, 2012</td>
<td>8:00am-8:30am</td>
<td>Servant’s Hall - East Wall on Entry</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 23” Small amount of dust from the exterior collecting around the edge of the entry door. Looking at the door in its open position the dust it is at the southwest corner.</td>
<td><img src="image5.jpg" alt="Photos" /></td>
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<tr>
<td>Date:</td>
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<td>Location:</td>
<td>Size of Debris Field:</td>
<td>Remarks:</td>
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<tr>
<td>Friday July 27, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 35&quot;</td>
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</tr>
<tr>
<td>Friday July 27, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 48&quot;</td>
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<tr>
<td>Monday July 30, 2012</td>
<td>8:00am-8:30am</td>
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<td>No new remarkable dirt or oil</td>
<td>Tripod height = 23&quot;</td>
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<tr>
<td>Monday July 30, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 35&quot;</td>
<td></td>
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<tr>
<td>Monday July 30, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>Slight beginnings of dirt/oil build up on south wall at a height ranging from approximately 51-54” across the width of the wall</td>
<td>Tripod height = 48”</td>
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<tr>
<td>Wednesday August 1, 2012</td>
<td>8:00am-8:30am</td>
<td>Servant's Hall - East Wall on Entry</td>
<td></td>
<td>No new remarkable dirt or oil</td>
<td>23&quot;</td>
</tr>
<tr>
<td>Wednesday August 1, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>Small build-ups on the left side of the wall near the garret architrave at approximately 33&quot; to 36&quot; &amp; 50&quot; to 55&quot; high. The field extends to an approximate width of 3&quot;-5&quot; at both locations.</td>
<td>Tripod height = 35&quot;</td>
<td><img src="image2.jpg" alt="Image" /></td>
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<tr>
<td>Wednesday August 1, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>Still the slight beginnings of dirt/oil build-up along the south wall at the same heights reported on Monday</td>
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<td>Servant's Hall - East Wall on Entry</td>
<td>Some small scratches that are about an inch in length are seen approximately 13.5&quot; from the bottom of the floor.</td>
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<td><img src="image4.jpg" alt="Image" /></td>
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<td>8:00am-8:30am</td>
<td>Mansion - Central Staircase Landing - East Wall</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 35&quot;</td>
<td><img src="image5.jpg" alt="Image" /></td>
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<tr>
<td>Date:</td>
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<td>Size of Debris Field:</td>
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<td>Friday August 3, 2012</td>
<td>8:00am-8:30am</td>
<td>Mansion - Back Hall &amp; Staircase - East &amp; South Walls</td>
<td>No new remarkable dirt or oil</td>
<td>Tripod height = 48&quot;</td>
<td><img src="image1.jpg" alt="Photos" /> <img src="image2.jpg" alt="Photos" /> <img src="image3.jpg" alt="Photos" /></td>
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APPENDIX B:

NATHANIEL RUSSELL HOUSE CLIMATE DATA
## APPENDIX B: NATHANIEL RUSSELL HOUSE CLIMATE DATA

Nathaniel Russell House Temperature and Relative Humidity - Office (Control)

<table>
<thead>
<tr>
<th>Date</th>
<th>Highest Temp, °F</th>
<th>Lowest Temp, °F</th>
<th>Difference</th>
<th>Highest RH, %</th>
<th>Lowest RH %</th>
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Average: 63.368 | 61.244 | 2.124 | 75.059 | 70.042 | 5.018
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Average: 64.953 62.150 2.803 69.898 66.666 3.233
APPENDIX C:

STAIR TREAD DEGRADATION MEASUREMENTS
### APPENDIX C: STAIR TREAD DEGRADATION MEASUREMENTS

#### Nathaniel Russell House Stair Tread Loss - First to Second Floor

<table>
<thead>
<tr>
<th>Stair:</th>
<th>Loss in Millimeters</th>
<th>Length</th>
<th>Width</th>
<th>Thickness</th>
<th>Rise</th>
<th>Notes</th>
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<td>1</td>
<td>5</td>
<td>5' 9-1/2&quot;</td>
<td>1' 6&quot;</td>
<td>1&quot;</td>
<td>6-5/8&quot;</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>5' 4-34&quot;</td>
<td>1' 5&quot;</td>
<td>1-1/8&quot;</td>
<td>6-1/2&quot;</td>
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</tr>
<tr>
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<td>5</td>
<td>5' 2-78/&quot;</td>
<td>1' 5&quot;</td>
<td>1-1/8&quot;</td>
<td>6-3/8&quot;</td>
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</tr>
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<td>4' 11-1/2&quot;</td>
<td>1' 5-3/4&quot;</td>
<td>1&quot;</td>
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<td>5</td>
<td>9.5</td>
<td>4' 8-3/4&quot;</td>
<td>1' 5-3/4&quot;</td>
<td>1-1/8&quot;</td>
<td>6-1/8&quot;</td>
<td>gap bigger on left side and center</td>
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<tr>
<td>6</td>
<td>7</td>
<td>4' 8&quot;</td>
<td>1' 5-3/4&quot;</td>
<td>1-1/16&quot;</td>
<td>6-1/8&quot;</td>
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<td>1' 5-3/4&quot;</td>
<td>1-1/16&quot;</td>
<td>6-3/16&quot;</td>
<td>even wear across tread</td>
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<td>1' 5-3/4&quot;</td>
<td>1&quot;</td>
<td>6-1/4&quot;</td>
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<tr>
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<td>6</td>
<td>4' 8-5/8&quot;</td>
<td>1' 5-3/4&quot;</td>
<td>1-1/8&quot;</td>
<td>6-3/16&quot;</td>
<td>wear greater on the right side of the tread</td>
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<td>1' 5-7/8&quot;</td>
<td>1-1/8&quot;</td>
<td>6-1/4&quot;</td>
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<td>9</td>
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<td>1' 5-1/2&quot;</td>
<td>1-1/8&quot;</td>
<td>6-1/4&quot;</td>
<td>greater on the left side</td>
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<td>1-1/16&quot;</td>
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<td>replacement on right side</td>
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<td>6-1/4&quot;</td>
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<td>6-1/4&quot;</td>
<td>greater on the right side of the tread</td>
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<td>1' 5-5/8&quot;</td>
<td>1-1/16&quot;</td>
<td>6-1/4&quot;</td>
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<td>1' 6&quot;</td>
<td>1-1/16&quot;</td>
<td>6-1/4&quot;</td>
<td>wear greater on the right side of the tread - step is also in front of the window</td>
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<td>1-1/16&quot;</td>
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<td>wear great on the left side of the tread</td>
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**Average** 6.44 N/A N/A N/A N/A
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<th>Thickness</th>
<th>Rise</th>
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<td>Steps 9-17 are near the windows. Heavy wear on right. Min wear left and center</td>
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<td>Cracked and split wood all the way across</td>
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<td>Wear consistent throughout with biggest loss in center</td>
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<td>Lots of wear on the right side and a little bit to the left of the center</td>
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Average 2.38 N/A N/A N/A N/A
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**Average** | 2 | N/A | N/A | N/A | N/A |
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<td>3</td>
<td>4' 6-1/2&quot;</td>
<td>1' 2-3/4&quot;</td>
<td>1&quot;</td>
<td>5-1/2&quot;</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>3</td>
<td>4' 6-1/2&quot;</td>
<td>1' 2-1/2&quot;</td>
<td>1&quot;</td>
<td>5-5/8&quot;</td>
<td>Wear to the center and right</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>4' 6-1/4&quot;</td>
<td>1' 2-1/2&quot;</td>
<td>1&quot;</td>
<td>5-5/8&quot;</td>
<td>Even wear across the entire tread</td>
</tr>
<tr>
<td>20</td>
<td>3</td>
<td>4' 6-1/4&quot;</td>
<td>1' 2-1/2&quot;</td>
<td>1&quot;</td>
<td>5-5/8&quot;</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>2.5</td>
<td>4' 6-1/4&quot;</td>
<td>1' 2-3/4&quot;</td>
<td>1&quot;</td>
<td>5-1/2&quot;</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>3</td>
<td>4' 6-1/4&quot;</td>
<td>1' 2-1/2&quot;</td>
<td>7/8&quot;</td>
<td>5-3/8&quot;</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>4</td>
<td>4' 6-1/4&quot;</td>
<td>1' 2-3/4&quot;</td>
<td>7/8&quot;</td>
<td>5-3/8&quot;</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>4' 6-1/4&quot;</td>
<td>1' 2-1/2&quot;</td>
<td>1&quot;</td>
<td>5-1/2&quot;</td>
<td>Wear more on the center</td>
</tr>
<tr>
<td>25</td>
<td>2</td>
<td>4' 6-1/2&quot;</td>
<td>N/A</td>
<td>1&quot;</td>
<td>5-1/4&quot;</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>2.78</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
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REFERENCES


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