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# The Colonist's Concrete: A Preservation Plan for the Seventeenth-Century Tabby Floor Found at the Miller Archaeological Site

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THE COLONIST'S CONCRETE:  
A PRESERVATION PLAN FOR THE SEVENTEENTH-CENTURY TABBY FLOOR  
FOUND AT THE MILLER ARCHAEOLOGICAL SITE

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

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

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by  
Lindsay A. Lee  
May 2014

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Accepted by:  
Dr. Carter L. Hudgins, Committee Chair  
Frances Ford  
Katherine Pemberton

## ABSTRACT

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In 2009, a seventeenth-century floor was discovered at the Miller Archaeological Site at Charles Towne Landing. Unearthed but covered with plastic sheeting since then, the floor is a remnant of Charleston's first English settlement. Labeled on site as tabby, the material is typically comprised of oyster shells, sand, lime, and water. The lack of whole shell in the floor's material suggests a role in the broader pattern of augmented earthen flooring deriving from the Caribbean, and in turn, Africa and Europe. Deteriorating at an unknown rate since its discovery, it is the hope of South Carolina State Parks to employ a mitigation plan for the floor that both conserves and interprets it simultaneously.

Through historic, analytical, and precedent research, this thesis provides the information required to chose an appropriate conservation plan for the Miller Site. The goal is to encourage longevity of the floor and public awareness of tabby, mortar, and other forms of earthen construction. Preserving and exhibiting the floor at the Miller Site is another step in the ongoing research of tabby as a material, and the best methods of its conservation. Previous surveys of existing tabby in the Southeast suggest the floor is a rare asset. The best way to ensure the longevity of the floor is to understand the physical characteristics and degradation patterns. If interpreted correctly, the Miller Site will attract both visitors, and encourage scholars to explore tabby's application in the Southeast.

## DEDICATION

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This thesis is dedicated to the memory of Griffin Anderson Lee, for the constant reminder of just how precious life can be.

## ACKNOWLEDGMENTS

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This thesis is incomplete without acknowledging the amazing individuals who offered their guidance, support, and helping hands throughout this arduous journey. First, it is with my deepest gratitude that I thank my committee chair, Dr. Carter L. Hudgins. Only through Carter's constant support, encouragement, and extreme patience, did I in turn, transform a unique suggestion into a refined and authoritative argument. To my other committee members, Katherine Pemberton and Frances Ford, your ingenuity in the fields of archaeology and conservation inspired all of my methods, and for that I thank you.

In addition, I would like to acknowledge Andrew Agha and the entire staff of Charles Towne Landing and South Carolina State Parks. Thank goodness for the persuasive abilities of baked goods, and your unfaltering belief in my abilities, without you, this thesis truly would not have been possible.

Thanks to Amalia Leifeste, who was the inspiration behind all the graphics for this thesis. Her critical eye for detail and never ending appreciation for art and design acted as my motivation.

Special thanks to my classmates in the MSHP program, your constant reassurance was a comforting reminder that we are all in this together. To my other thirds, Brittany McKee and Lindsay Lanois, your mental support was unparalleled and integral in finding my own stability.

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Last but not least, I would like to specifically thank Mom, Marty and Erik, for the countless hours spent reading, editing and offering emotional support. Your love and enthusiasm were cherished more than you will ever know.

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## INTRODUCTION

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David Hurst Thomas, American Museum of Natural History curator, archaeologist, and Columbia University professor once said, “It’s not what you find, it’s what you find out.”<sup>1</sup> This notion has manifested itself in the local discovery of a lime-based floor, found at the Miller Site at Charles Towne Landing. Charles Towne Landing is located on the west bank of the Ashley River, just upstream of Charleston, South Carolina, on Oldtown Creek (Figures 1 and 2). Charles Towne Landing currently marks and interprets the site of the original seventeenth century settlement of Charleston, as well as its subsequent years as a privately owned plantation. South Carolina State Park archaeologists uncovered the floor most recently in 2009. Although covered with plastic sheeting since then, the site has otherwise remained open to the elements.

Referred to as tabby since its discovery, the floor at the Miller Site raises a question to its labeling. While composed of the same materials, tabby in South Carolina, like that seen at Colonial Fort Dorchester (circa 1757), looks vastly different than the floor found at Charles Towne Landing (Figure 3). The floor is a homogenous gray, with large shell fragment inclusions. It is visually similar to a coarse bedding mortar and roughly measures twenty by twenty five feet.<sup>2</sup> Included in the floor are areas of both solid material and rubble due to root and pest disturbance. Comprised

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<sup>1</sup> David Hurst Thomas, *Archaeology, Second Edition* (Fort Worth: Holt Rinehart And Winston, Inc, 1989) 31.

<sup>2</sup> Rebecca Shepherd, “The Colonial Use of Tabby as a Flooring Material: Evidence from Charles Towne Landing,” *ARCHNEWS*, Spring 2012, 5.



Figure 1. USGS Locator Map of Charleston County, South Carolina. Approximate location of the Miller Site indicated in red (United States Geological Survey, [www.topoquest.com](http://www.topoquest.com)).

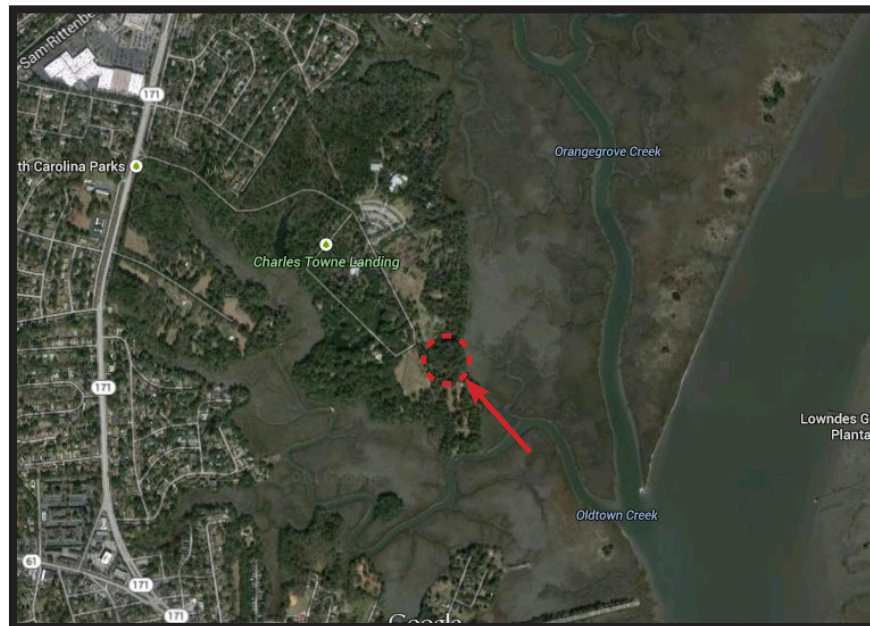


Figure 2. Google Earth Image of Charles Towne Landing. Approximate location of the Miller Site indicated in red (Google Earth, [earth.google.com](http://earth.google.com)).



*Figure 3. Image Comparing tabby from the Miller Site (left) to Colonial Fort Dorchester (right), (Photographs by author, 2014).*

of lime, sand, water and an aggregate, based on material composition alone the floor calls for a new label of identification. The floor at the Miller Site offers a new category in the broader realm of augmented earthen flooring, more accurately described as “lime concrete” than tabby as it is historically defined. The Miller Site floor plays a pivotal role in the longstanding tradition of utilizing carbonic materials to create a floor surface, and combined with its rarity, provides a measure for significance that demands conservation.

A symposium on the conservation and preservation of tabby held on Jekyll Island, Georgia in 1998, defined tabby as “an early cast in place construction material consisting of sand, lime (from shells and wood ash), and water.” The material found at the Miller Site fits this description. However, the definition goes on further to explain that tabby can “be considered a lime-based concrete, unreinforced, with shell and

shell fragments serving as the coarse aggregate.”<sup>3</sup> The Miller Site floor is comprised mainly of sand, lime, oyster shell fragments (no whole shells) and water. The lack of whole oyster shells distinguishes the Miller Site floor from all other examples of tabby construction in the Southeast.

Lime mortar, a varying mixture of lime, water, and sand, follows nearly the exact definition of tabby with the inclusion of shells and shell fragments. For the floor to be then labeled as mortar, the evidential shell pieces would then need to be much smaller. The floor as a result, hangs in an uncategorized space between tabby and mortar. Despite the apparent differences in composition, tabby is the chosen terminology on site. However, for the purpose of this thesis, the floor will be labeled by a more broad but accurate identifier: lime concrete.

The conservation and interpretation of the tabby floor at the Miller Site is the final stage of a thorough investigation of its historic and material properties. The history of tabby included in this report is derived from Lauren B. Sickels-Taves’ *The Lost Art of Tabby*. In her book, Sickels-Taves provides a comprehensive analysis and history of tabby in the Southeast. She argues that English colonists influenced tabby construction in South Carolina. Therefore, the French Huguenot colonists known to have settled at the Miller Site in 1694 and their tabby floor lie within what Sickels-Taves argues is a broader English technique.

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<sup>3</sup> David C. Fischetti, “Tabby: Engineering Characteristics of a Vernacular Construction Material,” in *The Conservation and Preservation of Tabby* (presented at A Symposium on Historic Building Material in the Coastal Southeast, Jekyll Island, Georgia: Georgia Department of Natural Resources, Historic Preservation Division, 1998), 55.

The history of the Miller Site is derived from archaeological reports written by archaeologists Johnny Miller in 1969, Stanley South in 2000, and Andrew Agha in 2014.<sup>4</sup> Through his current archaeological investigations, archaeologist Andrew Agha offers insight into the history of the Miller Site through its residents and the artifacts they left behind. With the aid of architectural remnants and artifact distribution, Agha has suggested what the building surrounding the floor looked like and how it was used.

Though a complete list of artifacts found at the Miller Site has yet to be compiled, artifact reports from the Fall of 2012 through Summer of 2013 give a glimpse into the site's seventeenth century interpretation. All shovel tests revealed no eighteenth century artifacts, pipe stems with hole diameters larger than 6/64", and ceramics (particularly Spanish ceramics) linked to other seventeenth-century sites in the Lowcountry.<sup>5</sup> Other significant artifact counts from the site include 1,000 wine bottle fragments and concentrations of hand-wrought nails throughout the house site and locations of possible slave-related outbuildings. The amount of bottle fragments is high enough to suggest a domestic character for the site but not high enough to infer a tavern. Overall, ongoing research has archaeologists unsure about the precise function of the floor and the structure it was once part of.

This thesis proposes a specialized preservation plan for a rare seventeenth-century structural artifact. This plan will explore efforts to preserve, conserve, and utilize the floor as a learning tool for future park visitors and scholars. Once fully

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<sup>4</sup> Johnny Miller, "Report of Archaeological Excavations: Site of Old Town Landing, Dec. 1967-Feb. 1968." Paper on file, South Carolina Institute of Archaeology and Anthropology (1968)., Stanley South, "Exploratory Archeology at the Site of 1670 - 1680 Charles Towne on Albemarle Point in South Carolina" (1969). Research Manuscript Series. Book 137., Andrew Agha, "Historical Archaeology at Old Towne Plantation: Miller Site Excavations Fall 2012-Spring 2014" (2014), unpublished research report on file at Charles Towne Landing State Historic Park, Charleston, SC, 2014.

<sup>5</sup> Agha, *Historical Archaeology*, 5.



analyzed, preserved, conserved, and exhibited, the floor at the Miller Site should prove an invaluable asset to the cultural and historical interpretation of the park. Recommendations for conservation and interpretation of the floor proceed from a thorough understanding of its materiality and significance.

The presentation of this plan is organized into three components. First, a history of the Miller Site as well as its past archaeological investigations discusses how the building and floor fit into early settlement history. Next, a materials conservation study of the floors' physical characteristics, as well as an assessment of intended use for the floor, will lead to suggested remediation, mitigation and stabilization plans. Finally, all options for conservation are based on comparative case studies and national guidelines such as those suggested by the American Institute of Archaeology. Investigations into the floor will add useful information on an often overlooked historic construction technique. Simultaneously, the floor will increase tabby awareness and provide a learning tool for the future.

## CHAPTER 1

### HISTORY AND ARCHAEOLOGY

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#### ARCHAEOLOGICAL HISTORY: 1969-2013

The current historical understanding of history of Albemarle Point is based squarely on research conducted by archaeologist Stanley South in the 1960s and 1970s. South was a pioneer of historic archaeology in the Southeast, particularly North and South Carolina. South's 1969 manuscript report "Exploratory Archeology at the Site of 1670-1680 Charles Towne on Albemarle Point in South Carolina" provides the historical baseline from which the State Park draws much of its interpretation. South's 1969 report mentions tabby twice. Both refer to ruins with nineteenth-century artifacts, neither of which match the description of the Miller Site. The site's "Miller" name comes from amateur archaeologist Johnny Miller, who first uncovered the tabby floor in 1968 just prior to the work completed by South (serving as his motivation for further excavation). The Miller Archaeological Site, and subsequent floor, lie just north of the palisade wall and settlement excavated by South in 1969 (Figure 4).

In 2009, Rebecca Shepherd, the previous head of archaeology at Charles Towne Landing, reopened the site. Through their work at the Miller Site, Shepherd and her team uncovered the extents of the tabby floor in order to pinpoint a date of construction by comparing archaeological data from both sides of the palisade wall. Shepherd's involvement with the site continued until 2012 when Andrew Agha succeeded her. Agha continues to work on the site in 2014.

# Charles Towne Landing State Historic Site



Figure 4. Charles Towne Landing Park Map with Approximate Location of the Miller Site Indicated in Red (Charles Towne Landing/South Carolina State Parks).

## **SITE HISTORY: CHARLES TOWNE AND ALBEMARLE POINT**

Settled in November of 1670, Charles Towne is located on a point of land, then known as Abermale Point, set between the Ashley River and the marsh. The site was chosen by accident when a storm separated the original three ships sent by the Lords Proprietors from England in August of 1669. One ship, the *Three Brothers*, was blown off course and landed first in Virginia, and then on St. Catherine's Island off the coast of Georgia, where it was met with resistance from the Spaniards. Meanwhile, the remaining two ships, the *Port Royal* and the *Carolina*, landed much closer to their intended target. Headed for Port Royal, South Carolina, the ships found themselves just north of their goal on land controlled by native peoples. In contrast to the individuals aboard the *Three Brothers*, these settlers were met with no resistance. After eventually being reunited and hearing of the ordeal on St. Catherine's Island, all of the original settlers decided to remain where they had landed rather than continue on to Port Royal. The result was the settlement of Charles Towne at Albemarle Point.<sup>6</sup>

In an effort to lay out lots within the town, the governor of the province of Carolina, Sir John Yeamans, commissioned surveyor general John Culpepper to create a map.<sup>7</sup> The Culpepper Map of 1671 illustrates the original settlement on Albemarle Point including the site of Charles Towne (Figure 5). The settlement at Charles Towne was successful, due in part to the rich natural resources that filled the surrounding countryside. The prevalence and diversity of building materials, fresh water, food sources, and faunal life attracted nearly 684 settlers to the Carolina colony between 1670-1680. Nearly as many colonists came from Caribbean colonies as from England. Due to the Atlantic trading triangle that existed between Western Africa, the

<sup>6</sup> South, *Exploratory Archaeology*, 2-3.

<sup>7</sup> Susan Baldwin Bates and Harriott Cheves Leland, eds. *Proprietary Records of South Carolina*. Volume Three: Abstracts of the Records of the Surveyor General of The Province, Charles Towne, 1678-1698. Charleston: History Press, 2007.

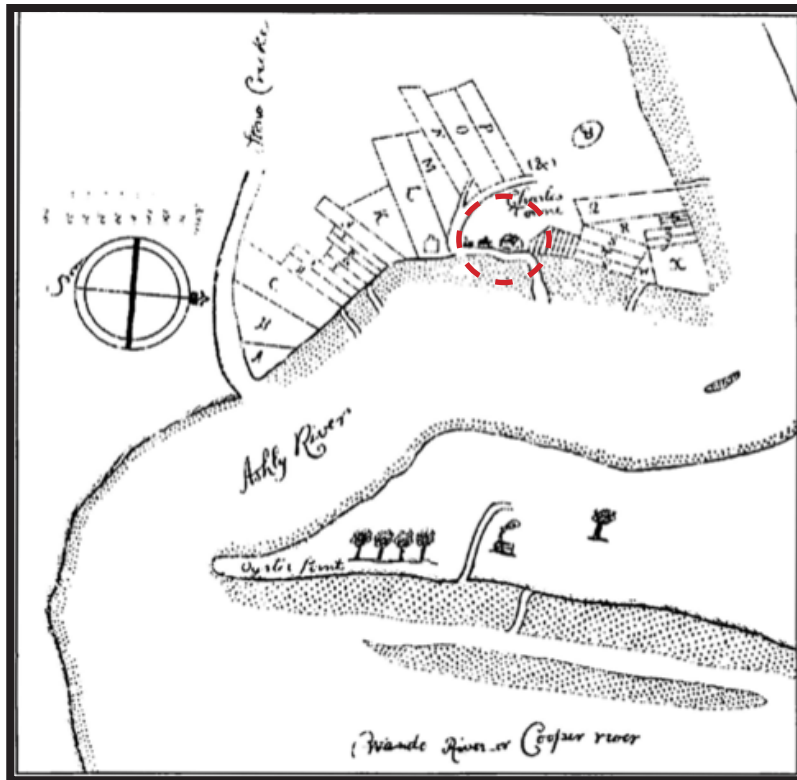


Figure 5. Culpepper Map of 1671, approximate location of the Miller Site Indicated in red.

Caribbean, and the colonies, a stream of people, goods, and ideas were constantly transmitted (Figure 6). Arrival of substantial numbers of colonists cemented a relationship between South Carolina and the islands that lasted through the eighteenth century.<sup>8</sup>

As early as January of 1671, the inhabitants of Charles Towne considered moving the settlement from Albemarle Point across the Ashley River to Oyster Point, the current location of Charleston. Though this location at the end of the peninsula

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<sup>8</sup> Stanley South, "Exploratory Archeology at the Site of 1670 - 1680 Charles Towne on Albemarle Point in South Carolina" (1969). Research Manuscript Series, Book 137, 14.

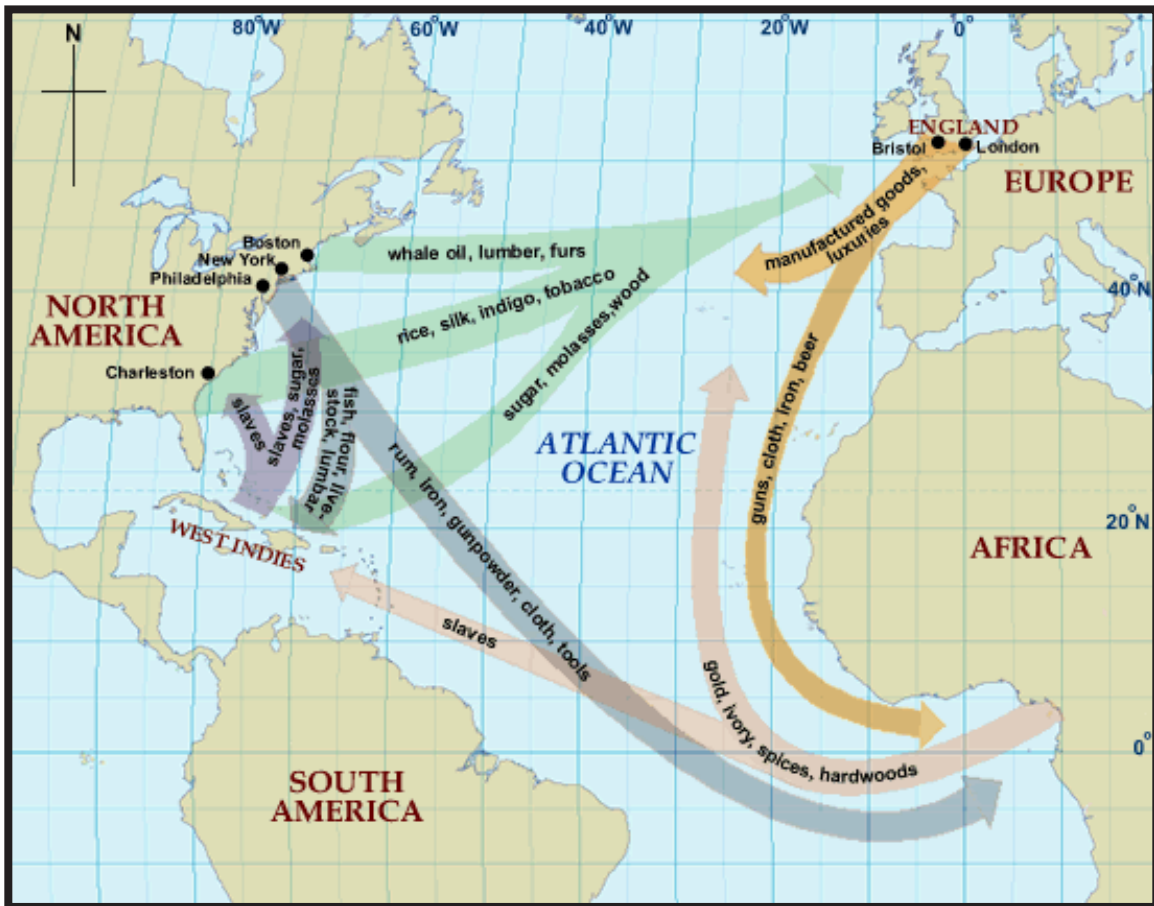


Figure 6. Map depicting the Atlantic trade triangle between Europe, West Africa, and the colonies. (Image courtesy of the National Archives of the United Kingdom).

and framed by the Ashley and Cooper Rivers would be harder to defend, it would allow for larger ships in the natural harbor east of the city along the Cooper River. Oyster Point became the permanent location for Charles Towne by 1680.

A smaller population continued to thrive at Albemarle Point. Between 1694 and 1697 James Le Sade was granted 760 acres of the surrounding land on Albemarle Point in order to create “Old Town Plantation.” This property covered the entire point and included the original settlement of Charles Towne. The property would remain in the Le Sade Family until 1716. Archaeologists believe that the Miller Site and floor are remnants of the family’s occupation.<sup>9</sup>

After the Le Sades left Albemarle Point and Charles Towne in 1716, Old Town Plantation passed through multiple families. The eighteenth-century owners included John Beresford, William Branford and his heirs, and Ann Branford Horry and Elizabeth Branford Horry. The Horry family retained ownership of Albemarle Point and old Charles Towne until 1774.

The British attacked Oyster Point and new Charleston from the south in 1780. In order to ensure that weapons and goods could be supplied to the city throughout the war, redoubts, or small fortifications, were built along river routes. Just in front of the main fortification ditch remaining from 1670 Charles Towne, the tip of Albemarle point was considered a prime location.

During the early nineteenth century Albemarle Point changed hands three times in twenty years. Anthony Barbot purchased the property in 1833 and then conveyed it to Jonathon Lucas in 1835. Finally, William McKenzie Parker purchased the property in 1850. When the land was offered for sale in 1867, the property included a plantation house, slave settlement, church, and other related outbuildings. The

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<sup>9</sup> Agha, *Historical Archaeology*, 6.

Legare family, who purchased the land that same year, maintained ownership until 1969 when it was transferred to the South Carolina Tri-centennial Commission for the purpose of creating a State Historic Park.

### **OWNERSHIP OF ALBEMARLE POINT: THE LESADE FAMILY 1685-1716**

In 1685, French Huguenots James LeSade and his wife Elizabeth set sail on the *Margaret* from Holland. In a transfer of 760 acres, an amount nearly equal to the original town's settlement, James LeSade purchased Albemarle Point and the surrounding lands between 1694 and 1697. With this purchase, LeSade established "Old Towne Plantation" and built a house near the marshes edge, just north of the old palisade wall. James LeSade occupied the site with his wife until his death in 1703.<sup>10</sup>

Upon James' death, his widow Elizabeth took ownership of the land. A 1716 record lists the names of the LeSade's nineteen enslaved Africans located at "Old Towne Plantation." This account, drafted thirteen years after her husband's death, leads us to believe that Elizabeth maintained working order of the plantation until her death in 1722. Posthumously, the property was transferred to James' brother Peter LeSade. Over the course of the next ten years, Peter LeSade sold off four lots of the property in 1723, and later relinquished any remaining land ownership by selling off the residual property in 1732.<sup>11</sup>

Archaeologists have verified that the LeSade house was looted, dismantled, and salvaged before being sold off by Peter LeSade in 1732. However, just prior to the property transfer, accounts suggest a tenant named David Macqueen lived on

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<sup>10</sup> Agha, *Historical Archaeology*, 8-9.

<sup>11</sup> *Ibid*, 8-9.



the site after Elizabeth died. These accounts list Macqueen as having use of a fenced pasture with cattle, as well as one room of the existing house, suggesting the LeSade house was still standing into the 1730s.<sup>12</sup>

Since 2009, archaeological excavations uncovered both artifacts and structural evidence of the LeSade homestead. Evidence of the structure that once sat at the Miller Site include a tabby floor, two brick piers believed to have supported the structure, as well as a brick fireplace hearth (Figures 7 through 10). It is believed the floor would have served as a ground-level basement or crawlspace, utilized by slaves. The brick piers would have supported a one or possibly two-story wooden structure above. Artifacts found on the tabby floor, as well as the surrounding site, all suggest a late seventeenth century date.

Further interpretation of the site's archaeology has lead experts to suggest an earlier English presence before the LeSades took ownership. During recent excavations, Agha discovered a trench-shaped linear feature underneath the level of packed lime-concrete rubble.<sup>13</sup> This information is congruent with the notion that later arrivals improve previously settled sites rather than clearing new ones. Individuals construct buildings directly on top of previously existing structures for convenience. Analysis of archaeological features, as well as artifacts both above and below the floor of the Miller site, suggest occupation of the area well before the LeSades arrival in 1694.

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<sup>12</sup> Ibid, 8-9.

<sup>13</sup> Agha, *Historical Archaeology*, 4-5.

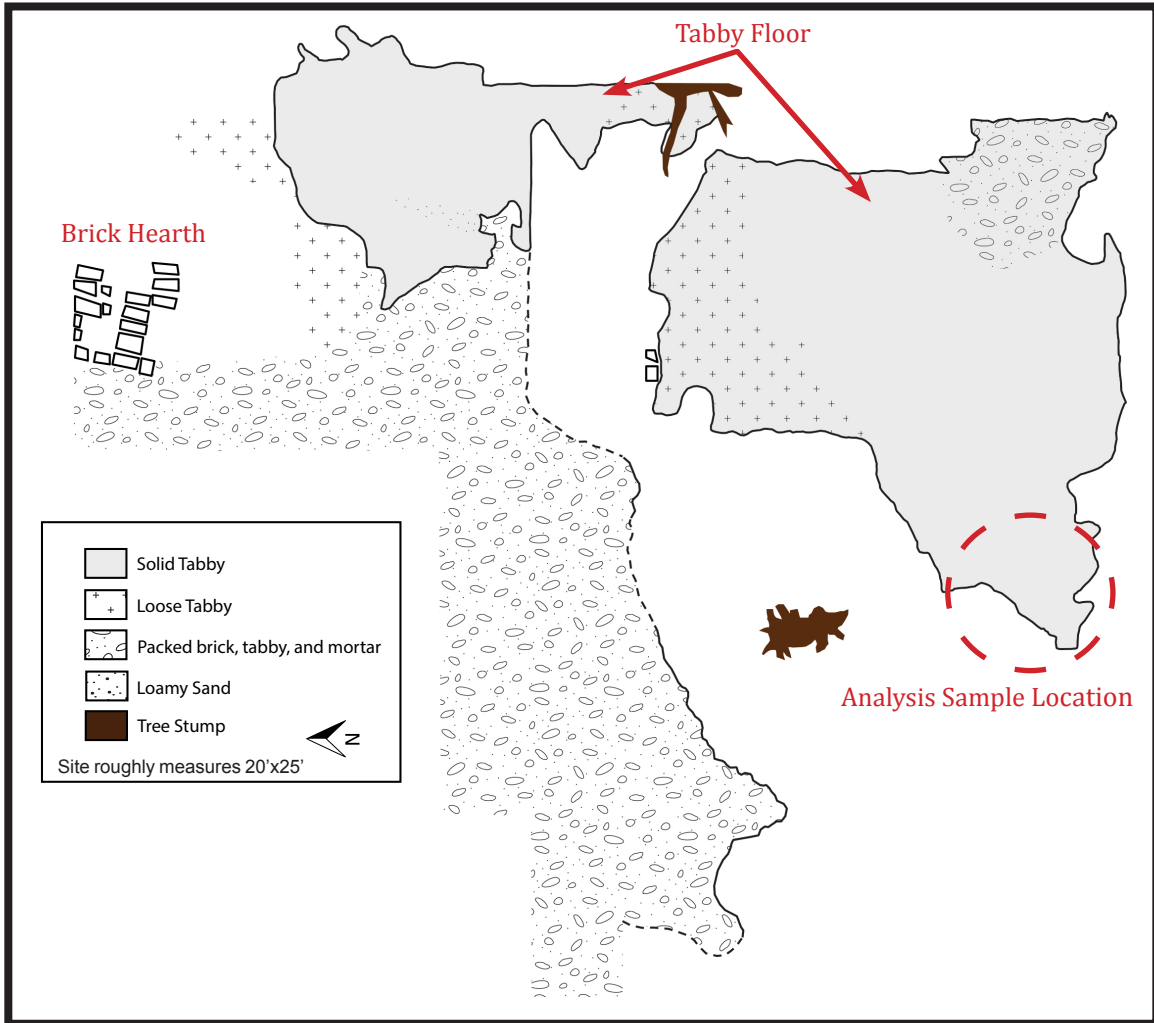


Figure 7. Archaeological Plan of the Miller Site Including Architectural Features. (Plan illustrated by Andrew Agha and the author).



*Figure 8. Image Showing Tabby Floor at the Miller Site (Charles Towne Landing, 2009).*



*Figure 9. Image Showing Brick Piers at the Miller Site (Photograph by author, 2014).*



*Figure 10. Image Showing the Brick Hearth at the Miller Site (Charles Towne Landing, 2012).*

### **TABBY: THE COLONIST'S CONCRETE**

By definition, tabby is a historic construction material similar to concrete, employing an equal ratio of lime, sand, water and oyster shell. Historically, tabby construction is concentrated in the coastal southeastern United States. While tabby was a material most commonly utilized prior to the Civil War, modern versions can still be found today. Modern variants use Portland cement in place of lime. Like modern concrete, tabby was poured and molded by forms. In order to protect the new construction it was hidden under a layer of stucco. The stucco then became the sacrificial element in the assembly.

Tabby, as a Lowcountry construction material, traces its origins to both Old and New World influences. Old World traditions of 'tapia' and 'tapia real' can be linked to both Spain and Morocco after 1200 A.D. The Spanish word 'tapia' translates to "earth compacted between boards," and upon finding its way from Spain to Morocco was changed to 'tapia real' literally meaning, "royal compacted earth."<sup>14</sup> The most common and successful application of 'tapia real' was in the construction of military structures in Spain. The Spanish utilized readily available clay, lime, and stone to produce strong, durable structures in Europe. They used the same technology in New World settlements.

When the Spanish settled St. Augustine, Florida in 1565, the earliest structures were constructed of wood. However, within fifteen years, 'tapia real' had been introduced to the construction repertoire as an option for low-cost housing. The change from 'tapia real' as a "royal" material to that of common nature was due to the discovery of coquina, a naturally occurring limestone composed of broken shell and coral. Coquina, with its porous, spongy, and soft texture, looks very similar to tapia and tabby, and was easily cut into blocks for construction with less intensive labor. Coquina was associated with the wealthy, relegating tabby and tapia to those lower in the social hierarchy.<sup>15</sup>

The discovery of coquina acted as one of the initial limitations of tabby application in the colonies. Formed naturally, coquina dominated early masonry construction because it took such little effort to manipulate. Similar in color and use as tabby, the two are often confused based on their physical characteristics, as well as their

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<sup>14</sup> Lauren B. Sickles-Taves and Michael S. Sheehan, *The Lost Art of Tabby Redefined* (Southfield, MI: Architectural Conservation Press, 1999) 4.

<sup>15</sup> Sickles-Taves, *The Lost Art of Tabby*, 5.

common exterior stucco coating. The rise in tabby popularity eventually developed due to the limited geographic availability of coquina and the monopoly held on its use by the Spanish military.<sup>16</sup>

British colonists in the southeast also utilized tabby construction, though when they first did so is not known. British soldiers invaded and siezed St. Augustine in 1702. It is plausible the British learned about tabby construction and brought the methods back to Charleston. Evidence of this dissemination of tabby methods to Charleston can be seen in the erection of a tabby powder magazine with brick facing (Figure 11).<sup>17</sup> The powder magazine in Charleston dates between 1703 and 1713. This early example of tabby in South Carolina was not isolated. Evidence of tabby construction can be seen throughout the state's coast, especially at Beaufort.

English tabby in South Carolina appears to have reached its peak in popularity after the 1730s. In the Beaufort vicinity, builders employed tabby components with strong frequency. For the next fifty years, tabby construction in Beaufort, was used not only in defense structures, but for domestic and religious buildings as well. Examples of tabby from this period include the Chapel of Ease on St. Helena Island (circa 1726), and the one-and-one-half-story home of Jean de la Gaye (circa 1738) at Retreat Plantation. By the end of the eighteenth century whole buildings in Beaufort were built of tabby.

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<sup>16</sup> Ibid, 5.

<sup>17</sup> James D. Kornwolf, *Architecture and Town Planning in Colonial North America* (JHU Press, 2002), 859.



*Figure 11. Image of the Charleston Powder Magazine (Photograph by author, 2014).*

## **THE ART OF TABBY CONSTRUCTION**

The tabby process, like other methods of vernacular architecture, was rarely recorded. Colonist Henry Myers in 1741, for example, described the cost effectiveness of tabby for house construction, but he failed to discuss the labor load required.<sup>18</sup> Tabby relied on the availability of four components: oyster shell, lime, sand, and water. Ash, a fifth ingredient, was a by-product of burning oyster shells for lime and added strength to tabby. In the nineteenth century, a sixth component, Portland cement, was introduced creating a stronger, faster setting product, that did not require the outer stucco coating.

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<sup>18</sup> William M. Kelso, *Captain Jones's Wormslow: A Historical, Archaeological, and Architectural Study of an Eighteenth-Century Plantation Site Near Savannah, Georgia.*(University of Georgia Press, 2008) 61.

Shells, most often oyster shells, were the easiest material to acquire in the tabby process. Indian middens throughout the Southeast provided a wealth of both fresh and saltwater shells. Middens are collections of disposed cultural remains including food materials, tools, and organic matter. Any shells could be used in the process of tabby creation, however, oyster shells were the most plentiful. The purpose of shell in tabby construction was to provide strength, serve as an aggregate, and act as the raw material for the production of lime. Like gravel in modern concrete, shells added volume to the tabby, extending the less plentiful materials like lime and sand. Shell inclusion in the tabby minimized shrinkage in the final product, and limited cracks and spalling while increasing the tabby's longevity.<sup>19</sup>

The most time and labor intensive aspect of the tabby process was the production of lime. Lime was the binding that held the mixture of sand and shell aggregate together to form tabby. The quality of the lime, and as a result the quality of the tabby, was easily affected by numerous factors including weather, the burning process, and

<sup>19</sup> Sandor Popovics, *Concrete-Making Materials* (Washington: Hemisphere Pub. Corp., 1979) 158.

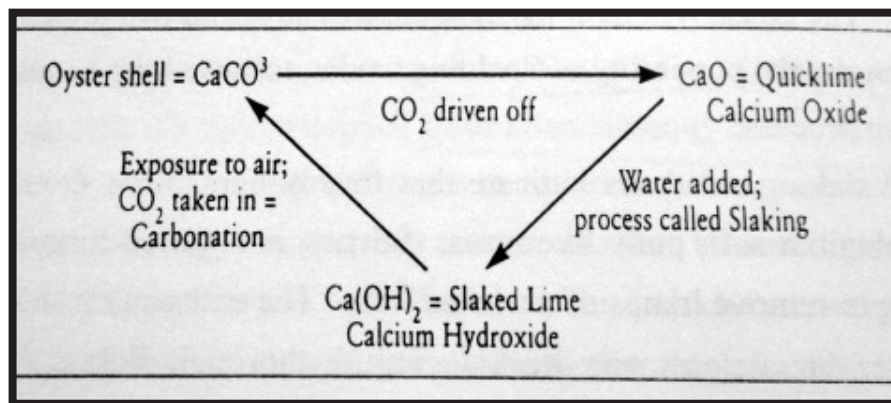


Figure 12. Diagram of the Calcium Cycle (*The Lost Art of Tabby Redefined*, 22).



the mixture. Burning oyster shells created lime through three stages. First, a sufficient amount of oyster shell had to be collected. Next, a homemade kiln or lime-rick was erected near the construction site. Barrels were built on-site to store the lime, especially if hydrating or slaking was required. Finally, slaking, a technique used in ancient Rome, involved creating a violent chemical reaction through the addition of water. This process created a substance similar to putty (Figure 12). While slaking provided a stronger, less brittle, more water resistant product, it was unnecessary in the tabby process.<sup>20</sup> Until the 1800s, lime was often utilized immediately after burning.

Other than shell and lime, sand was the other key component in the successful execution of tabby. For construction purposes, the coastal southeastern colonies could choose from four types of sand: channel or river, beach, dune, and the final, pit sand, is a naturally occurring stratigraphic layer found underground through excavation. Mainland tabby construction utilized pit sand due to the inaccessibility of water-based sands, while more coastal forms of tabby construction could choose from any of the three remaining types. Roman architect, author, and engineer Vitruvius argued that in order to make a structure as strong as possible, the sand used must first be free of dirt and salts. Vitruvius further suggested that river sand, due to its smoother properties, was best used for stuccowork while pit sand should be saved for masonry.<sup>21</sup> Based on the location of historic tabby examples in proximity to the coast, it can

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<sup>20</sup> Dallas N. Little, Jon A. Epps, and Peter E. Sebaaly, “Hydrated Lime in Hot Mix Asphalt” (2006), 8.

<sup>21</sup> Vitruvius Pollio and M. H Morgan, *The Ten Books on Architecture* ([S.l.]: Elibron Classics, 2004), 44-45.

be assumed that it employed channel or river sand, as pit sand would have required extra labor in the locating and digging of pits. While easier and less labor intensive to collect, river or channel sand would present higher levels of salt.<sup>22</sup>

Water was required to create the viscous mixture necessary for pouring, forming and molding tabby into a desired shape. In the creation of tabby, two types of water, salt and fresh, were available. Even during the seventeenth century, the corrosive properties of salt water were well known. This, combined with Vitruvius' recommendations away from sand with high salt content, left fresh water as the preferred option. Further, early settlements would require a fresh water source to sustain living and planting, so its accessibility from a tabby site is likely.

The final ingredient, a by-product of the lime process, was ash. Because wood was used to burn shells for lime, the inclusion of ash in tabby was inevitable. Ash has hydraulic characteristics similar to lime in that it hardens by chemical action. In his books, Vitruvius discusses pozzolana, a material formed with volcanic ash, that hardens and chemically reacts with calcium hydroxide when in the presence of moisture. Through a reaction likely unknown to most colonists, wood ash when mixed with water and lime, acquired cementitious properties.

Foundations and walls were the most common applications of tabby construction through the Southeast. Tabby in the form of floors were rare. Commonly poured over tamped earth, in higher quality construction, the tabby mixture was poured over boards or shell rubble. Regardless of the chosen foundational material, after pouring, the floor now two to three inches thick, was tamped and covered in linseed oil for protection and aesthetic value. In this process, "tabby was tamped, then brushed with a coat of linseed oil to form a hard seal. Continuous beating

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<sup>22</sup> Sickles-Taves, *The Lost Art of Tabby*, 24.

brought a concentration of lime to the surface, and upon mixing with the oil, created a marble-like, cream-colored finish.”<sup>23</sup> Inevitably, constant foot traffic, combined with the floor’s inherently weak structural properties from lack of whole shells, lead to a pitted and uneven surface. A single pour tabby floor, if regularly used, would have a short life span. Pouring over the old floor with new tabby layers could restore the surface and reestablish aesthetics.

To construct successful foundations and walls, wet tabby was poured and tamped by hand into wooden forms on site. After drying for two to three days, the forms were removed and moved up. The forms were continuously moved in order to pour another layer on top of what had previously dried. This layering process was repeated until the wall or foundation reached a desired height. The finished tabby structure was then brushed with a broom before applying a protective coating of stucco.<sup>24</sup> Depending on available materials, tabby recipes and forming techniques changed continuously throughout the eighteenth, nineteenth and twentieth centuries.

Few tabby structures remain in the Charleston vicinity. The Fort at Colonial Dorchester (circa 1757) eighteen miles north of Charles Towne Landing on the Ashley River, the Chapel of Ease on St. Helena Island (circa 1740) seventy-five miles south near Beaufort, as well as the ruins at Wormsloe Plantation (circa 1733) 115 miles south outside of Savannah, Georgia, are all nearby examples. These sites provide comparative examples of tabby construction in the functional realms of defense, religion, and residential.

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<sup>23</sup> Janet B. Gritzner, “Tabby in the Coastal Southeast: The Culture History of an American Building Material” (dissertation, Louisiana State University, 1978), 38.

<sup>24</sup> Lauren B. Sickels-Taves, “Understanding Historic Tabby Structures: Their History, Preservation, and Repair,” *APT Bulletin* 28, no. 2–3 (1997): 22–29.

## CHAPTER II

### METHODS AND ANALYSIS

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Successful conservation of the historic floor found at the Miller Site hinges on understanding the material and how it was used. Determining the physical properties of the floor facilitates comparisons with known characteristics of tabby construction throughout the Southeast. Understanding the floor's physical properties is also integral for the formulation of conservation and exhibition recommendations. This thesis proposes conservation and interpretation suggestions that cover preservation options ranging from more conservative treatments to active use in interpretive plans. Ultimately, these recommendations incline toward less active use by utilizing display interpretations of the floor.

Conserving the tabby floor at the Miller Site presents a unique set of challenges to conservators and park employees. Uncovered archaeologically in 2009, the floor remains exposed but protected, deteriorating at an unknown rate. Current research provides limited information on tabby construction and recommendations for its conservation. Projected deterioration of the floor at the site is based on environmental factors, visitor impact, and analysis of the material.

#### SUMMARY OF ANALYTICAL METHODS

In the early 1990s, Lauren B. Sickels-Taves summarized what was then known about the material, historical, and practical aspects of tabby. Her book, *The Lost Art of Tabby Redefined* is divided into these same three categories and is the only comprehensive scholarly analysis of tabby to date. Sickels-Taves provides an in-depth history

of the material and presents the correct procedures required to complete successful repairs on historic tabby structures. Her purpose for writing *The Lost Art of Tabby* was to encourage, preserve and conserve the remaining examples of tabby construction in the Southeast. Sickels-Taves provides analytical tests on how to examine tabby's physical characteristics as well as means for developing an appropriate restoration recipe. The results of these tests bring tabby usage and conservation into the modern and practical world.<sup>1</sup>

Samples of material from the floor at the Miller Site were examined to determine their material properties. Analysis followed the procedures Sickels-Taves adapted from mortar analysis techniques.<sup>2</sup> Sickels-Taves, utilizing historic tabby recipes, developed twenty-four samples for testing. Her results served as comparisons for all tests performed on the tabby from the Miller Site. Sickels-Taves drew conclusions from nine laboratory tests in her research, seven of which were recreated for this study and explained below. The tests quantify compressive strength, water absorption, specific gravity, saline hydrological effects, acid rain sensitivity, chemical analysis/acid digestion, and void ratio determination. These tests were performed on two samples taken from the southern portion of the floor at the Miller Site (Figure 13).

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<sup>1</sup> Lauren B. Sickels-Taves and Michael S. Sheehan, *The Lost Art of Tabby Redefined* (Southfield, MI: Architectural Conservation Press, 1999) 109.

<sup>2</sup> E. Blaine Cliver, "Tests for the Analysis of Mortar Samples," *Association for Preservation Technology Bulletin* 6 (1974), 68-73.



*Figure 13. Image showing Extents of Miller Site Tabby Floor and Approximate Location Sampling Identified (Photograph by Charles Towne Landing, 2010).*

## **ANALYSIS AND RESULTS**

The following tests were performed on samples from the Miller Site in December-January 2013-2014. Information derived from the tests is described below. The intention was to compare the physical properties, components and stability of historic tabby. Results from testing the floor found at Charles Towne Landing were compared to samples cast by Lauren B. Sickels-Taves. Analytical tests followed procedures also developed by Sickels-Taves.<sup>3</sup>

### ***Compressive Strength Test***

Testing the compressive strength of a given material measures its ability to withstand loads under applied stress. Testing compressive strength in tabby is vital because like concrete, the material compatibility of a repair determines the estimat-

<sup>3</sup> Sickels-Taves, *The Lost Art of Tabby*, 109-124.

ed longevity of the object. If a material repair made to historic tabby is too strong, it can cause rapid deterioration in the original historic material. Likewise, if a material repair made to historic tabby is too weak, it will degrade too quickly and not provide enough support. Lauren B. Sickels-Taves argues that compressive strength tests glean the most useful information about tabby.<sup>4</sup> This test was performed on the floor material taken from the Miller Site in order to determine its load capacity, an appropriate repair mix, and compare the floor to historic tabby.

According to Sickels-Taves, historic tabby has a compressive strength of approximately 350PSI (pounds per square inch). Repairs to historic tabby should have a compressive strength of equal or lesser value. Based on tests performed by Sickels-Taves, an appropriate tabby repair mix should use the ratio of “1:2:8.75” for the addition of Portland cement, lime, and sand to the tabby mix of oyster shells and water.<sup>5</sup>

The compressive strength of the tabby (PSI) found at the Miller Site was determined using a hand-operated hydraulic compressive testing machine. This device was favored over a universal testing machine as it allowed for testing of the historic material rather than a modern test cube.

A four by three inch section of floor was extracted from the southwest corner of the the Miller Site. When tested in a hydraulic cylinder, the floor sample proved to have a compressive strength of 203.142 PSI. This number was calculated by taking the pounds of pressure necessary to crush the sample and dividing it by the area of the piston in the hydraulic cylinder. Sickels-Taves claims that historic tabby should have a compressive strength of 350, a number much higher than that of the sample from the Miller Site. Comparing the compressive strength of the floor to Sickles-Taves

<sup>4</sup> Sickels-Taves, *The Lost Art of Tabby*, 111.

<sup>5</sup> Sickels-Taves, *The Lost Art of Tabby*, 112.

other samples mimicking tabby recipes, the floor aligns more closely to those with an additive of Portland cement. The related recipe with the closest PSI to the tested floor material without being too strong, is a Sickels-Taves' "1:2:9 gl" mixture of Portland cement, lime, sand, oyster shell, glass microbeads and water. This recipe tested with a compressive strength of 172.8825 and utilizes glass microbeads (gl) as inert filler. If reparative measures were to be taken on the floor, park employees should utilize a mixture with a similar ratio.

### ***Water Absorption Test***

Like masonry mortars, the durability of tabby is dependent on the material's breathability. The tabby's internal absorption and evaporation of water molecules are both important for its ability to adequately dry. Tabby repairs that utilize a material with a greater absorption rate than the original material could lead to rapid deterioration due to water build-up. However, a repair recipe with a lower rate of water absorption could also lead to decay from trapped moisture in the original structure. Testing the samples from the Miller Site for water absorption is important because historic tabby has a much higher absorption rate than modern tabby with a Portland cement component. A higher absorption rate however is directly related to tabby's deterioration.<sup>6</sup>

Samples taken from the Miller Site were tested for water absorption using the guidelines of ASTM Standard Z43977: Standard Test Method for Water Absorption of Hardened Masonry Mortars.<sup>7</sup> Calculation of the absorption rate for the samples

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<sup>6</sup> Sickels-Taves, *The Lost Art of Tabby*, 112.

<sup>7</sup> American Society for Testing Materials, *Standard Test Method for Water Absorption of Hardened Masonry Mortars*, American National Standard Z43977: 1996. This standard was currently under ballot at the time *The Lost Art of Tabby Redefined* was published (1999). The modern complement to ASTM Z43977 would be ASTM C1403-13: Standard Test Method for Rate of



required a small section to be weighed and placed in three millimeters of Ashley River water. At intervals of fifteen minutes, one hour, four hours and twenty-four hours, the sample was removed, weighed, and replaced. The water absorption rate was then calculated according to the formula:  $A_T = (W_T - W_0) \times 12,730 / d^2$ .<sup>8</sup>

The results of water absorption testing on the Miller Site floor were intriguing and unexpected. As depicted in Table 1 and Graph 1, the absorption rate was most significant in the initial fifteen minutes. While the sample continued to absorb water through the remainder of the testing period, the rate of absorption peaked during this first time interval, meaning the sample had reached its carrying capacity. These results from the Miller Site tabby differ greatly from the information gathered by Sickels-Taves. Undoubtedly, this discrepancy is due to variations in sample size.

Comparisons of the Miller Site tabby and the samples tested by Sickels-Taves can be made by looking at the absorption rate graphs. The line in Graph 1 mimics those depicted for samples “1:2:9ae,” a mixtures of Portland cement, lime, sand, oyster shell, air entrainer (ae), and

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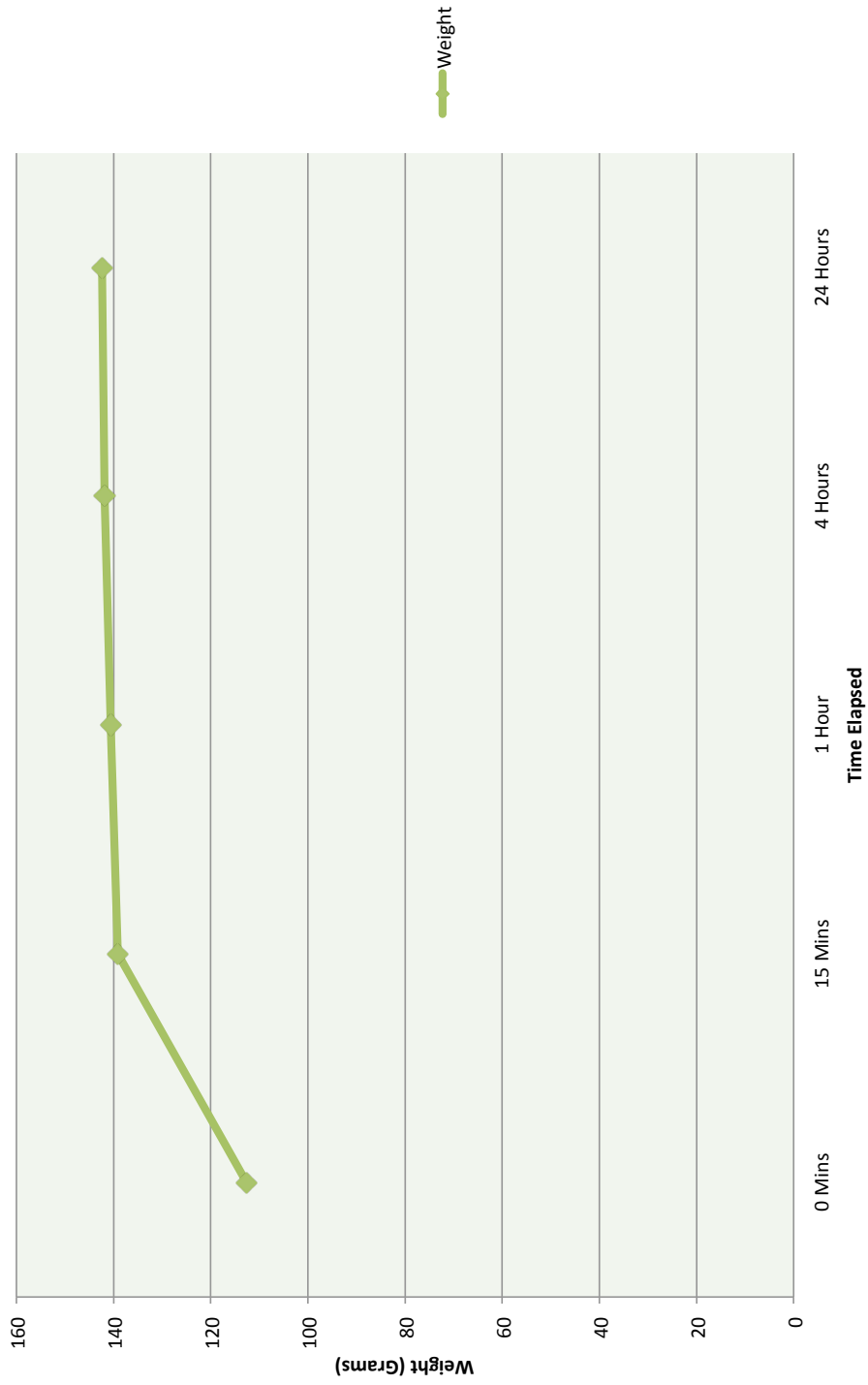
Water Absorption of Masonry Mortars.

<sup>8</sup> Sickels-Taves, *The Lost Art of Tabby*, 112. In the case of this formula,  $A_T$  is the absorption rate,  $W_0$  is the original weight of the sample,  $W_T$  is the weight of the sample after each elapsed time segment, and  $d$  is the diameter of the sample in millimeters.

**Table 1: Water Absorption**

Time Elapsed	Weight	% Change	Absorption Rate
0 Mins	112.55	0	0
15 Mins	139.14	123.28%	3070.21
1 Hour	140.62	101.05%	3241.09
4 Hours	141.81	100.84%	3378.5
24 Hours	142.37	100.34%	3443.16

**Graph 1: Water Absorption of Miller Site Tabby**



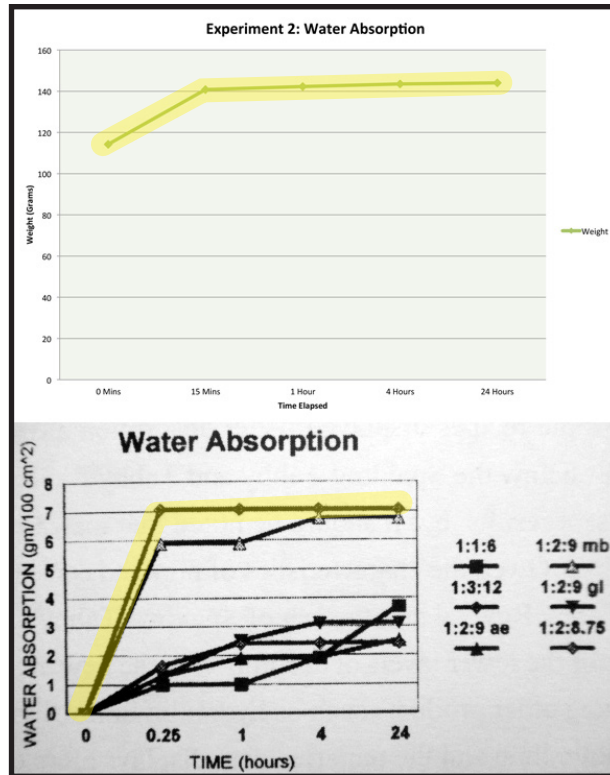


Figure 14. Comparison of Graphs Depicting Water Absorption (Graphs by author and *The Lost Art of Tabby* page 113).

water, as well as “1:2:9mb,” comprised of Portland cement, lime, sand, oyster shell, microballoons (mb), and water (Figure 14). The microballoons expand when in contact with water in order to mimic the natural voids in tabby. This similarity is noteworthy as it reaffirms the results of the compressive strength test, and bolsters the “1:2:9” recipe created by Sickels-Taves as an appropriate restoration mix. Interestingly, the Miller Site samples absorbed water at a rate more similar to a mix with modern additives rather than other tested historic recipes. It is possible that the Miller Site tabby is more closely related to a modern mixture rather than historic structural tabby because it is a different material all together.

### ***Specific Gravity***

Specific gravity testing provides another means of measuring the water absorption potential of a given material. A tabby sample of known mass and volume is first placed in a measured amount of water. The specific gravity is determined by then dividing the density of the tabby sample by the density of the water in which it is submerged. The resulting calculation yields a ratio without a unit of measure. Sickels-Taves determined the specific gravity of a poured section of tabby wall from Hampton Plantation in McClellanville, South Carolina, to be 2.013 and a tabby brick from a plantation near Hazzards Neck, just south of St. Simons Island, Georgia to be 2.203.

The results of the specific gravity test show that the sampled floor from the Miller Site has a specific gravity of 1.99. Comparing the results from the Miller Site with those of Sickels-Taves, the difference can be equated to the floor's lower compressive strength and higher absorption rate. These physical characteristics give an overall interpretation of the Miller Site floor being "weaker" than examples of historic tabby. "Weakness" for the purpose of this analysis is defined by lower compressive strength, and a higher absorption rate, meaning more voids and a lighter weight final product. Further, these weakening characteristics offer a possible explanation for the limited use and single pour of the floor.

### ***Saline Hydrological Test***

In all forms of masonry construction, the presence of salt can cause severe deterioration. Though neither lime nor oyster shells have been associated with any significant forms of decay, tabby is composed of materials naturally saturated with salt. Sickels-Taves devised a cyclical test to evaluate the effects of salt-water immer-

sion on tabby and therefore mimic the tidal saline hydrological conditions in the area of the Ashley River. The expectation, as concluded on by Sickels-Taves, is that historic tabby becomes harder in the presence of saltwater. This experiment aims to find the effect of water with a lower salinity (found near the Miller Site) in comparison to the results found by Sickels-Taves.

Considering the Miller Site is located on Old Towne Creek, a tributary to the tidal Ashley River, the floor would have been exposed to water with a lower salinity and much higher variance in salt concentrations than sites closer to the Atlantic Ocean. The dividing line between fresh and saltwater in the Ashley River is located at a bend adjacent to Magnolia Plantation, in Charleston, South Carolina, nine miles upriver of Charles Towne Landing and the Miller Site. According to the National Oceanic and Atmospheric Administration (NOAA), Charleston Harbor, and specifically the Ashley River, experiences an annual tidal range of five feet annually, and six feet in the Spring. This average is considerably higher than the northern portion of the state and manifests in the constant variance of water salinity and daily movement of the “salt-wedge” along the river’s length.<sup>910</sup>

Testing involved immersing a sample in salt water. The water sample was taken at high tide on the Ashley river in December 2013, allowing for a higher salinity. After being submerged for twenty-four hours, the sample was removed, observed, and analyzed for physical changes. The sample then was allowed to dry for an addi-

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<sup>9</sup> United States Department of Transportation and the Federal Highway Administration. “Highways in the Coastal Environment- NHI-07-096.” (Second Edition, 2008) chapter 2.2.5. [www.fwha.dot.gov](http://www.fwha.dot.gov), <http://www.fhwa.dot.gov/engineering/hydraulics/hydrology/hec25c2.cfm> (accessed March 11, 2014).

<sup>10</sup> Michael C. Barth and James G. Titus. Greenhouse Effect and Sea Level Rise: A Challenge for this Generation. (Van Nostrand Reinhold Company Inc., 1984) 81-82.

**Table 2: Saline Hydrological Test**

	24 hr. Period	Weight (g)	Observations
12-Dec	Day 1 (Wet)	53.05	Fingernail hardness (2.5), grainy and sandy to the touch, easy to break, small holes and pores evident, shells visible.
13-Dec	Day 2 (Dry)	44.74	Fingernail hardness (2.5), sample still remains grainy and sandy to the touch and appears easy to break.
14-Dec	Day 3 (Wet)	51.05	No change evident; fingernails hardness (2.5), and sample remains grainy and sandy to the touch while appearing easy to break.
15-Dec	Day 4 (Dry)	47.74	No change evident; fingernails hardness (2.5), and sample remains grainy and sandy to the touch while appearing easy to break.
16-Dec	Day 5 (Wet)	50.89	Sample remains at fingernail hardness (2.5) and appears easy to break, but feels less grainy and sandy to the touch.
17-Dec	Day 6 (Dry)	45.98	No Change evident from previous day; sample remains fingernail hardness (2.5) and appears easy to break but feels less grainy and sandy to the touch.
18-Dec	Day 7 (Wet)	50.55	No Change evident from previous day; sample remains fingernail hardness (2.5) and appears easy to break but feels less grainy and sandy to the touch.
19-Dec	Day 8 (Dry)	45.96	Sample feels overall less grainy, gritty and sandy, however it remains at the same fingernail hardness (2.5). The samples feels slightly harder to break but not not impossible.

tional twenty-four hours before being re-submerged. This sequence was repeated four times over the course of eight days. Observations were recorded after each twenty-four hour submergence based on the sample's physical changes (Table 2).

The results of the saline hydrological test were significantly different than the findings recorded by Sickels-Taves. Contrary to the hypothesis of tabby strengthening due to cyclical exposure to salt water, the sampled Miller Site floor sample remained unaffected until the completion of the test. Throughout the four cycles of wetting and drying, the sample remained grainy, sandy, and gritty to touch. Utilizing the Moh's hardness scale, which measures an object's ability to resist scratching by using harder materials to scratch softer materials, the Miller Site sample was found with a hardness of 2.5 due to its ability to be scratched by a fingernail. Physical changes were not apparent until all four cycles of the test were completed. At that point, the sample appeared minimally more difficult to break and harder to scratch.

### ***Acid Rain Test***

Known to have severe effects on all forms of construction, acid rain causes both modern and historic material properties to decay. The United States Environmental Protection Agency estimates standard rain to have an average pH of 5.6. In contrast, the most acidic rainfall in the country measures with a pH around 4.3.<sup>11</sup> In a 2012 map measuring national rainfall pH created by the National Atmospheric Deposition

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<sup>11</sup> United States Environmental Protection Agency. "Measuring Acid Rain." [www.epa.gov/acidrain/measure/index.html](http://www.epa.gov/acidrain/measure/index.html) (accessed March 11, 2014).

Program, Charleston and its surrounding area are shown to have an average rainfall pH of around 4.7.<sup>12</sup> This relatively high acidity should be considered as a means of possible degradation for the tabby floor and its organic composition.

In order to analyze the effects of acid rain on tabby, full strength or diluted vinegar may be substituted due to its similar acidic properties. Utilizing full strength vinegar allows a rapid simulation of the long term effects of acid rain on earthen material. In this test, a 59.75-gram sample of the floor from the Miller Site was immersed in 200mL of full strength vinegar. Observations of the resultant reactions were recorded. Large samples and lengthy immersion times were unnecessary due to the concentrated reaction that occurred.

This experiment required a five minute observation time. To increase the scope of the experiment, the sample was allowed to continue soaking in vinegar for a full day checking it after ten minutes, thirty minutes, and then after a full twenty-four hours. Within the first two minutes, sand and large particles began detaching, and the sample instantly began to release gas as evidenced by rapid fizzing and bubbling. This indicated that chemical reactions were underway and that the sample was being affected by the vinegar. Precipitates as well as gaseous bubbles (dissolved CO<sub>2</sub>) from the reaction turned the vinegar a greenish-brown color. The reaction further caused the dirt on the sample to float to the top. After ten minutes, the sample produced gaseous bubbles at the same rate as when it was first immersed, and the vinegar had turned a murkier yellow/brown. The bottom of the beaker continued to collect more sand while the top remained gaseous. The thirty-minute check produced many of the

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<sup>12</sup> National Atmospheric Deposition Program (NRSP-3). "Hydrogen ion concentration as pH from measurements made at the Central Analytical Laboratory, 2012." (NADP Program Office, Illinois State Water Survey) [nadp.isws.illinois.edu, http://nadp.isws.illinois.edu/maplib/pdf/2012/pH\\_2012.pdf](http://nadp.isws.illinois.edu/maplib/pdf/2012/pH_2012.pdf) (accessed March 11, 2014).



same observations. The sample remained intact but continued to degrade rapidly in now darker and murkier vinegar. After twenty-four hours, the reaction stopped. The floor sample was covered in a thick film but it was still solid and had not completely disintegrated. A thick layer of sand coated the bottom of the beaker, and it appeared as though most of the exterior binder had dissolved leaving large shell fragments exposed in the sample.

Overall, the results of the acid rain test were interesting and revealing. If accurate, the evidential effects of acid on lime-mased materials could be catastrophic when left exposed to the elements. Though the sample had completed fizzing within twenty-four hours, repeated application of fresh vinegar would have reinvigorated the disintegration process. Of all the tests completed on the sampled floor from the Miller Site, the simulation of effects of acid rain caused the most damage. These results should therefore be of highest concern moving forward.

### ***Chemical Analysis/Acid Digestion***

In order to propose compatible repairs for historical tabby construction and structures, chemical analysis/acid digestions can provide characterization of the aggregate, fines and binder. This information aids in the creation of a repair material applying components with similar characteristics. Both the binder and the aggregate have a significant influence on the strength of tabby. Chemical analysis on floor samples from the Miller Site followed techniques applied to the analysis of historic mortar.<sup>13</sup>

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<sup>13</sup> E. Blaine Cliver, "Tests for the Analysis of Mortar Samples," *Bulletin of the Association for Preservation Technology* 6, no. 1 (January 1, 1974): 68–73.

A 35.02g sample from the Miller Site was first weighed, photographed, and then analyzed for general characteristics including appearance, layer structure, bulk color, texture, inclusions and hardness. The sample was then powdered with a mortar and a pestle and dried in a No. 120 incubator for twenty-four hours before weighing. The sample was then placed in 600mL beaker and moistened with 200mL of water. Under a fume hood, muriatic acid was slowly added in order to dissolve the binder. Muriatic acid is continually added during this process until no further reaction is apparent. During this step, reactions were observed and recorded. The beaker was then placed on a mechanical stirring plate with a stirbar and left to react for twenty-four hours. A watch glass was also placed on top of the beaker at this time to prevent liquid or gas leaks.

Following the digestion of the sample, separation, filtration and sieving are necessary to decipher the larger aggregates from the fines. Filter paper was weighed and then positioned in a funnel in order to refine the acid and sample mixture into a larger beaker. Water was slowly added to the sample and swirled to suspend the fine particles before being poured into the funnel. This process was repeated until the added water in the beaker remained clear. Both the beaker and the filter paper were then placed inside the No.120 incubator for twenty-four hours before being weighed. The ratio of aggregate to fines was then calculated as a weight-to-weight percentage of the whole sample. The amount of dissolved binder was calculated by adding the percentages of aggregate and fines and subtracting them from the weight of the initial sample and multiplying by one hundred. Binder percents are slightly skewed due to the fact that presumably some shell is dissolved during the acid digestion process.

Sieving the remaining aggregate after the digestion helps to determine the particle size distribution within the material. The aggregate was sieved through a small standard sieve set for ten minutes and then weighed to express the amount of each particle size as a percentage of the whole. Finally, color, sorting, sphericity, and size further characterized the aggregates by screen size. All data throughout the chemical analysis was recorded on an analysis sheet (Appendix A).

The results of the Miller Site acid digestion and chemical analysis very closely resembled the results of Sickels-Taves' tests of historic tabby. The particle distributions in both the Sickels-Taves tabby, as well as the Miller Site floor, resulted in the three smallest sieves having the highest concentration of aggregate (Figure 15, Table 3). Photomicrographs of the Miller Site sample's aggregate and fines exhibit a mostly tan sample with varying sizes of white and black particles before the sieving process (Figure 16). Both samples were comprised mostly of small and fine particles with the large aggregate being crushed oyster shell that was dissolved by the acid. The aggregate was poorly sorted and mostly subangular in shape with Munsell colors in the families of 7.5YR and 10YR (Table 4).

### ***Void Ratio Test***

While chemical analysis examines the nature of a binder used in tabby construction, the void ratio test is a simple procedure used to determine the amount of binder necessary in a restoration recipe. The specific purpose behind a void ratio test is to determine the amount of binder needed to fill voids between aggregates in new tabby or mortar. In order to apply this test to the floor at the Miller Site, dry sand from the original floor sample, left over from the sieve test, was poured into a test tube. A second test tube was filled with an equal volume of water. The test tube

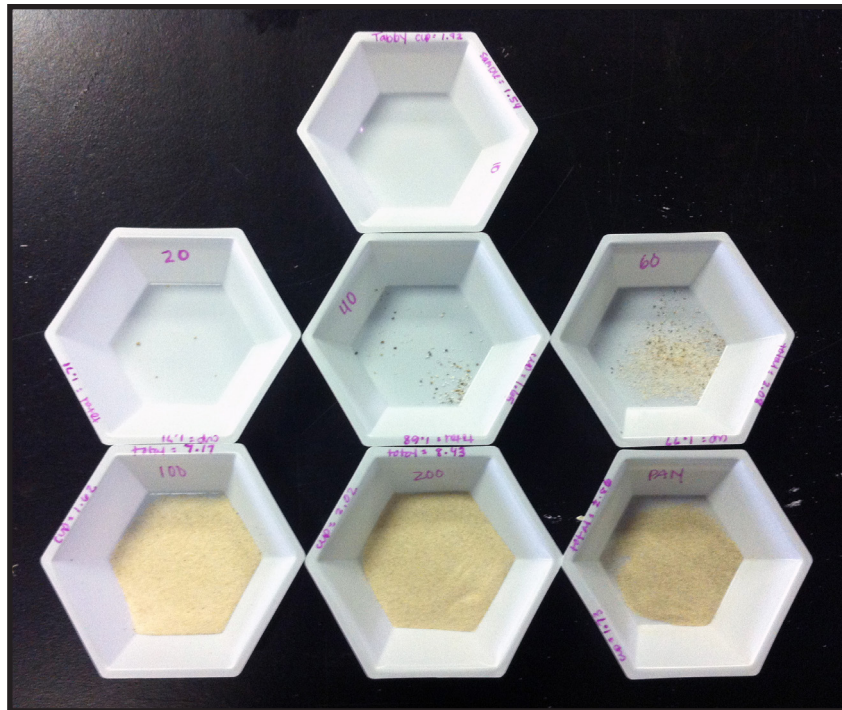


Figure 15. Image Showing Results of Sieve Test after Acid Digestion (Photograph by author, 2013).

Table 3: Chemical Analysis Particle Distribution

Sieve screen number	Mass of container	Mass of sample and container	Mass retained	% mass retained
10	1.89g	1.89g	0g	0%
20	1.98g	1.98g	9g	0%
40	1.71g	1.75g	.04g	0.12%
60	1.68g	2.04g	.36g	1.08%
100	1.66g	6.74g	5.08g	15.29%
200	1.70g	6.16g	4.46g	13.42%
pan	1.67g	2.46g	.79g	2.38%

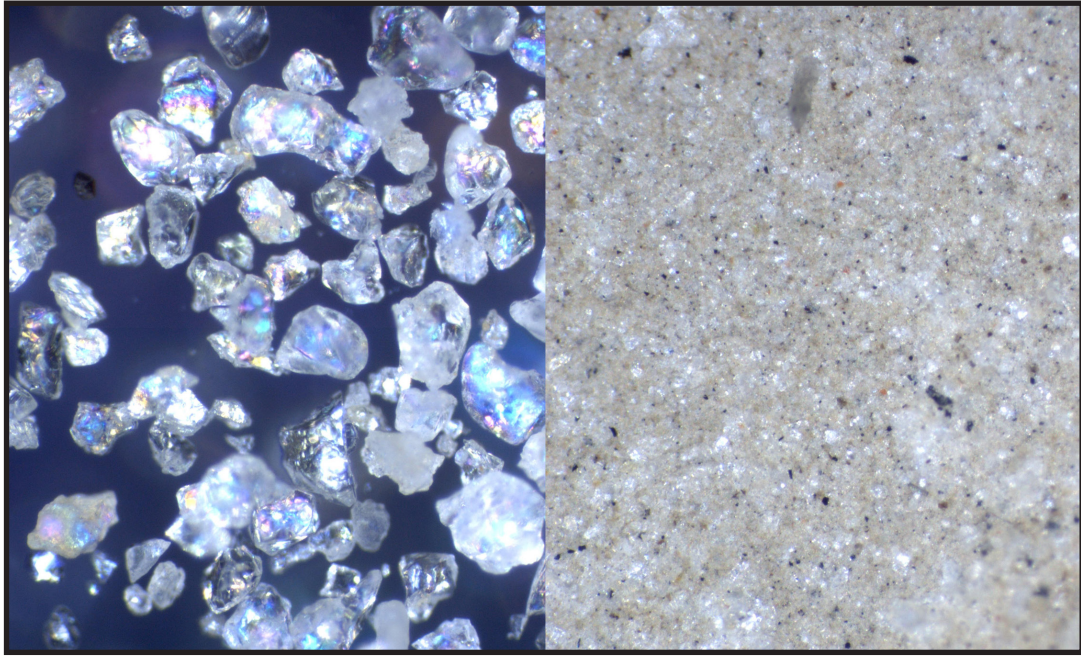


Figure 16. Photomicrograph of Miller Site Tabby Aggregate (left) and Fines (right) at 4X Magnification. (Photographs by author, 2013).

Table 4: Chemical Analysis Aggregate Characterization

Sieve #	Size	Sphericity	Roundness	Sorting	Color
10	n/a	n/a	n/a	n/a	n/a
20	Coarse Sand	Subequant/High	Subangular	Coarse poorly sorted	7.5YR7/4
40	Coarse Sand	Very Equant/ High	Subrounded + Subangular	Coarse poorly sorted	7.5YR6/3
60	Medium Sand	Very Equant/ High	Rounded + Subangular	Medium poorly sorted	10YR8/2
100	Fine Sand	Elongate/Low	Subangular	Medium well sorted	10YR8/2
200	Very Fine Sand	Subequant/High	Subrounded	Fine poorly sorted	10YR8/2
Pan	Very Fine Sand	Subequant/High	Subangular	Fine poorly sorted	10YR7/2
Fines	Silt	Subelongate/Low	Subangular	Fine poorly sorted	10YR6/2

Fines consist of: Solidified 10YR6/2 residue with tan, white and black inclusions.

containing water was then poured into the other, until the water level reached the top of the sand. The amount of water remaining in the test tube was then measured using a graduated cylinder and subtracted from the original amount. The difference in the water volumes is equal to the amount of binder needed to fill the voids in the measured amount of sand.<sup>14</sup>

When tested, two test tubes were filled with both 9mL of water and the Miller Site sand aggregate. The water from the test tube was then poured over the sand until it was just covered, leaving 5.4mL of water remaining. The remaining difference of 3.6mL is equivalent to the amount of binder necessary to fill the voids in the initial measured amount of sand. These numbers then yield a sand to binder ratio of 3.6:9.0 or 1:2.5 which very closely resembles a 1:3 mixture used in nearly all of Sickels-Taves' restoration recipes.

## **CONCLUSIONS**

The combined results of the tests performed on the Miller Site floor, provide important insights into its conservation. Overall, the sampled and tested Miller Site floor was weaker than expected. A compressive strength of 146.86 PSI less than the historic tabby offered by Lauren B. Sickels-Taves, proves that the material found at the Miller Site does not match the standard. The inherent weakness of the floor could be responsible for its current condition, as well as its limited use in the seventeenth and eighteenth centuries as seen by the single pour process.

Further, knowing the compressive strength of the Miller Site floor allows for a more appropriate and durable restoration recipe to be determined. If restoration of the floor is ever implemented, the recipe will require a result with a compressive

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<sup>14</sup> Sickels-Taves, *The Lost Art of Tabby*, 118.

strength of 203.142 PSI or less. Utilizing the results of Lauren B. Sickels-Taves, the tabby sample with the most similar PSI to that of the Miller Site is a “1:2:9gl” mix of Portland cement, lime, sand, oyster shell, glass micro-beads (gl) and water. This ratio found to have a compressive strength of 172.8825 PSI, is appropriate restoration mixture. When taking into consideration the floor’s comparatively low strength, possible insight is gained into the floor’s poor condition.

Another cause of weakness in the floor may be caused by its ability to rapidly absorb water. Whereas Sickels-Taves recorded that historic tabby should steadily absorb water over an extended period of time, the lime-concrete sampled from the Miller Site absorbed its full capacity of water within the first fifteen minutes, and then retained it for the duration of the test. This time frame of extended water retention could easily lead to deterioration and erosion of the particle bonds within the material, and therefore more drastic structural issues.

Results of the saline hydrological test lead to further discrepancies between the Miller Site floor and historic tabby. This variation could be due to a difference in water salinity of the tested sites. The water used in the experiment was taken directly from the Ashley River in an attempt to replicate water condition surrounding the floor. Due to the natural estuary that forms in Charleston harbor, and the tidal nature of the Ashley River, the water surrounding Charles Towne Landing has a higher salinity variation than the nearby Atlantic Ocean. In contrast, Sickels-Taves speaks of more southern coastal tabby that has direct contact with ocean saltwater. Sickels-Taves suggests saltwater increases tabby strength. This theory supports a hypothesis that the relatively weak Miller Site floor is a result of the lower salinity levels in the nearby Ashley River.

Of the executed experiments in regards to the Miller Site floor, one stood out as the biggest source of deterioration: acid rain. The acid rain test provided the most concrete evidence of the irreversible corrosion caused by acidic rainwater. This test above any other should be considered when attempting to determine and strategize mitigation and conservation options for the floor.

Through the tests defined by Sickels-Taves, it was determined that the Miller Site floor is different than what she defines as historic tabby. Compared to the historic standard, the floor is relatively soft and susceptible to damage from acid rain. Otherwise, it is unknown whether this differentiation is due to the virtually nonexistent comparable examples of seventeenth century tabby in the Lowcountry, the equally sparse instances of tabby floors throughout the southeast, or the fact that the floor may not be tabby at all. Regardless of the cause, the lime-concrete floor at the Miller Site is an irreplaceable rarity. The floor is a small part of the broader pattern of augmented flooring in the Southeast and should be conserved and interpreted as such.



## CHAPTER III

### SIGNIFICANCE AND CONSERVATION

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The use of archaeological sites as educational and recreational tools depends on their continued conservation. Archaeological sites that include elements of earthen architecture require careful consideration and inventive solutions. Earthen construction techniques such as compacted earth, tabby, plaster, and mortar are particularly susceptible to accelerated deterioration. Precedents for their conservation have been set through shelters, backfilling, removal, and relocation. Sites like Casa Grande, in Coolidge, Arizona, and Menokin, in Warsaw, Virginia, utilize these methods based on their unique place and artifact. The lime-concrete floor at the Miller Site requires equal assessment. This chapter outlines the significance of the floor, available methods and options for conservation, and a definitive suggestion for conservation of the Miller Site.

An inherent tension exists between archaeological conservation and exhibition methods. Some argue that successful exhibition of the Miller Site floor requires its full display and visitor accessibility. This option, however, puts the floor at greater risk of environmental and anthropogenic forces. In contrast, a more conservative approach includes reburying the floor, and relying on signage for interpretation. Backfilling the floor and the surrounding archaeological site certainly limits its accessibility. Arguments to utilize the floor as a visible learning tool or successfully conserve it seem to collide. Exploration of the widest possible range of conservation options for the floor will assist in determining a strategy that blends conservation and exhibition.

Three broad options are explored in this chapter. Each option hones in on either the floor's longevity as a resource, utilizing it as a learning tool, or finding equilibrium between the two. All conservation options recommend interpretive signage to present the story of the site and the individuals who occupied it. Likewise, all three conservation options aim to have the least impact on the surrounding area, while protecting the floor and providing adequate visitor information.

Regardless of how the floor is eventually displayed, there are overarching imperatives for its general conservation. Following the site's excavation in 2009, the greatest amount of deterioration has stemmed from water infiltration, wildlife, and vegetative growth. Controlling these factors prevents further catastrophic damage to the floor in the future. Consequently, a majority of the conservation options suggested for the site emphasize protecting the floor from water damage. Suggestions for all conservation options results in lists of pros and cons to be later weighed by Charles Towne Landing officials.

### **SIGNIFICANCE OF THE MILLER SITE TABBY FLOOR**

Lauren B. Sickles-Taves conducted an intensive survey of surviving tabby buildings and ruins throughout the coastal southeast between 1994-1995 (Figure 17). In documenting 170 structures between Charleston, South Carolina and St. Augustine, Florida, she recorded 150 examples of historic tabby. Historic tabby constitutes structures and buildings constructed before 1870, prior to the introduction of Portland cement. Most of these structures dated from the nineteenth century. Thirty-nine structures date from 1700-1799, of which only one is confidently dated

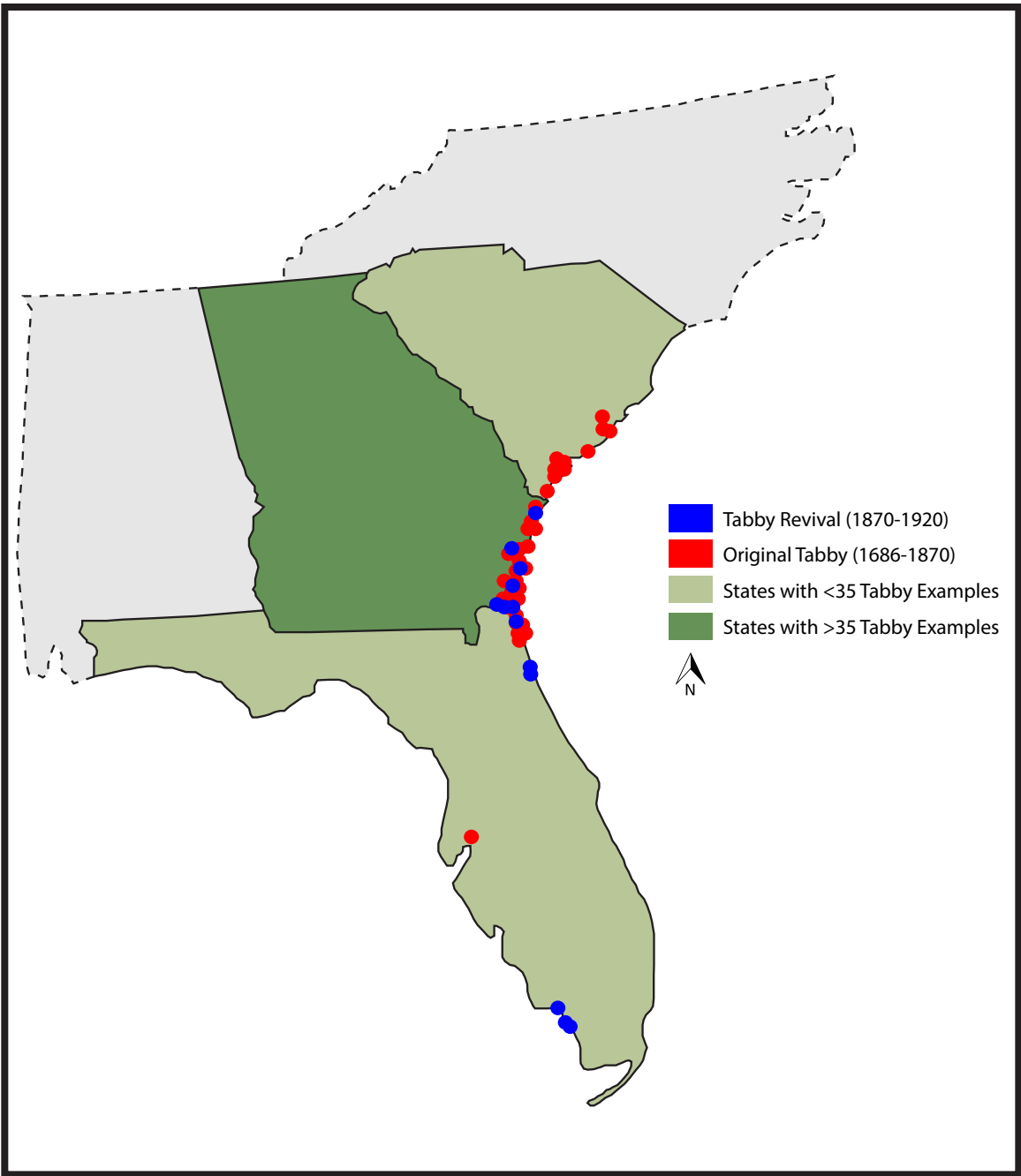


Figure 17. Map Depicting Surveyed Tabby Distribution in the Southeast (Illustration by author).

before 1700. A majority of original tabby structures (thirty-five) are concentrated in Georgia. Sickles-Taves found fewer examples (less than thirty-five) in Florida and South Carolina (Figure 18).

Twenty tabby revival structures were documented in the survey. With the exception of three dating to the twentieth century, all examples of tabby revival date from 1875 to 1896. The most tabby revival buildings are concentrated in Georgia. A smaller number of tabby revival structures are located in Florida. Sickles-Taves however, found none in South Carolina (Figure 19).

Sickles-Taves recorded flooring as the rarest application of tabby. Flooring comprises 1.76% of documented tabby. All examples of tabby floors documented by Sickles-Taves are found in Georgia and Florida. Two of these tabby floors are located on St. Simons Island, Georgia. One floor is located at Fort Frederica (circa 1740) and the other at Cannon's Point (circa 1812).<sup>12</sup> The remaining floor, dated to 1825, is located at Kingsley Plantation on Fort George Island, Florida (Figure 20).<sup>3</sup>

Archaeologists documented tabby kitchen floors at the ruins of both Cannon's Point and Kingsley Plantation. Originally constructed in 1812 as a plantation for sea-island cotton, Cannon's Point consisted of three dwellings with corresponding trash middens. Through his excavations, archaeologist John Solomon Otto compared and

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<sup>1</sup> Taylor P. Davis, "Tabby: The Enduring Building Material of Coastal Georgia" (Masters Thesis, The University of Georgia, 2006) 35.

<sup>2</sup> Harold Bush-Brown, "King's Magazine Remains, Fort Frederica, St. Simons Island, Glynn County, FL," Historic American Buildings Survey Report (HABS No. GA-2162). (Philadelphia, PA: Eastern Office, Division of Design and Construction, National Park Service, 1958) 4.

<sup>3</sup> Charles Fairbanks, "The Kingsley Slave Cabins in Duval County, Florida, 1968," *Conference on Historic Sites Archaeology Papers* (1974) 73.

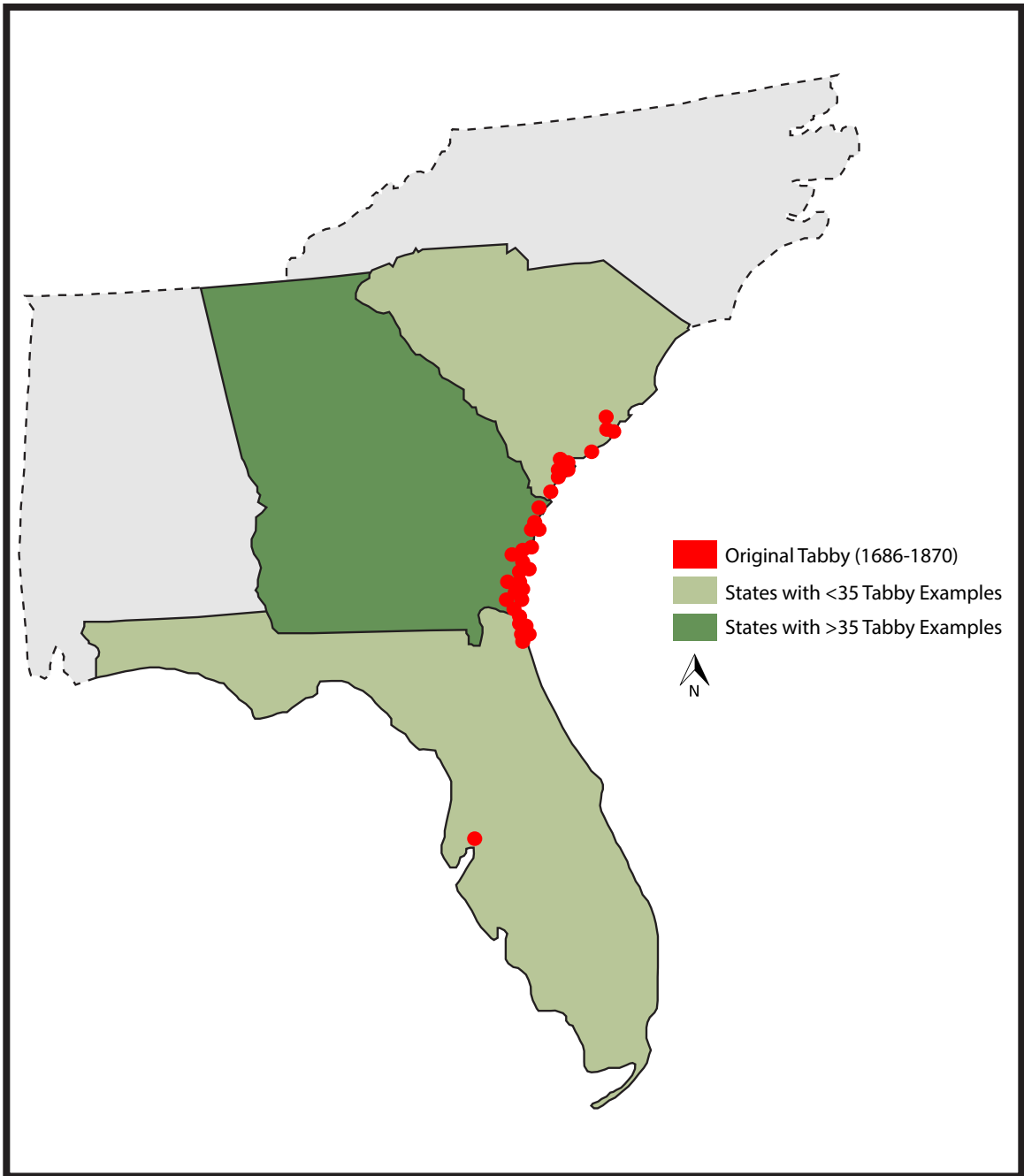


Figure 18. Map Depicting the Distribution of Original Tabby in the Southeast (Illustration by author).

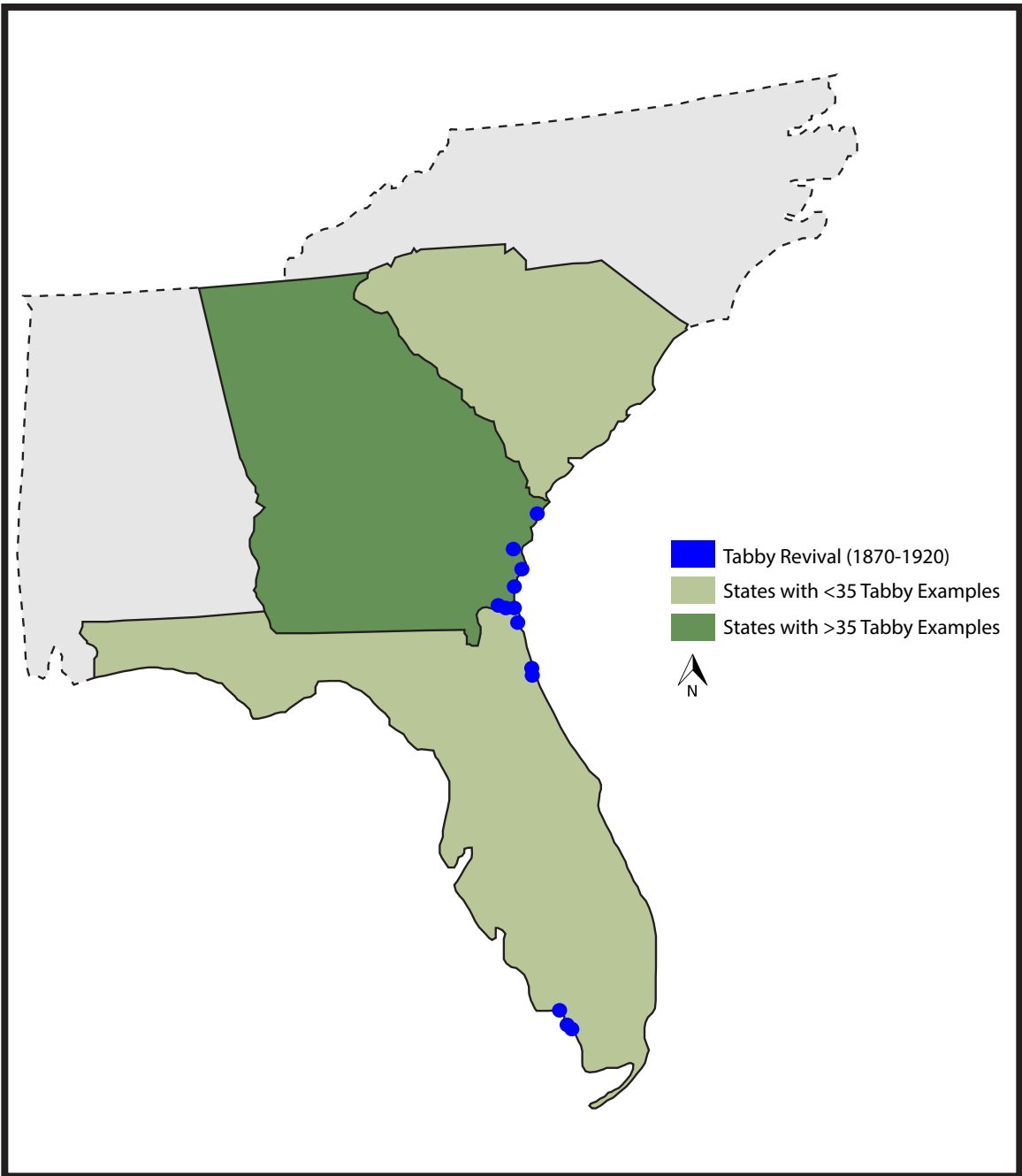


Figure 19. Map Depicting the Distribution of Tabby Revival in the Southeast (Illustration by author).

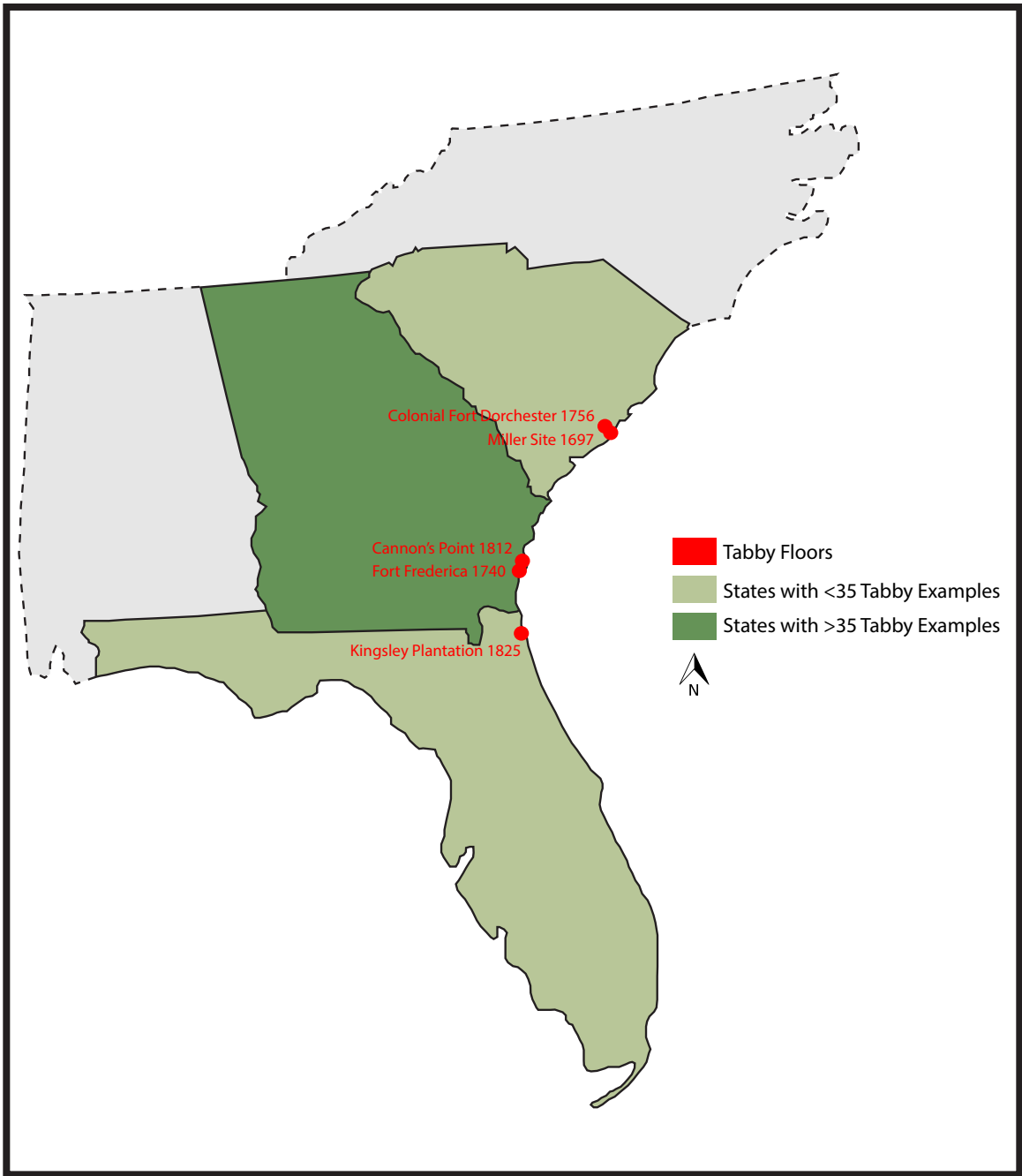


Figure 20. Map Depicting the Distribution of Tabby Floors in the Southeast (Illustration by author).

contrasted the living conditions of slaves, overseers, and planters. As a result, Otto discovered the tabby-brick fireplace in a kitchen at Canon's Point sitting on a tabby and compacted earth floor in 1975.<sup>4</sup>

Among the first archaeologists to study slavery through archaeological research, Charles Fairbanks and his team excavated Kingsley Plantation's two remaining slave cabins and a well in 1968. Fairbanks describes "cabin #1 west" as a two-room structure with a kitchen hearth located in the western room. A tabby floor, "poured 0.2' to 0.3' virtually up to the walls on all sides" paved the western room.<sup>5</sup> In an interview with the *Florida Times Union*, Dan Matterson described the Kingsley Plantation tabby floor as a better insulator than wood, insect and water resistant, low-cost, and easy to construct.<sup>6</sup>

Unlike the kitchen floors at Cannon's Point and Kingsley Plantation, the floor at Fort Frederica served a military function. A Historic American Building Survey from May of 1958 provides a technical description of the floor. The survey describes the tabby floor in the North room of the King's Magazine at the fort as being four feet five inches below the doorsill, and ten feet below the crown of the vaulted ceiling. This space between the tabby floor and a raised plank floor would have provided a crawl space for ventilation. The tabby floor with crawl space at Fort Frederica is very similar to one of the interpretations of the Miller Site (though it has a much later date).

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<sup>4</sup> The slave village at Canon's Point Plantation, Georgia has been the focus of extensive archaeological investigation which began in the 1970s with John Solomon Otto, "Status Differences and the Archeological Record: A Comparison of Planter, Overseer, and Slave Sites from Cannon's Point Plantation (1794-1861), St. Simons Island, Georgia" (Ann Arbor, MI: Xerox University Microfilms, 1975), 118-132.

<sup>5</sup> Fairbanks, *The Kingsley Slave Cabins*, 73.

<sup>6</sup> Colleen Steffen, "Crumbling Past," *The Florida Times Union*, February 6, 2000.



Sickles-Taves does not include the tabby floor at Fort Dorchester in Summerville, South Carolina (circa 1756) in her survey. It is possible Sickles-Taves overlooked the floor at Fort Dorchester during her survey because Stanley South and Leland Ferguson discovered and documented it nearly twenty-one years earlier. The Institute of Archaeology and Anthropology at the University of South Carolina led the project. During preliminary excavations, South and Ferguson uncovered the tabby floor in the east and south interior areas of Fort Dorchester in the spring of 1972. The report states that “at a depth of 1.0 to 1.5 feet below the surface, a thin tabby paved floor averaging 1/4 to 1/2 inch in thickness was found in all of the units.”<sup>7</sup> Portions of the tabby floor were uncovered in all six, ten foot square units, along the interior of the Fort’s east wall. When the floors were discovered, with similar characteristics to the surrounding fortification walls, South and Ferguson extrapolated that they were made of the same basic material and therefore labeled as tabby. The report further describes the floor as being thin, fragile, and damaged. South and Ferguson deduce these remnants of living or working quarters were destroyed and then covered during the American Revolution. South and Ferguson never tested for physical characteristics of the floor at Fort Dorchester and reburied at the conclusion of their excavation.

## **CARIBBEAN INFLUENCES**

Archaeologist James Delle report’s plaster floors, similar in composition to tabby, occurring in the Caribbean. Two methods of plaster flooring seen throughout Jamaica were employed in kitchen houses, outbuildings and some slave quarters. To

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<sup>7</sup> Richard Carrillo, “Preliminary Archeological Investigations at Fort Dorchester (38DR4),” *Research Manuscript Series* (April 1, 1973), 21.

create stronger floors, Jamaicans discovered the benefits of using clay as an additive and cobbled stone as a foundation. Although these floors were fairly common, neither was as popular as packed earth or wood planks.

The first type of plaster flooring involves laying a base of cobblestones and then packing plaster, or marl (limestone powder) on top to create a level, and easy to sweep surface. James Delle found examples of these floors at Seville Heritage Park, a cultural site in Jamaica. The site once contained a prehistoric indigenous village, a sixteenth century Spanish settlement, and a British sugar plantation. Plaster floors found at Seville are attributed to the structures that comprised the plantation's earliest slave village in the 1690s.<sup>8</sup>

Brought from India to supplement the absence of enslaved Africans, wage laborers occupied Seville during the 1840s. James Delle and his team discovered an Indian laborer household within the old African settlement through archaeology. Found on top of the ruins of an earlier structure, the Indian laborer's house was twice the size and implemented different materials. Described as pink mortar, the floor of the house is another variant of plaster-based flooring.<sup>9</sup> This type employed a higher density plaster mixed with bauxite, a local red clay. Believed to create a stronger and denser floor, the clay produced a reddish hue in the final product. The addition of red coloring agents in newly poured Portland cement based floors reflects this traditional method.<sup>10</sup>

While neither example from Jamaica is exactly like the floor at the Miller Site, knowledge of the cobble-based plaster flooring could be a source for the subsequent appearance of similar floors in the colony of Carolina. Due to the Southeast's lack of

<sup>8</sup> James A. Delle, *Out of Many, One People: The Historical Archaeology of Colonial Jamaica*, 1st Edition (University of Alabama Press, 2011) 84.

<sup>9</sup> Delle, *Out of Many*, 94.

<sup>10</sup> James Delle, e-mail communication to author, January 29, 2014.

naturally occurring stone, it would have been difficult to gather materials for a cobble and plaster floor. Therefore, pouring plaster or tabby on packed earth would have been the only remaining option.

The Miller Site floor at present is the only exposed tabby floor in the state of South Carolina. One of the lasting remnants of Charleston's first English settlement, the lime-concrete floor is the only known seventeenth-century floor in the Southeast. While the floor is rare, its uniqueness is not a sole measure of its significance. Research has revealed that the floor at the Miller Site fits into the broader pattern of augmented earthen flooring in the colonies. These material variations resulted in utilizing packed earth, clay, lime, mortar, and tabby. Similar to the exchange of slaves and goods like coffee, tea, cacao, tobacco, and sugar across the Atlantic Basin, cultural links encouraged the transfer of constructions methods as well. Possible connections to earthen floors in West Africa, England, and the Caribbean, can glean insight on the adaptability of tabby floors and their derivatives, based on the needs of the builder and the materials available.

### **THREATS TO TABBY CONSTRUCTION**

The material properties of tabby make it highly susceptible to many environmental factors. Vegetation, wildlife, and water all play substantial roles in the structural stability of tabby construction. The humid subtropical climate of coastal South Carolina provides an ideal environment for biological growth and the germination of plants in the floor's preexisting cracks. Prolonged months of warmer weather accommodate habitats for burrowing animals such as chipmunks, raccoons, moles, woodrats, voles, and armadillos. A combination of these factors present a considerable challenge for conservators and park employees.

Unlike most masonry assemblies that are highly susceptible to the destructive abilities of salt water, efflorescence does not affect tabby. Due to its close proximity to water, incredible porosity of the material, and the humid climate of the area, tabby construction naturally undergoes a cycle of absorption and evaporation. This cycle poses no immediate threat to tabby's structural integrity. However, problems arise when excessive amounts of water impede the structure's ability to dry.

Standing water is especially problematic in plaster or stucco coated features such as walls and foundations. Examples of harmful water infiltration include: seeping rainwater through exterior cracks, rising damp, and condensation. In all of these signs of deterioration, the physical and chemical bonds between the tabby ingredients are put at risk. When the bonds between aggregates are compromised the structural integrity is also put in jeopardy. The presence of excessive water and inevitable bond damage will cause stucco to delaminate, therefore causing further water absorption and damage deeper within the structure.<sup>11</sup>

The effects of animals and vegetation on tabby construction can cause the most catastrophic damage. Growing plant and tree root systems can span large areas, causing cracks and upheaval. Throughout the site's most recent excavation, trees with established root systems were found growing in the middle of the floor. Underground bioturbation, or the reworking of soils by plants or animals, creates tunnels, similar to those formed by roots, causing sinkholes and points of failure in the floor above. Due to the site's age and long exposure to the elements over time, the Miller Site floor has experienced degradation in both forms.

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<sup>11</sup> Lauren B. Sickels-Taves and Michael S. Sheehan, *The Lost Art of Tabby Redefined* (Southfield, MI: Architectural Conservation Press, 1999) 131.

## METHODS OF TABBY CONSERVATION

Very little has been published on tabby floor conservation. Though the information is limited, an array of conservation options exist. These options include water mitigation, patching, rehabilitation, and consolidation. Addressing water mitigation is the most important step in impeding structural tabby decay. Simple waterproofing of tabby construction, whether by means of stucco or linseed oil coatings, can be the simplest and most effective forms of remediation.<sup>12</sup> Historically, earthen floors were waterproofed and thereby preserved because they were located inside of a structure. Installing a roof or shelter over exposed tabby can therefore mimic the historic precedent and eliminate the direct effects of rainwater. Other means of water mitigation can be addressed by resolving improper drainage issues at a site. Leveling the ground, and introducing a means of egress for storm water, can provide an easy solution for waterproofing with little to no effect on the floor.

In assessing the condition of tabby, areas of loss act as additional infiltration points for water. As long as proper measures are taken, patching areas of missing tabby is an effective repair option. Newly applied tabby should match as closely as possible in terms of color, texture, and porosity to the original material. After repairs have been made and problem areas addressed, maintenance plans are the best way to schedule preventative measures therefore reducing future repair costs.

Traditionally, when tabby floors began to show wear, large scale “patching” took place. This method employed leveling the worn floor by adding a new layer or “pour” of tabby overtop the old. The new layer then followed the same techniques of tamping and coating with linseed oil in order to give it a smooth, hard finish. While

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<sup>12</sup> Lauren B. Sickels-Taves, “Understanding Historic Tabby Structures: Their History, Preservation, and Repair,” *APT Bulletin* 28, no. 2–3 (1997): 22–29.

this method would be beneficial in rehabilitating the tabby floor; preservation standards set by the Secretary of the Interior require all that projects be reversible.<sup>13</sup> Conserving the tabby floor at the Miller site should instead take on a more “preservation” approach, protecting it in its current state from further damage. In short, repairing the floor is not an option as it implies the floor’s restoration. Restoring the floor would destroy the historic material and is therefore not considered a method of conservation.

Another available conservation option not considered for the Miller Site is consolidation. Used by conservationists since the 1960s and 1970s, consolidation is the reestablishment of grain-to-grain cohesion in a material through chemical additives. As of 2011, the Getty Conservation Institute has been reevaluating the performance and risks of consolidants such as ethyl silicate on earthen materials. Though popular, the treatment is still not fully understood.<sup>14</sup> For now, the usage of ethyl silicate is reserved for decorated earthen surfaces.<sup>15</sup> Further research is required to determine how factors such as earthen material composition and condition, consolidant composition, application methodology, and environmental conditions can affect the performance of ethyl silicate. The unknown risks of applying a consolidant to the tabby floor are too high for its recommendation.

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<sup>13</sup> United States Department of the Interior and the National Park Service. “The Secretary of the Interior’s Standards for the Treatment of Historic Properties.” Nps.gov. <http://www.nps.gov/history/hps/tps/standguide/index.htm> (accessed March 4, 2014).

<sup>14</sup> The Getty Conservation Institute. “Earthen Architecture Initiative: Assessment of Ethyl Silicate Consolidants for Earthen Finishes.” Getty.edu. [http://www.getty.edu/conservation/our\\_projects/field\\_projects/earthen/earthen\\_component4.html](http://www.getty.edu/conservation/our_projects/field_projects/earthen/earthen_component4.html) (accessed March 4, 2014).

<sup>15</sup> Leslie Rainer and The Getty Conservation Institute, “Conservation of Decorated Earthen Surfaces,” in *Terra Literature Review: An Overview of Research in Earthen Architecture* (J. Paul Getty Trust, 2008), 124.

Once conservative plans for the tabby floor and the Miller Site are set in place, a public outreach and exhibition plan can be developed. The site's current interaction with the park's other attractions is at the bare minimum. Set off the park's preexisting path and outside of the reconstructed palisade, visiting the site currently requires a conscious effort and offers no signage explaining the ongoing work. Visitors who stumble upon the site often leave with unanswered questions and a missed opportunity to learn about one of Charles Towne Landing's earliest architectural artifacts. The conservation plan for the site should include interactive signage, displaying the location of the excavation and its relation to the rest of the settlement. A new attraction will allow for visitors and scholars to see the historic floor and provides the opportunity for demonstrating tabby construction through historic techniques.

## **METHODS OF ARCHAEOLOGICAL SITE CONSERVATION**

The preservation of archaeological sites has attracted academic discussion for decades. The Archaeological Institute of America and The Getty Conservation Institute have taken the lead in developing strategies for saving national heritage through the conservation of art, architecture, and archaeology. These institutions sponsor research specifically for the preservation and conservation of archaeological sites worldwide.

In recent years, archaeological sites have become one of the biggest attractions for tourists traveling abroad. With the number of individuals visiting archaeological sites increasing every year, the negative impacts on the site become significantly higher, with some having to close as a result.<sup>16</sup>

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<sup>16</sup> Guide to Best Practices for Archaeological Tourism [Manual]. (2013). Boston, MA: American Institute of Archaeologists, ARCHAEOLOGY, American Travel Trade Association, 1.

A successful archaeological site must have an adequate maintenance plan to match the increase in revenue value. Maintenance plans assure that a site will be protected for the future by mandating conditions assessments, landscape care, and documentation. Inherently fragile archaeological sites must be treated with consideration to avoid possible destruction of their historic and economic potential.<sup>17</sup>

In April 2013, The Archaeological Institute of America (AIA) in conjunction with the Adventure Travel Trade Association (ATTA), and *ARCHAEOLOGY* magazine, developed a manual for archaeological site managers and tour operators. This comprehensive guideline sets the standard for ‘best’ practices and provides an outline for “proper, sustainable archaeological tourism.” The manual defines archaeological tourism, and the key concepts, dangers, and necessities behind it. Recommendations for the managing of archaeological sites are broken down to be utilized by site managers, tour operators, tour guides, and tourists.

Archaeological tourism is necessary because it inspires interest in the field of archaeology, creates revenue for an area, draws awareness to a “place”, and therefore provides community development. Archaeological sites provide a means of adventure to what is usually inaccessible by non-scientists. When people visit archaeological sites, they draw revenue not just to the site and its owners, but in return, they support local businesses and provide jobs to the community. New and exciting archaeological sites can also act in drawing attention to otherwise unknown communities. This heightened awareness can result in an increase of community development. Identifying with an archaeological site encourages the local population to invest in its maintenance when they directly benefit from it.<sup>18</sup>

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<sup>17</sup> *Guide to Best Practices for Archaeological Tourism*, 1.

<sup>18</sup> *Guide to Best Practices for Archaeological Tourism*, 2.



The “Guide to Best Practices for Archaeological Tourism” manual suggests there are three main concepts to remember when interacting with an archaeological site. The first concept reminds individuals that all archaeological sites are unique, irreplaceable, fragile, and non-renewable resources. Meaning, any damage done to a site, whether by fault or accident, is permanent. Potential loss of an archaeological site is equally as important as the loss of the artifacts removed from it. When the context of material culture disappears, the information gleaned from it is invalid. Damage to an archaeological site is the main concern when considering it as a tourist attraction. Similarly, improper maintenance of a site by its managers can cause equally as harmful and unnecessary damage. Consequently, site managers should work to preserve and protect the site while providing adequate information and infrastructure to support the needs of visitors.<sup>19</sup>

The second concept introduces the idea that archaeological sites and the communities that surround them must intertwine. Sustainable tourism means the respect of rights, values, and ideas of a local population. Taking into account the impact on the local environment, the success of an archaeological site is directly linked to what the community will allow. Community involvement in a site’s tourism guidelines can assure that each entity benefits from the situation. A community has the capability to support an archaeological site both financially and with volunteers. The preservation of a site becomes marginally easier when there is local investment.<sup>20</sup>

Finally, the AIA and ATTA remind archaeological site managers and visitors that it is unlawful and unethical to remove or destroy any cultural material. The law protects archaeological sites from looting of cultural and natural material. Further, the sale of any cultural material is also illegal. Aside from the legal aspects of site and

<sup>19</sup> *Guide to Best Practices for Archaeological Tourism*, 2.

<sup>20</sup> *Ibid*, 2.

artifact removal, looting can compromise and destroy a site's informational integrity. An archaeological site's management and security must be prioritized to deter vandalism and looting. It is the duty of site managers and tour operators to monitor visitors and themselves.<sup>21</sup>

The Miller Site does not currently employ an ongoing maintenance or monitoring plan. Left generally unattended, the floor is susceptible to both vandalism and looting. Adequate management of the site and its artifacts will help preserve it for the future. The park does however, utilize community involvement through volunteers who aid in excavation and artifact processing. These relationships encourage sustainability of the park and its revenue.

## **METHODS OF EARTHEN ARCHAEOLOGICAL SITE CONSERVATION**

In 2008, the Getty Conservation Institute held the 10<sup>th</sup> International Conference on the Conservation of Earthen Architecture in Mali. Published as a result, a literature review focuses on understanding earthen building materials, and the assessment and conservation of earthen architecture. In a paper from the conference, Anne Oliver, architectural conservator, and conservator with the National Park Service, specifically discusses the conservation of earthen archaeological sites. While tabby is not directly considered a form of earthen architecture, the conservation issues are similar. Both tabby and earthen architecture are historic forms of construction comprised of naturally occurring organic substances. These methods of archaeological site conservation, and all suggestions for conservation of the Miller Site, derive from her findings.

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<sup>21</sup> *Guide to Best Practices for Archaeological Tourism*, 3.

There are four main treatment options for the floor at the Miller Site. Oliver's suggestions include: provide no intervention other than monitoring and evaluating, construct a temporary or permanent shelter, backfill and stabilize the site, or remove and relocate the floor. Each method has positive and negative aspects to be weighed by park officials based on time, cost, and long-term effects. One option not considered for the Miller Site floor is reconstruction. Reconstruction of the floor would negate its historical importance and draw fewer tourists. If it is the desire of the park to educate visitors on the construction process, it is recommended that a new tabby floor be created elsewhere on the property following historic techniques.

Oliver argues that as vulnerable as archaeological sites are, when combined with earthen architecture, the possibility of deterioration increases drastically. The employment of roofs, drainage systems, foundations, and maintenance of protective coatings make earthen structures practical. However, archaeological sites with incorporated earthen architectural features usually lack these necessities. Restoration and maintenance of these structural aspects is often considered inappropriate and unpractical. As with the floor at the Miller Site, pouring a new layer of tabby would add much needed support but would destroy the floor's integrity as a historic artifact. Oliver's arguments help support a theory that conservation recommendations for the floor at the Miller Site should be cautious. Reestablishing a roofing system over the floor would eliminate water infiltration and deterioration while simultaneously maintaining historic integrity. Oliver's suggestions for conservation are defined in detail below.<sup>22</sup>

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<sup>22</sup> Anne Oliver and The Getty Conservation Institute, "Conservation of Earthen Archaeological Sites," in *Terra Literature Review: An Overview of Research in Earthen Architecture* (J. Paul Getty Trust, 2008), 85.

### ***No Intervention***

The cost of mitigation often limits the available options of earthen structures and archaeological sites. An unpopular option for sites is no intervention. A stabilized site, lack of funding, or general philosophy can influence a decision for no intervention. Continuous site monitoring and evaluating are the best means to measure the impact of leaving a site unmitigated. Methods for monitoring and evaluating include regular photography, and recorded observations of present conditions.

### ***Installation of Temporary or Permanent Structures***

An extensive amount of literature exists about the covering of earthen structures and archaeological sites with temporary or permanent structures. The most common issues related to the construction of a shelter include: how the structure affects the physical environment that it covers (generally in the retention of water and moisture), and what effects the structure has on the surrounding area that is unprotected by the shelter (water drainage and anchoring systems). Other factors regarding the use of shelters are: the effects of the shelter on the surrounding area aesthetically, the cost of the shelter and its maintenance, and the required degree at which the shelter separates the site from the visitor.<sup>23</sup>

Over the years, four main shelter types have evolved for the purpose of covering archaeological sites. Shelter designs vary in style based on the location of the site and its surrounding climate, culture, and type of archaeological resource. The first shelter is purely functional and simple, ignoring any artistic or architectural value of the site. These shelters usually begin as temporary and become permanent over time. A second type of shelter is a large, single roof, covering a vast area. In this case,

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<sup>23</sup> Oliver, *Conservation of Earthen Sites*, 85.

the relationship between site and shelter is very limited. Shelter types three and four deal directly with covering areas of artistic value. These shelters tend to meet or go beyond museographic requirements, and create large spaces sculpted to the limits and proportions of the site.<sup>24</sup>

### ***Site Stabilization and Backfilling***

The option of backfilling an archaeological site as a means of preservation is a relatively new idea. Although no direct evidence supports backfilling an archaeological site, it can be assumed backfilling provides long-term stabilization and preservation. Oliver discusses the preferred methods of backfilling and preserving earthen-plasters, a material that mimics the composition of the floor at the Miller Site. The approved materials for affectively backfilling archaeological sites are clean, salt-free sand underneath clean, salt-free, compactible, sandy loam. Other coverings may include rubber membranes or root barriers, to prevent moisture penetration and discourage deep root growth. If the goal is to provide interpretation and visitation to the site, partial burials are also a recommended form of mitigation. Though backfilling is believed to require little maintenance, to gauge the success of the backfill materials, continuous monitoring is required.<sup>25</sup>

### ***Removal and Relocation***

The final method of mitigation for earthen archaeological site conservation is removal and relocation. A majority of a site's history is the combined development and evolution it experiences. However, the dismantling of murals, mosaics, and architectural fragments for global exhibition has been common for centuries.

<sup>24</sup> Oliver, *Conservation of Earthen Sites*, 85.

<sup>25</sup> Oliver, *Conservation of Earthen Sites*, 88.

Acknowledging the value of an artifact's context is a practice gaining deserved recognition. Only as a last resort should the removal of earthen architecture be considered.<sup>26</sup>

Anne Oliver's thorough investigation of earthen archaeological sites covers the array of options available when looking to conserve and interpret them. Though Oliver does not directly refer to tabby architecture or threats specific to the coastal southeastern United States, her recommendations can be adapted for the purpose of the floor at the Miller Site.

### **PRECEDENT FOR SHELTERS: CASA GRANDE AND MENOKIN**

Throughout Europe, the custom of covering an archaeological site with a shelter is a common practice. Places such as the 9,000 year-old Neolithic site Çatalhöyük, in modern Turkey, and the several thousand-year-old Roman remains outside of Chur, Switzerland, employ grand architectural designs attached to famous names. Considering archaeological sites in the United States are marginally younger, the demand for expensive, large-scale projects is rare. Two examples of archaeological sites and ruins utilizing shelters in the United States are Casa Grande, in Coolidge, Arizona, and Menokin, the house of Francis Lightfoot Lee, near Warsaw, Virginia. Used at both Casa Grande and Menokin, temporary and permanent shelters aim to conserve informational integrity and inspire continued research.

#### ***Casa Grande***

Casa Grande, a village constructed by the ancient Sonoran desert people in 1350 along the Gila River, contains a great house, ball court, and community plaza.

The village follows the trend of the Classic period beginning around 1175, identi-

<sup>26</sup> Oliver, *Conservation of Earthen Sites*, 89.

fied by rejection of numerous small villages in favor of fewer, larger, walled-in compounds. The original structures within Casa Grande are constructed primarily of caliche, a naturally occurring sedimentary rock, and modern twenty-first century adobe buildings. In 1355, catastrophic floods began to plague the area, threatening the irrigation-based society. As a result, the settlement at Casa Grande was completely abandoned by 1450.<sup>27</sup>

Designated as the first prehistoric and natural reserve by President Benjamin Harrison on June 22, 1892, Casa Grande has utilized shelters as a means of conservation almost since its conception. The first shelter over the Great House of Casa Grande was erected in 1903 at a cost of \$1,975 (Figure 21). Built of simple materials, the roof employed redwood timbers, a painted corrugated metal roof, and provided a six-foot overhang over the ruins.<sup>28</sup> At this time, the main purpose of the roof was to protect the ruin from rain and provide a sheltered area for archaeological investigations.

Designated as a national monument in 1918, the ruin's original roof needed replacing by the 1920s. Designed by Frederick Law Olmstead Jr. and completed in 1932, the new shelter roof cost \$27,724 (Figure 22). The roof consists of leaning beams under a metal-hipped roof, glass skylights, and copper louvers to reduce upward wind pressure. Since its initial construction, the roof has required little maintenance. Currently, the only required maintenance for the roof includes repainting it every fifteen to twenty years, with the most recent coat being applied in 2003 at a cost of over \$100,000.

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<sup>27</sup> A. Berle Clemensen, *Casa Grande Ruins National Monument, Arizona: A Centennial History of the First Prehistoric Reserve 1892 – 1992*. (Washington, D.C.: United States Department of the Interior and the National Park Service, 1992) Chapter I, (accessed March 2, 2014) [http://www.nps.gov/history/history/online\\_books/cagr/index.htm](http://www.nps.gov/history/history/online_books/cagr/index.htm).

<sup>28</sup> Clemensen, *Casa Grande Ruins*, Chapter III.



*Figure 21. Image Showing the Original Shelter over Casa Grande circa 1903 (National Park Service, [www.nps.gov](http://www.nps.gov)).*



*Figure 22. Image Showing the Current Shelter over Casa Grande circa 1932 (National Park Service, [www.nps.gov](http://www.nps.gov)).*



Though the cost of repainting the roof at Casa Grande is high, adaptations of coverings like it might be appropriate at the Miller Site. Rather than high quality, desert-grade paint, cost effective asphalt singles could be used in its place. Similarly, a proposed shelter could forgo skylights, and copper louvers in favor of a simple wood-trussed design. In this way, an overall lower budget is achievable by eliminating unnecessary attributes and reducing the project's scale. Replacing a shelter roof every fifteen to thirty years would be a small price to pay for conserving a vestige of South Carolina history.

### ***Menokin***

In 1769, John Tayloe II built a large Georgian house as a gift for the marriage of Francis Lightfoot Lee to his daughter Rebecca. Tayloe, owner of the neighboring plantation Mount Airy, funded the construction of Menokin and its outbuildings on Cat Point Creek, five miles upstream from the Rappahannock River. A two-story structure, Menokin boasted fine colonial architectural details and impressive interior woodwork. The house passed through the hands of the Tayloe family until the late nineteenth century. By 1923, Menokin fell into serious disrepair.

The Historic American Building Survey documented the house in 1940, when a majority of Menokin was still standing. However, with continued deferred maintenance, the house threatened to collapse in 1964, when the then current owner removed the interior woodwork for safekeeping. Relocating the interior woodwork eliminated the risk of degradation in the hope that the house might one day be conserved and restored. In 1971, the United States Department of the Interior designat-



*Figure 23. Image Showing the Shelter over Menokin circa 2000 (Menokin Foundation).*

ed Menokin a National Historic Landmark, though its condition continued to decline rapidly. The ruins of the house however, did not begin their path towards preservation until the acquisition of the property by the Menokin Foundation in 1995.<sup>29</sup>

The Menokin Foundation began work on a long-term plan for the ruins and the grounds immediately. The Foundation aimed to provide the property with infrastructure in the form of roads, water, electricity, and telephone lines. Completed in 1996, this task also included the construction of buildings to house an office and gatekeeper's quarters. Other goals for Menokin were the stabilization of the building's remains to prevent further damage, and the decision to install a detached shelter that would cover and protect the entirety of the building. Workers completed the shelter over Menokin in 2000 at a cost of \$200,000 (Figure 23).<sup>30</sup>

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<sup>29</sup> The Menokin Foundation. "History of Menokin." Menokin.org. <http://www.menokin.org/history.htm> (accessed March 2, 2014).

<sup>30</sup> Martin King, "President's Report," *Menokin Afield*, Winter 2001, page 1.

The Washington, D.C. architectural firm Quinn-Evans, designed a steel roofed and trussed shelter for Menokin. The shelter protects the ruins from direct contact with the elements therefore preserving the original stone, brick masonry and wooden structural framework. The Menokin Foundation deemed the shelter “medium-term” while a long-term plan of action was drafted allowing the exhibition and conservation of the house.<sup>31</sup>

The Menokin Project was started in early 2012. The project’s goal is to preserve what remains of the house while displaying its assembly. Plans included reconstructing the missing portions of Menokin with glass in order to transform the house into a teaching tool for historic construction techniques and conservation methods. With the Menokin Project still early in the planning process, the steel roof remains in place currently in 2014.

While the Miller Site is a much smaller-scale project, Casa Grande and Menokin offer examples of well-executed, permanent and temporary conservation shelters. A shelter over the Miller Site, no matter how simple, in conjunction with a maintenance plan, could offer long-term preservation of the lime-concrete floor.

## **MILLER SITE CONSERVATION AND EXHIBITION RECOMMENDATIONS**

In developing a course of action for the floor at the Miller Site, the issues of conservation and exhibition must be explored in tandem. Displaying the floor to its fullest capacity requires the site be open for public view and interpretation but also exposed to the elements. Without a mechanism to mitigate effects of environmental deterioration, the floor of the Miller Site becomes sacrificial. In contrast, the best method for conserving the floor would be to completely back-fill the site. This option,

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<sup>31</sup> Edward Chappell, “The New Shelter,” *Menokin Afield*, Winter 2001, page 1.

however, does not allow for much display, and precludes interaction between the site and the visitors to Charles Towne Landing except through photographs or electronic presentation. The source of tension that neither conservation, nor exhibition, could be fully executed without sacrificing the other is a result of these scenarios. Consequently, three options for the tabby floor were developed. All of the conservation options suggested for the Miller Site deal with the floor and its surrounding archaeological site. Each suggestion follows a varying path towards conservation and derives from methods studied by Anne Oliver.

The Archaeological Institute of America, and Anne Oliver from the National Park Service, discuss concerns and threats that all conservation scenarios must address. First, whether the floor is completely exposed or fully covered, water abatement and protection from the elements remain the most important issues. Second, a long-term maintenance plan should be created for the continued preventative safeguarding of the site. Small actions, such as monitoring the site for sprouting plants, mildew, and burrowing animals would save the park from unnecessary costs and stop degradation at an early stage before crisis. Finally, anytime back filling is an option, it is recommended that rubber matting, or a similar root deterrent be laid over the floor before recovering it with soil. This method will help prevent further damage from vegetation roots and discourage bioturbation.

### ***Option One: Focus on Interpretation***

The first conservation option for the tabby floor at the Miller Site is to leave it completely exposed. By keeping it visible, this option utilizes the historic resource as an interpretive tool for the public. The tabby floor would remain uncovered with interpretive signage, while the surrounding archaeological site is back-filled to elimi-

nating safety concerns and create an even viewing surface. A full-coverage shelter should be constructed for protection and water abatement while also blocking physical contact between visitors and the floor. Signs directing visitors to the nature trail, and therefore the Miller Site, should be installed around the park, and park maps adjusted to include the site. Interpretive signage should be available under the shelter, showcasing the Miller Site history, site plans, artifact photos, and renderings of the excavated structure.

This option protects the floor from the elements, and provides full viewing accessibility. Putting the floor on full display also has the ability to draw additional visitors. A majority of the current attractions at Charles Towne Landing are reconstructions of historic structures discovered through research. The uncovered tabby floor would become the first visible real colonial structural artifact. The floor would thus attract more attention and earn more revenue. Leaving the floor visible to both visitors and scholars will further the knowledge of tabby's existence in the Southeast and its variability. Creating interest in the floor will result in encouraging research, and the conservation of tabby structures elsewhere. The floor should be interpreted explaining how it fits into the broader realm of augmented earthen flooring and how it compares to tabby construction.

A full coverage shelter should be employed for both water abatement and to limit access to the floor by visitors if this option is chosen. Both Sickles-Taves and Oliver argue that excessive amounts of water at the site and on the floor can lead to the disintegration of the tabby's binder. As acidic rain absorbs into the floor, the bonds between the lime and the aggregate are dissolved. Water infiltration at the site will also cause cracking from freeze-thaw, and the growth of vegetation. Protecting the floor from the elements with a similarly sized roof, would allow visitors to visu-



*Figure 24. Image Showing the Precedent for Shelters at Charles Towne Landing (Photograph by author).*

alize how a structure of the same dimensions might have occupied the site in the seventeenth century. The precedent for shelters at Charles Towne Landing was previously set when a similar permanent archaeology exhibit was established within the palisade walls (Figure 24). The current exhibit fully covers a faux archaeology site, provides adequate shade and protection for visitors, and offers explanatory signage. This shelter requires minimal maintenance. Maintenance would include any necessary repairs to the structure, raking, and cleaning of debris. The current sheltered exhibit is geared more towards the explanation of archaeological methods and is not an actual open and active site. A simple shelter, similar in size and adapted from examples at the park and Casa Grande would cost the park relatively little but assure a large degree of conservation.

This interpretive option offers the highest level of interpretation and visitor interaction but also has the highest risks. While this option would be beneficial if interpretation were the only goal, the rarity of the floor requires a plan geared

more towards conservation. Other negative aspects of this option include cost, required maintenance, and risk of damage. Due in part to the climate of the southeastern coast, the floor would suffer largely from driving rain, as well as anthropogenic effects. According to the National Weather Service, Charleston County receives approximately forty-five inches of rain per year on average. Without question, some of this precipitation would find its way to the floor. While this interpretive based option is viable, it is not worth the risk of irreversible damage.

Placing a shelter over the floor, yet leaving it exposed to the atmosphere, raises the risk of damage from anthropogenic forces. Vandalism has long been an issue at historic sites as visitors hope to leave a mark on the historic remnants they are viewing.<sup>32</sup> Though not generally through acts of malice, some visitors, fascinated by historic archaeological sites, desire to bring “mementos” home. Damages of this kind, defined by federal law for federal sites is considered looting, and jeopardizes a site’s historic integrity. Once threatened, a site risks being closed to the public completely. The threat of vandalism at the Miller Site would require constant monitoring.

Required maintenance for the Miller Site would be demanding and labor intensive. Vegetation control, in the form of weeding, trimming, and cleaning, should be performed to keep new growth off the floor and removed from the site. Further landscape care in the form of clearing the trail that leads to the Miller Site would benefit visitor and maintenance traffic. To limit upheaval from underground roots, and discourage the habitation of burrowing and tunneling pests, invasive, deep-growth

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<sup>32</sup> *Guide to Best Practices for Archaeological Tourism* [Manual]. (2013). Boston, MA: American Institute of Archaeologists, ARCHAEOLOGY, American Travel Trade Association, 3.

vegetation should be removed. General maintenance would also include raking, the collection of garbage, and security. Required man-hours for maintenance should be considered when determining a conservation option.

### ***Option Two: Focus on Conservation***

The second option for conservation at the Miller Site has the opposite approach and suggests the floor be completely backfilled and recovered. Focusing entirely on the conservation of the floor, this option gives less consideration to viewing the actual floor. This option is the most fiscally responsible for the park and requires the least amount of continued maintenance. The method of option two is to rebury the floor, thereby allowing it to be protected from the elements above. Backfilling archaeological sites is a common practice that returns the site to something approaching its condition before the excavation therefore conserving and maintaining the site to be studied in the future. It is possible the floor might continue to deteriorate after being backfilled. The process however would be slowed and water infiltration managed through absorption by the above soil and grasses.

It is suggested the floor be backfilled as per the guidelines compiled by Anne Oliver. After cleaning the floor of vegetation and debris, it should first be covered in a layer of clean, salt free sand. Following the sand, a layer of clean, salt-free, compactible loam should be spread. Next, a root barrier either in the form of drainage fabric, rubber matting, or other similar product, should be laid before the introduction of top soil and naturally occurring shallow rooted vegetation such as grass. Without the necessity for a shelter at the site, Charles Towne Landing could direct remaining project funds towards interpretive signage and boundary demarcations for the floor's location.



Interpretation of the site through this option is flexible. Following the National Park Service suggestions for the documentation of boundary demarcations on a landscape, the extents of the tabby floor should be marked by a fence, wall, or change in vegetation.<sup>33</sup> If a wall is to be erected, constructing it of modern tabby is a beneficial way to provide a visible example of the material. Other options for demarcating the site should follow any precedent previously set by the park.

Signage for this option follows a similar plan as option one. Signs directing visitors to the nature trail, and therefore the Miller Site, should be installed around the park, and park maps adjusted to include the site. Interpretive signs placed near the demarcation of the site would focus on the tabby floor unable to be seen by visitors. Other aspects of the interpretive signage include a site plan for context, artifact photos, and history.

Covering the tabby floor has many conservative benefits. Removing the accessibility of it to visitors through backfilling, will vastly diminish the effects of weathering and discourage anthropogenic harm. Underneath layers of clean, salt-free sand and soil, the floor will be protected and preserved for future study by scholars and conservators. Reburying the floor is also the more cost effective option for South Carolina State Parks. A breakdown of costs for this option includes: materials, interpretation, and less frequently required maintenance. Maintenance for option two is limited to upkeep of the trail leading to the site, controlling unwanted deep-root vegetation, and landscape care.

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<sup>33</sup> United States Department of the Interior. National Park Service. Documentation of Landscape Characteristics. Washington, DC: GPO, 1999. [http://www.nps.gov/history/nr/publications/bulletins/nrb30/nrb30\\_12.htm](http://www.nps.gov/history/nr/publications/bulletins/nrb30/nrb30_12.htm) (accessed March 4, 2014).

The negative aspects of this option are less obvious. The main drawback from covering the tabby floor is not being able to view it. The floor is a rare remnant of seventeenth century flooring techniques, and should be valued as such. Without the option to view and study the floor, it is useless in the development of a richer augmented flooring history. Covering the floor would restrict the park from the possibility of new visitors and impede increased revenue possibilities.

This plan for the tabby floor and the Miller Site is second best. While this option privileges conservation of the floor, the option leaves little aside from signage to attract and draw visitors to the site. Considering the rarity of tabby in the Charleston area, let alone tabby variations as flooring in the Southeast, it would be detrimental to limit accessibility to scholars and visitors. Were the floor to follow a path similar to those found and forgotten at Colonial Fort Dorchester, a piece of Charleston's earliest history could be permanently forgotten.

### ***Option Three: Focus Equally on Interpretation and Conservation***

A third option for conservation of the tabby floor at the Miller Site should be given preference. This option is a compromise, offering a method to interpret and conserve the floor. This method combines a small shelter and interpretive signage, and requires the floor to be three-quarters reburied. By partially back-filling the site, a large majority of the floor is conserved for future study and the development of more successful preservation methods. While covered, the floor is also less susceptible to deterioration from climatic and anthropogenic forces. While the cost for options one and three is similar, the amount of long-term maintenance necessary for this option are less. With less of the overall floor open to the elements, the site would

require less vigorous monitoring. Other aspects of this option include demarcation of floor's extents on the site, and interpretive signage including the history, artifact photos, and site plans.

Re-covering a majority of the floor should not be done haphazardly. First, a portion of the floor to be left uncovered is chosen. This selected part of the floor should reflect the best example of the material. The size of this exposure window can be adjusted to to the park's requirements and should be limited only to flooring in good condition. Exposed flooring that is in good condition will be less likely to degrade over time if treated properly. Once a portion of the floor is chosen for exposure, the remainder of the floor should be re-covered following the same recommended suggestions in option two (see page 76).

In this option, the buried floor's boundaries should be demarcated. Demarcation guidelines should similarly follow the suggestions previously stated for option two and set by the National Parks Service. Demarcation recommendations include the introduction of a fence, wall, or change in vegetation and should limit visitor foot traffic over the floor.

Finally, a small shelter, covering only the exposed portion of the floor, should be employed. This shelter will include a physical barrier between visitors and the floor, and protect it against water infiltration. As argued for option one, excessive amounts of water at the site and on the floor can lead to the disintegration of the tabby's binder, cracking from freeze-thaw, and the growth of vegetation. Any supports for the shelter should avoid the remainder of the tabby floor. Damage to the floor for the purpose of installing a shelter would be counterproductive. If executed correctly, a simple shelter, similar in size and adapted from examples and styles already seen at the park, would be of low cost and high benefit.

The benefits of this option are a combination of those for both options one and two. Covering a majority of the floor, and removing its accessibility to visitors, vastly diminishes the effects of weathering and discourages anthropogenic harm. Underneath layers of clean, salt-free sand and soil, three-quarters of the floor is protected and preserved for future study by scholars and conservators. However, the uncovered portion of the tabby floor becomes the first visible authentic colonial structural artifact, and thus attracts more attention and earns more revenue. Leaving a portion of the floor visible to both visitors and scholars aids in furthering the knowledge of tabby's existence in the Southeast and its varying abilities.

Negative aspects for this option are minimal, and follow those described previously. Leaving any amount of the floor exposed requires a higher amount of maintenance and monitoring, and puts the floor at a higher risk for damage. Precipitation, vandalism, wildlife, and vegetation would all pose as threats for the floor's exposed portion. Due to these dangers, maintenance and monitoring would require a more vigilant eye, but on a much smaller scale than option one. A maintenance plan for this option includes upkeep of the trail leading to the site, controlling unwanted deep-root vegetation, landscape care, and the accompanied cost of labor.

This option, which combines all the benefits from both the conservation and interpretation geared alternatives, is the recommended plan of action for the Miller Site. At a median cost, this option allows the accessibility necessary to attract visitors off the preexisting path of Charles Towne Landing, while still protecting the floor as an irreplaceable asset. By leaving the floor partially exposed, tabby awareness is encouraged through research and public outreach. As a result, the promotion of the Miller Site and its active conservation will benefit the Southeast's collection of tabby in its entirety.

## CHAPTER IV

### CONCLUSIONS

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The successful exhibition of archaeological sites depends on a clear understanding of its history, composition, significance, and threat. Analyzed and weighed, these factors establish a suggested level of conservation needed to maintain future stability. Following this outline, this thesis developed a conservation plan for the floor found at the Miller Archaeological Site. Located on Oldtown Creek at Charles Towne Landing, the Miller Site is rich with seventeenth-century history attributed to South Carolina's first English settlement.

Dated to between 1694-1697, the floor at the Miller Site is a lasting architectural remnant of the LeSade family occupation at Charles Towne. After colonists relocated the settlement of Charles Towne across the Ashley River in 1680, the LeSades purchased the property with the intention of establishing a plantation. The floor, a brick hearth, two brick piers, and artifacts are all that remain of the LeSade homestead. Discovered by amateur archaeologist Johnny Miller in 1968, the floor was completely uncovered in 2009 and the site remains actively excavated to this day.

Labeled as tabby since its discovery, the floors' composition calls into question its classification. Tabby by definition is a ratio of equal parts lime, sand, and water, with shell and shell fragments used as aggregate for strength. The Miller Site floor however, employs no whole shell. Instead it is similar to a rough bedding mortar used commonly in masonry construction. It is possible the floor derives from plaster floors found in the Caribbean and packed earth floors found throughout the southern United States. The Miller Site introduces a broader pattern of earthen floors through-

out the Atlantic Basin. These floors were developed by historic builders based on precedents and available materials. The Miller Site draws inspiration from seventeenth and eighteenth century floors in the Caribbean, and in turn, parallels vernacular techniques in Africa and Europe. The floor at the Miller Site is the only exposed lime-concrete floor in South Carolina and one of the only known seventeenth-century floor in the Southeast. Representative of the rarest application of tabby-variant construction, the floor at the Miller Site confirms the formation of cultural links across the Atlantic trading basin. Consequently, earthen floor variants including packed earth, clay, lime, mortar and tabby were the result.

Based on the standards for mortar analysis, samples from the tabby floor endured seven tests including: compressive strength, water absorption, specific gravity, saline hydrological effects, acid rain sensitivity, acid digestion, and void ratio determination. Data was collected between December and January 2013-2014 in order to facilitate comparisons of the floor to other known tabby characteristics. Results of the testing concluded the tabby floor at the Miller Site has a low compressive strength, high rate of water absorption, and extreme vulnerability to the effects of acid rain. Comparatively weaker than the expected historic standard, this material characteristic could be responsible for the floor's current condition. These results influence the level of conservation needed at the Miller Site and the available options for displaying the floor.

Other than its intrinsic weak state, the Miller Site tabby floor is also vulnerable to external damaging forces. External forces that pose a threat to the structural stability of tabby include vegetation, wildlife, and water. The humid subtropical climate of coastal South Carolina provides an ideal environment for biological growth and year-round habitation of burrowing animals. Root growth and animal tunnels

cause upheaval, sink holes, and failure points for the tabby above. In addition, the presence of excessive rainwater can break down the chemical bonds in lime holding the aggregate together and therefore putting the structural integrity of the tabby in jeopardy.

These issues helped lay the foundation for the eventual conservation option suggested for the Miller Site tabby floor. Based on harnessing the best means of conservation and exhibition available, the recommended option leaves the floor both exposed and reburied simultaneously. Displaying a limited portion of the floor in good condition, allows visitors to view the architectural artifact while protecting the remaining three-quarters for future study and conservation. The uncovered tabby floor would become the first visible seventeenth-century structural artifact at Charles Towne Landing and one of the few in the entire Southeast, thus attracting more attention and earning more revenue. Leaving the floor visible to both visitors and scholars will aid in furthering the knowledge of tabby's existence in the Southeast and its varying manifestations.

### **SUGGESTIONS FOR FURTHER STUDY**

The realm of scholarly research on tabby is incredibly small. A few sources provide all of the available information on its history, structural trends, and conservation. Because tabby follows a vernacular theme, adjusted like mortar over time and space in order to achieve a specific goal, no methods of conservation cover the entire realm of its use in construction. Each tabby site must be treated uniquely with a strong comprehensive understanding of how that structure is either thriving or decomposing *in situ*. Depending on whether the goal of a tabby site is to be adapted for modern use or preserved as an artifact, the level of sensitivity necessary to main-

tain material integrity must be determined. When necessary, controlled destructive testing for the physical properties of tabby can reveal integral information needed to estimate a rate of degradation.

Throughout her research, Lauren B. Sickles-Taves tested tabby samples recreated from historic recipes. Following the basis of this thesis, further testing of actual historic tabby samples for their physical properties would be incredibly beneficial. Comparing aggregate, sand, and ratios of historic tabby structures throughout the Southeast, would help support a theory that tabby construction followed trends based on either English or Spanish cultural influences. Similarly, performing a conditions assessment on known tabby structures could both alert preservationists to those most at risk, and reinforce the possible theory that salt water bolsters tabby's strength and hardness.

Overall, any new research into tabby and its physical characteristics, structural trends, conservation, and influences would be advantageous. The testing of tabby at various sites would allow invaluable comparisons in order to find geographical and construction patterns. Left unattended, the floor at the Miller Site, with its similarities to lime mortar, will become a sacrificial element of the site and will degrade at a higher rate than other construction counterparts.



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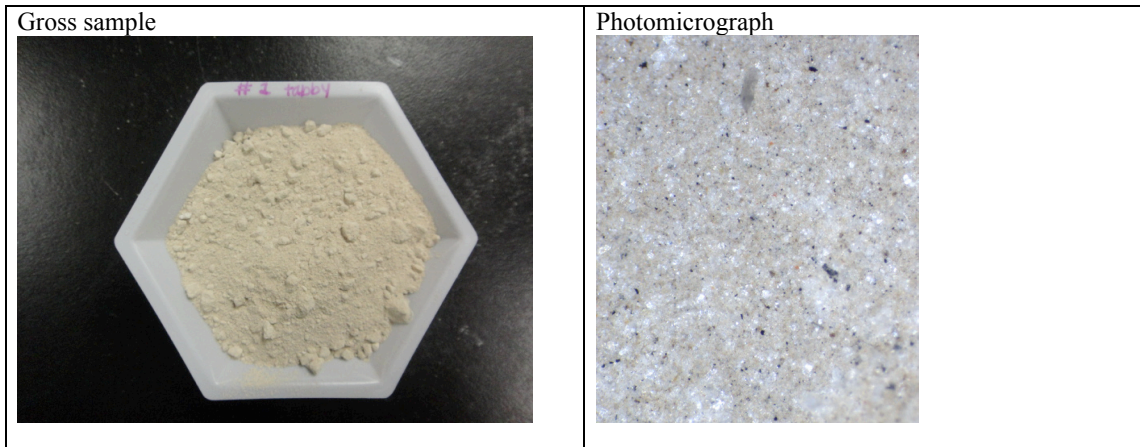
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**APPENDIX A**  
**CHEMICAL ANALYSIS FORM**

CLEMSON UNIVERSITY/ COLLEGE OF CHARLESTON  
GRADUATE PROGRAM IN HISTORIC PRESERVATION

**Architectural Conservation Laboratory**

Mortar Analysis	
<b>Sample number: Sample #1/Tabby Sample</b>	
Project/Site: Miller Archaeological Site	
Location: Charles Towne Landing State Historic Site	Date sampled: 11/8/13
Analysis performed by: Lindsay Lee	Date analyzed: 11/16/13-12/12/13
<b>Description of sample</b>	
Type/Location: Southwest Edge of Tabby Floor Limits	
Surface appearance: Large broken shell inclusions, no visible layer structure, homogenous color aside from shell, coarse poorly sorted	
Cross section:	
Snap Strength:	
Color: 10YR8/1	Texture: 100
Hardness: 2.5 (fingernail)	Gross weight: 35.02g



<b>Components</b>					
Fines:		Color: 10YR6/2	%weight: 12.13%	Weight: 4.03g	
Organic Matter: Burned shell and or soil and coloring agent					
Composition: Fine sand, silt and soil					
Acid soluble fraction:		%weight: 55.58%	Weight: 18.47g		
Description of reaction: Muriatic acid was poured five times into the solution. The first pour resulted in an immense amount of large, dark green bubbles that took approximately ten minutes to settle. The second pour resulted in nearly the same amount of active bubbles. The bubble and fizz were both slow to react and long lasting. Pours three, four, and five resulted in a high amount of fizz than bubbles. Fumes and odors were present with each pour.					
Filtrate color: Greenish yellow					
Composition: Large crushed oyster shell					
Aggregate characterization:					
Sieve #	Size	Sphericity	Roundness	Sorting	Color
10	n/a	n/a	n/a	n/a	n/a
20	Coarse Sand	Subequant/High	Subangular	Coarse poorly sorted	7.5YR7/4
40	Coarse Sand	Very Equant/High	Subrounded + Subangular	Coarse poorly sorted	7.5YR6/3
60	Medium Sand	Very Equant/High	Rounded + Subangular	Medium poorly sorted	10YR8/2
100	Fine Sand	Elongate/Low	Subangular	Medium well sorted	10YR8/2
200	Very Fine Sand	Subequant/High	Subrounded	Fine poorly sorted	10YR8/2
Pan	Very Fine Sand	Subequant/High	Subangular	Fine poorly sorted	10YR7/2
Fines	Silt	Subelongate/Low	Subangular	Fine poorly sorted	10YR6/2
Fines consist of: Solidified 10YR6/2 residue with tan, white and black inclusions.					

Sieve screen number	Mass of container	Mass of sample and container	Mass retained	% mass retained
10	1.89g	1.89g	0g	0%
20	1.98g	1.98g	9g	0%
40	1.71g	1.75g	.04g	.12%
60	1.68g	2.04g	.36g	1.08%
100	1.66g	6.74g	5.08g	15.29%
200	1.70g	6.16g	4.46g	13.42%
pan	1.67g	2.46g	.79g	2.38%

Photos may be added of all weigh boats after digestion.

