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Rammed Earth Architecture's Journey to the High Hills of the Santee

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RAMMED EARTH ARCHITECTURE'S JOURNEY TO THE HIGH HILLS OF THE SANTEE AND ITS ROLE AS AN EARLY CONCRETE

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Abstract

Rammed earth, a form of earthen architecture and construction that has been used for thousands of years, has gone through periods of resurgence and decline. Its modern era rediscovery through practice and publications during the late 18th and early 19th century was fueled by writers and practitioners who disseminated the ideas of pisé starting in France extending to England and eventually to other European countries and the United States. Once these ideas reached America, farmers and intellectuals alike were interested in this simple yet durable means of construction.

Rammed earth ideas, while intellectualized in Europe, originated from practice in Africa and the West Indies where enslaved and free Africans used their traditional methods of earth walling and wattle and daub construction. These traditions transferred to America through slave trade and immigration of free blacks and can be found in many southern states including Louisiana and South Carolina. Pisé and other forms of earthen architecture, tabby and bousillage, are examined to better understand earthen construction, its origins, methodology, influences, and position as an ancient and emerging construction technique.

In South Carolina, Dr. William Wallace Anderson of Stateburg built wings on his house out of pisé, seven outbuildings, and a nearby church of the material. These rammed earth structures in the High Hills of the Santee, the Borough House (c. 1821) and the Church of the Holy Cross (c. 1850 – 1852) are studied as exceptional examples of surviving rammed earth in the United States. Their histories are explored, current conditions assessed, and conservation efforts discussed. The physical composition of rammed earth, strong and hard to penetrate, is analyzed and broken down into material components. Based on the analysis, methods of repair are specified. Finally, the long standing question of preservationists and engineers is addressed: is pisé an early form of concrete that evolved just before the invention of Portland cement in the early 19th century?

Acknowledgements

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Chapter 1
Earthen Architecture

There are several forms of earthen architecture that have been in use for thousands of years and are continually used in many areas of the world today including Africa and the Middle East. Of these forms, pisé, tabby, and bousillage are regional variations on earthen construction. Pisé is the French method of rammed earth and has been practiced in southern France since it was learned from the Romans. Tabby began as a Spanish method of rammed earth, known as tapia, and was brought to the American colonies during the 16th and 17th centuries and thrived along the eastern seaboard. Bousillage is another French method that predominates in areas that were settled by the French along major waterways including Ste. Genevieve, Missouri, and various towns in southern Louisiana. Understanding these various forms of construction helps to provide a background into how forms using the same materials can be very different.

Pisé

Pisé, derived from the French verb "piser," which means to pound down, is the French term for rammed earth, a building technique used for thousands of years by ancient cultures including Romans, Africans, and the Chinese. The French, particularly from the Rhone Valley and Lyons, played an integral part in reintroducing rammed earth during the 18th century as a method of construction to Western Europe and America through formal publications and practice. Pliny, in his *Natural History*, mentions rammed earth walls, then known as formacean walls:

> Have we not in Africa and in Spain walls of earth, known as "formacean" walls? From the fact that they are moulded, rather than built, by enclosing earth within a frame of boards, constructed on either side. These walls will last for centuries, are proof against rain, wind, and fire, and are superior in solidity to any cement. Even at this day Spain still holds watch-towers that were erected by Hannibal.[1]

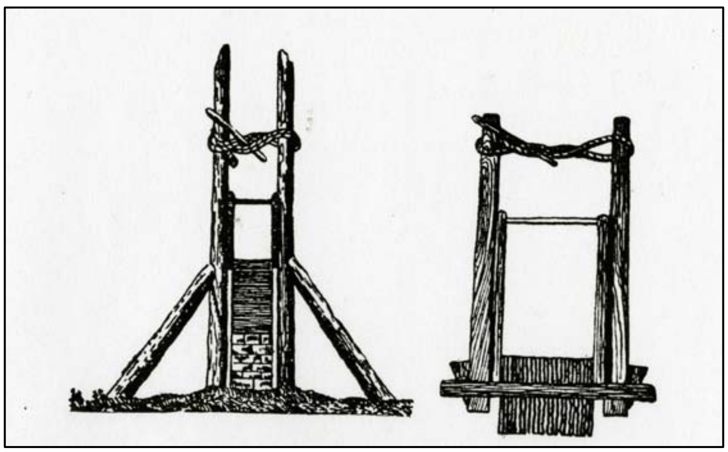

Figure 1. "Ancient Shutters" as described by Karl Ellington because to hold them taut, rope was used. (Image: Karl Ellington)

[1] Quoted in Karl Ellington, *Modern Pisé-Building*, and (Lindsborg: Bethany Printing Company, 1924): pg. 13.

Rammed earth was used by the Romans and it is likely that they introduced it to the French where it was used for many years, but was never specifically written about until the 18th century. In this period of the printing press, architects and designers spread the methods of pisé to wider audiences, lauding the benefits of building with earth. The techniques spread from France to England and other parts of Europe and eventually to America through translations of French works and personal relationships. The methods of pisé have survived into the 21st century and have evolved to include more modern materials, but the basics of rammed earth have remained the same.

A Brief History

Rammed earth has a long history of use and has experienced revivals throughout the past few centuries. A famous French pisé building is a church in Montbrison that had eighteen inch thick walls and a crepe finish on the exterior. It caught fire a few decades after its construction and it was decided to try to take the walls down. This endeavor was terribly unsuccessful as the walls were so hard even years after their construction. Instead, the walls were left up and the church was rebuilt.[2]

After regaining popularity in France in the 18th century, pisé made its way to England where it was experimented with in addition to the earthen construction methods already in place. Cob walling had been used for centuries in England and employed clumps of mud and straw that were lumped onto walls rather than placed in forms to build structures

[2] Stephen William Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, (New York: William Elliot, 1806): pg. 3.

because the straw acted as reinforcement. Cob could also be formed into blocks for building. Pisé was not as popular in England as it had been in France, but it was still found to be a sturdy and durable material. One English house, the Beatlands, was built on a cliff overlooking the sea in 1858. In 1924, when Karl Ellington, a Swedish proponent and author on pisé, observed it, it was still in good condition despite being subject to extreme winds and rain for over sixty years.[3]

When pisé's use spread to America in the early 19th century, it was used at several plantations in Virginia and South Carolina, reaching its height of popularity during the 1820s. There have been two American revivals of pisé after World War I and at the end of the Depression.[4] There is currently a revival of rammed earth across the globe starting in the late twentieth century due to rammed earth's cheapness and ecological advantages. Revivals in other parts of the world, particularly in England, occurred mainly because of shortages of housing and brickyards that couldn't meet demands during the 1920s. Pisé was the sensible alternative and over 500,000 houses were built of the material.[5] Pisé is a material that typically gains popularity for economic reasons as building with the readily available and abundant materials is cheaper than other alternatives. The ubiquitous use of pisé in all cultures demonstrates this success and durability of the material.

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[3] Ellington wrote a book entitled *Modern Pisé* in 1924 about the use of pisé in his native Sweden and throughout Europe, Ellington, *Modern Pisé-Building*, pg. 80.

[4] David Easton, *The Rammed Earth House*, (Vermont: Chelsea Green Publishing Company, 1996): 13.

[5] ibid, pg. 76.

General Information about Pisé

In 1806, an American writer named S.W. Johnson published *Rural Economy, containing a Treatise on Pisé Building (as recommended by the Board of Agriculture in Great Britain with Improvements by the Author).* Influenced by the British architect Henry Holland's translation of Francois Cointeraux's treatise on pisé, Johnson had experimented with rammed earth and built a house in New Brunswick, New Jersey. The twenty-seven foot long, nineteen foot wide, fifteen foot high, two story building was found to be strong and sturdy. Using local dirt from a nearby roadside, Johnson followed Holland's directions and after his experiment with the house, added his own ideas to create his publication.[6] In *Rural Economy*, Johnson outlined the basic tools, methods, materials, and other details dealing with pisé to provide guidance to others building with rammed earth. Of the information provided by Johnson, only minimal portions are his own work. The rest was essentially written by Cointeraux in the 1790s because there were not stringent copyright and citation rules in the 18th century.

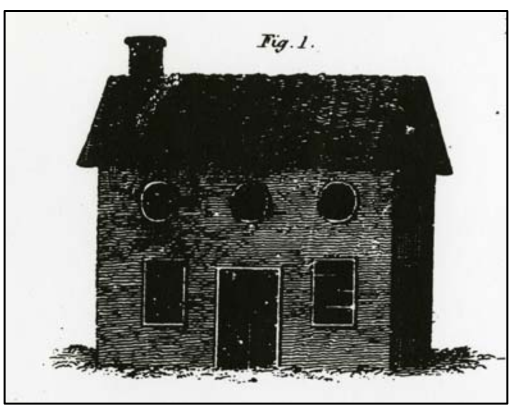

Figure 2. The house designed by S.W. Johnson of pisé in New Brunswick, New Jersey. (Image: S.W. Johnson)

[6] Johnson. *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author,* pg. 6.

The pisé process includes selecting soil for construction, mixing it up into a suitable consistency, and then placing it in framing. After ramming the earth down with a pisoir, or tamper, more earth is layered on top until the framing is filled. It is then moved to start an adjoining section of the earth wall and once the desired wall height is reached, the building is outfitted with a roof. The final step is to protect the earth with a protective finish.

Tools

There are several tools that are needed for pisé construction and the most basic are the pisoir, or rammer, and the mold, also known as shuttering or framing.[7] Framing and shuttering is constructed and includes putlogs, which are transverse timbers that help hold the shuttering in place. Each putlog is placed at three foot intervals along the wall.[8] After the drying period, the putlog holes are filled with either earth or a lime based mortar.[9] Other tools that can be used include spades, trowels, buckets, a watering pot, rake, hatchet, hammer, plumb rule, a square, and a saw.[10] The molds should be made of a light wood such as pine, poplar, willow, or any other wood that will not warp or bend.

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7 Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pg. 12.
8 John and Nicola Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth,* (Great Britain: English Heritage, 1988): 91.
9 ibid, pg. 91.
10 Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author,* pg. 12.

The suggested dimensions of the molds are ten to fourteen inches long constructed of one inch thick pieces of wood. At least three of the pieces of the mold should be planed and grooved so that the framing fits together more tightly. These details of the mold were changed from Cointeraux's original suggestions by Johnson after he built his own house of pisé. Other descriptions of the mold include that the height should be less than thirty three inches.[11] The thickness of pisé walls varies from ten inches to eighteen inches, but some of the outbuildings found at the Borough House in Stateburg, South Carolina, are twenty-four inches thick. The thickness of the wall depended on what sort of loads and stresses the wall is expected to bear.[12]

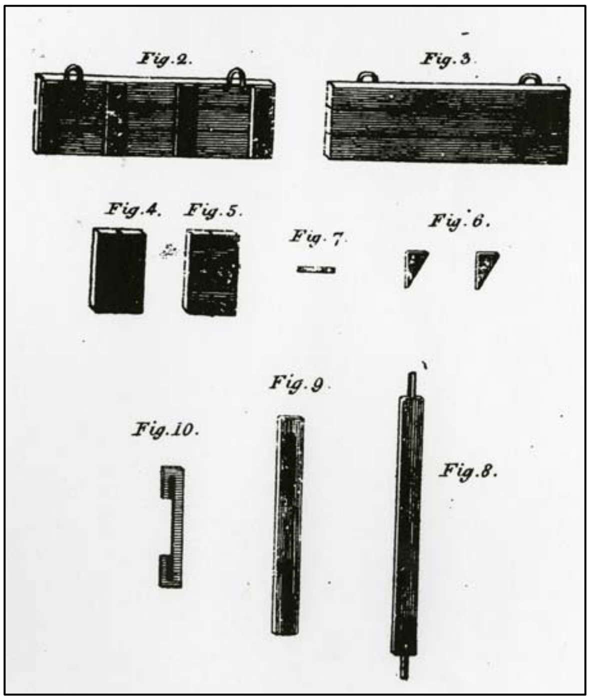

Figure 3. Sketch of the parts of the shuttering. (Image: S.W. Johnson)

[11] Hubert Guillaud, "Earth Architecture in France; history, localization, and prospect." *Adobe Today's Earthbuilder*, no. 39 (1983): 6.
[12] Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth*, pg. 91.

Cointeraux had written that the top of the molds should be narrower than at the bottom so that the wall ends up being tapered which helps with water runoff. Johnson disagreed with this suggestion and felt the walls should be perfectly perpendicular to the ground.[13]

Johnson also outlines specific details for the pisoir construction. The handle should be four feet in length and the entire weight of the pisoir, the head plus handle, should be between eight and thirteen pounds. The material to be used for the pisoir, in comparison to the light wood used for the mold, should be a heavy wood like oak, ash, beech, or walnut.[14]

In addition to the tools, Johnson described how much time and labor pisé needed as well as how much work coudl accomplished in a day. A minimum of three men were needed for pisé construction: one man retrieved the already mixed soil with a horse and cart and carries it to the molds. Another man helped put the dirt into the mold while the third man began to level the dirt with his feet. Two of the three would then ram the earth until it was less than half of its original thickness. While the earth in the mold was rammed, the man who brought the soil to the mold would also tend the soil by constantly mixing it up. He could also set up new framing, take down old framing, or do any other odd job that was needed. These three men working together could finish six square yards of pisé walling in a day.[15]

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13 Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pg. 17.

14 Guillaud, *Earth Architecture in France; history, localization, and prospect*, pg. 6.

15 ibid.

Preparing the Earth

Johnson wrote several chapters in *Rural Economy* on how to test and select the proper earth. For the easiest test for appropriate earth, place some in a tub or bucket, ram it, then dump it out and see if it retains its shape. Johnson suggests leaving the bucket shaped pisé outside and if it does not crack or break, but gains strength, then it is suitable for building.[16]

Many types of earth can be used for pisé construction, but the best soils are strong earths with small gravel mixed in them. Johnson describes these as large lumps of soil, in which if a mouse dug a tunnel through, the tunnels would stay smooth and not collapse. This soil is typically found on riverbanks and at the bottom of slopes.[17] The earth used for construction at the Borough House and the Church of the Holy Cross in Stateburg, South Carolina, was found at the bottom of slopes in the High Hills of the Santee.[18]

Depending on the type of earth that is available, it may need to be altered with additives. For example, a strong earth with lots of clay needs to be mixed with a milder, weaker earth that has more sand. A soil with high clay concentrations should be mixed with more gravel or sand. Whatever soil is chosen for pisé building, it should be fully understood for its physical properties so that the strength of the final product is ensured. Biological

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16 Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pg. 44.
17 ibid, pgs. 41 - 43.
18 Thomas A. H. Miller, *Report on the Condition of Rammed Earth Buildings, Built 1820 to 1854 on the Plantation of Mr. W.L. Saunders Located Near Sumter, South Carolina*, (Washington, D.C.: United States Department of Agriculture, 1926): 7.

substances should be removed from the earth because they will deteriorate leaving voids, which weaken its durability. Any pebble or gravel that is used in the pisé mixture should be round and flat as it will fit more tightly in the earth during compaction. Sharply shaped gravel does not adhere or bond as well with the earth and this affects the strength of the finished wall.[19]

To prepare the earth, remove it from its source, break up clumps and place it in a pile. Separate different soils into individual piles and then a shovelful of the best dirt is thrown into a pile with from one to six shovelfuls of lesser dirt depending on the determined use of the project. Never mix more dirt than is needed for one day's work and if there is left over, it needs to be covered for protection.[20] Also, sort the soil again to remove biological sources like straw, twigs, or animal bones that were previously missed.

Earth used for construction should be of a low moisture content of 10% and the earth should consist of about 25% clay and 75% sand and gravel. The earth should not be too dry or wet. If it is too dry, the earth won't bind, and if it is too wet, it will shrink and crack as it dries and it will be muddy and splash during construction. [21] The proper earth composition will not powder or splash when rammed.[22]

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[19] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pgs. 47 - 48.
[20] ibid. pg. 50.
[21] Guillaud, *Earth Architecture in France; history, localization, and prospect*, pg. 6.
[22] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author,* pgs. 38 – 39.

Wood in Pisé Construction

Wood is used in pisé construction for framing and for window and door headers. Thin boards are used to brace the building and are placed at each story for extra supports. These boards are placed in the pisé walls as bond timbers.[23] Traditional lime and sand mortar should be placed in the notch for the beams and all around them once they are placed in order to securely hold them in place. Any wood used as window or door headers should be put in place angled towards the ground so that water can run off them and not collect in the wall.[24]

Figure 4. Arrow points to the original bond timbers at the Church of the Holy Cross in Stateburg, South Carolina. (Photo: Author)

[23] Guillaud, *Earth Architecture in France; history, localization, and prospect*, pg. 7.
[24] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author,* pg. 58.

Methods

It is best to construct a pisé structure during the spring or fall. If done in the spring, the structure should be allowed to cure until the fall and if built in the fall, it should be allowed to cure until the spring. Once the curing time period is over, which was usually from two to six months, the exterior render can be applied.[25]

The foundation for a pisé building can be made of any kind of masonry, but is most often made of stone that is from eighteen inches to two feet above the ground level, which aids in protecting the earth walls from water splash.[26] The soil is then prepared and mixed. Shuttering or framing is built out of wood to mold the walls. Once the shuttering is built, the earth is placed in the frame at a depth of about three to four inches and is rammed down using a pisoir. The most efficient manner of doing this is with two workmen starting near the shuttering and working their way towards the center.[27] Once the earth has been reduced by a little more than half, the next layer of earth can be placed on in the form. Once the forms have been filled, the shuttering is removed and moved up the wall with the help of the putlogs. Each horizontal section of the wall is finished at a sixty degree angle so as to make it easier to join the next section. Also the pisé does not have to dry between courses, and this allows for large sections of the building to be built in a short period of time.[28]

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[25] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pg. 39.
[26] Guillaud, *Earth Architecture in France; history, localization, and prospect*, pg. 6.
[27] Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth*, pg. 91.
[28] ibid.

Door and window frames can be inserted while the tamping process is occurring. Some pisé enthusiasts recommend that openings should be cut out after the entire wall is built, but Johnson suggests leaving the openings as the wall is being built. Wood sills are placed and the window is framed out above a header piece of wood to complete the opening.[29]

Corners, windows, or doors could also be decorated with stone or other masonry, which adheres well with pisé, and would be framed the same way as if it were framed with wood. However, these materials would not be added until after the walls had finished curing. Interior doors, unlike the exterior openings, did not need to be framed with lintels.[30] The roofing structure and any other supports could be installed directly into the earthen construction when all the shuttering and ramming was done. At this point, the building was allowed to dry anywhere from two to six months.[31]

Pisé construction is not limited houses or outbuildings. It can be used to construct garden walls by placing molds end to end rather than moving them up a wall as with residences.[32] The standard height of the mold will help to make a good height for the garden wall and the end result is a durable fencing system.

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[29] Guillaud, *Earth Architecture in France; history, localization, and prospect*, pg. 7.
[30] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pgs. 35 - 36.
[31] Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth*, pg. 91.
[32] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pg. 58.

Protective Finishes

According to the French method outlined by Francois Cointeraux during the last decade of the 18th century, the exterior walls should be covered with a pebble dash finish, which is a type of sand, lime, and gravel roughcast slurry slung on the walls. The exterior can also be finished with traditional stucco. The interior walls were most often finished with plaster or limewash.[33] After curing, the walls must be brushed of any loose material. If a render is applied before curing is done, the render will likely fail. The wall is indented using a hatchet or other sharp tool to create a key for the render.[34]

For the roughcasting process, two workers are needed. One sprinkles the wall with a wetted brush while the other dips a brush of reeds into the roughcast and throws it on the wall. The laborers start at the top of the walls and work their way down. The roughcast is the better surface coating for pisé because of the nature of how it is applied: thrown on the wall to fit every nook and cranny, which creates a stronger bond than stucco.

If stucco is chosen for the outside coating, three to four laborers are needed, two of whom are on scaffolding. One brushes the wall with water and lays the stucco on with a trowel and spreads it thinly and evenly. The second worker lightly wets the first coat of stucco and puts another coat on to form an even coat that is rougher than the first coat. The stucco can then be finished in a variety of ways including lime washing or scoring it to

[33] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pgs. 68, 71.
[34] ibid, pgs. 64 – 67.

look like stone.[35] Other optional renders could include tallow, alum, powdered glue, skimmed milk. and tinted pigments. One of the most popular pigments was a simple ferrous oxide that gave the render a red color. Some mud plasters were used as well with three parts sand to one part clay.[36]

The interior walls are often finished with a plaster. The wall is prepared the same way as the exterior walls and after the plaster is applied, a limewash is used. Unslaked lime is dissolved in clear water and then brushed on the wall while the plaster is still wet. [37] A limewash will help the plaster to become harder and stronger and adheres strongly to the plaster.[38]

In Lyons and the Rhone Valley in France, the final exterior coat was fresco painted, meaning the pigment was integral to the stucco. This method of exterior coat was recommended by Cointeraux as it was cheap and aesthetically pleasing. Working at the same time as the plaster is applied, an artist painted designs or scenes on the wet plaster. Sometimes, the plaster was even just painted a solid color. The paint was made of diluted lime and coloring such as yellow ochre, red ochre, or other minerals. As with a limewash,

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[35] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pg. 68 – 71.
[36] Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth,* pg. 93.
[37] Unslaked lime is quicklime that has not had water added to it and is in a powder form.
[38] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author,* pg. 72.

the fresco painting adheres readily to the plaster and it will last many years without fading or washing off.[39]

By the mid 1800s, wire mesh lath was beginning to be used over the pisé to provide a mechanical key for the render. 20th-century practices included adding Portland cement to the render mix for waterproofing purposes. A limewash could also be used as the exterior render for a pisé building. The walls were tarred with hot coal and sand before applying the limewash. Several months later, the limewash was applied in order to avoid bleeding of either material.[40]

Reuse of rammed earth during the 20th century

Following World War I, shortages in materials and money allowed for pisé to make a comeback during the 1920s. A decade later, a large population of unemployed laborers due to the Great Depression also created a situation that was suitable for a reuse of pisé. One enthusiast of this time from England was Clough Williams-Ellis, who became interested in cob houses when he realized that underneath the layers of stucco on English country cottages lay old walls of mud and straw that had survived for many years. He published *Cottage Building in Cob, Pisé, Chalk, and Clay* in 1919.[41]

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39 Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author*, pg. 75.
40 Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth*, pgs. 93 - 94.
41 Clough Williams-Ellis. *Cottage Building in Cob, Pisé, Chalk, and Clay.* (New York: Charles Scribner's Sons, 1919).

Another European who was interested in pisé and its use during this time was Karl J. Ellington from Sweden. In 1924, he wrote *Modern Pisé Building: House-Building with Compressed or Rammed Earth (Pisé de Terre).*[42] Ellington had grown up with rammed earth buildings in his native country where pisé methods were learned through translations of Cointeraux's work. Written 118 years after S.W. Johnson's *Rural Economy*, Karl Ellington's *Modern Pisé Building*, at times directly borrows from Cointeraux. Ellington not only discussed methods and tools used for pisé, but he also discussed the use of pisé in various European countries. He does not mention its use in America and his treatise explains how pisé use and methods evolved and changed in Europe during the 20th century. Like S.W. Johnson did in *Rural Economy,* Ellington outlined the tools, methods, and steps it took to construct a building out of pisé.

Tools

As the many enthusiasts before him, Ellington continued to advocate for the use of a pisoir. However, he did suggest using differently shaped pisoirs in a certain order to compact the earth, instead of just one type.

[42] Ellington, *Modern Pisé-Building,* (Lindsborg: Bethany Printing Company, 1924)

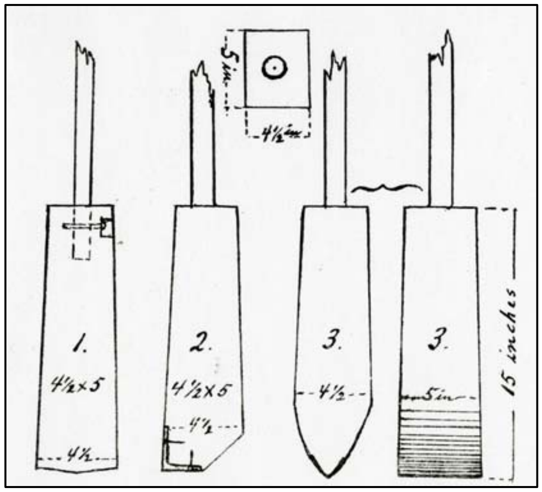

Figure 5. Designs for Pisoirs. (Image: Karl Ellington).

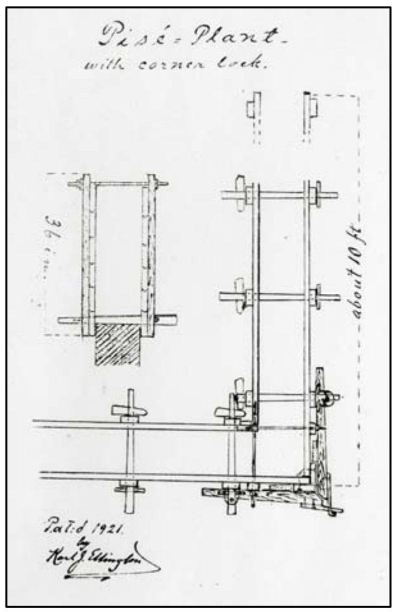

Figure 6. Designs for framing and shuttering. (Image: Karl Ellington)

Preparing the Earth

According to Ellington, the best soil consists of finer sand, gravel, and clay in equal proportions.[43] Ellington also offers advice on the moisture content when preparing the soil for ramming. Like Johnson and predecessors, it is ideal that the soil not be too dry or

[43] Ellington, *Modern Pisé-Building*, pg. 31.

too wet. However, if the soil does become too dry, it can be lightly watered with a watering can and should only be done while mixing.[44] The builder should also be very careful to not use too much water because once the dirt transforms into a muddy consistency, it may be unusable.

Methods

Ellington, like Johnson, suggests stone for the foundation walls, but Ellington also includes a modern material. The upper part of the foundation should be constructed of concrete while the lower part stone. On top of the foundation, before the pisé is added, a damp proof course should be laid to protect the pisé from rising damp from the foundation walls.[45]

In addition to the cement or stone foundation, Ellington also suggested using other modern materials to reinforcing the structure. These can include wood as with historic pisé, but it can also be barbed wire, chains, cables, or iron waste and is used most frequently near the corners where stresses are the highest.[46]

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[44] Ellington, *Modern Pisé-Building*, pg. 32.
[45] ibid, pgs. 27 - 28.
[46] ibid, pg. 38.

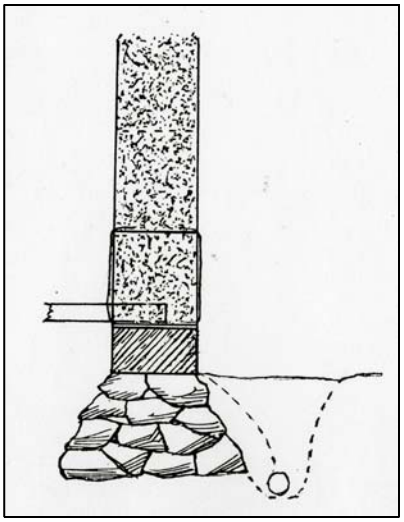

Figure 7. Ellington's sketch of the foundation for pisé buildings. (Image: Karl Ellington)

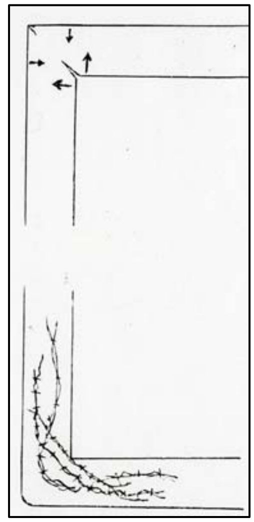

Figure 8. Barbed wire reinforcement at corners. (Image: Karl Ellington)

Protective Finishes

Unlike Johnson, Ellington offered little information about the exterior coverings of pisé structures. The only finish he discussed is whitewash and stated that in Europe, it has been seen as the most suitable treatment of earth buildings. Whether this is true to all of Europe or just to regions familiar to Ellington is not specified. He included several recipes for whitewash recipes, which contain various ingredients including quicklime, rye flour, rock salt, table salt, skimmed milk, and Portland cement.[47]

At the same time that Williams-Ellis and Ellington published their books in Europe, Thomas Miller completed surveys of historic rammed earth structures in America. Likely influenced by the findings of Williams-Ellis in England, the United States Department of

[47] Ellington, *Modern Pisé-Building*, pgs. 99 – 100.

Agriculture sent Miller to Stateburg, South Carolina, to inspect the condition of the Church of the Holy Cross and the Borough House.[48] Another employee of the Department of Agriculture, Harry Baker Humphrey, built a two story house out of pisé in Washington, D.C. in 1926 with walls that were eighteen inches thick. Following the construction of his own house, Humphrey teamed up with Miller and together, they drafted a manual for rammed earth construction entitled *Farmer's Bulletin No. 1500: Rammed Earth Walls for Buildings*.[49]

The public's interest in rammed earth was higher during the 1920s than it had been during the 1840s and this interest inspired experiments, publications, and projects. Over one hundred articles on rammed earth were published during the years 1926 – 1950 in journals and magazines.[50] Many of the experiments that were conducted were done through higher educational institutions like colleges and universities. Ralph Patty, who worked with the Agricultural Experiment Station at South Dakota State University, built test walls, farm structures, and other buildings to test soil types, how the pisé weathered, floor construction, wall coverings, and the stability of various earth mixtures. Other land grant and engineering schools, including Texas A & M University, the University of California at Berkeley, and Clemson University also conducted experiments in pisé.

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48 Miller, *Report on the Condition of Rammed Earth Buildings, Built 1820 to 1854 on the Plantation of Mr. W.L. Saunders Located Near Sumter, South Carolina*, pg. 1.
49 Easton, *The Rammed Earth House*, pgs. 14 – 15.
50 ibid, pg. 15.

Their experiments and subsequent publications helped fuel the movement towards using rammed earth in everyday construction.[51]

Figure 9. House of Harry Baker Humphrey outside of Washington, D.C. (Image: David Easton)

These tests and publications inspired Thomas Hibben, who worked with the Resettlement Administration during the Great Depression, to suggest rammed earth be used at homestead communities. The National Resettlement Act of 1933 was established to create homestead communities for relocation from crowded cities to more rural communities. Residents could work in the cities part time and then work their land to grow food. Communities were set up in North Carolina, Wisconsin, Georgia, West Virginia, Pennsylvania, Ohio, and Alabama. Outside of Birmingham, Alabama, at Gardendale, seven test houses were built, but they were kept a secret at first in case the experiments failed. The houses were designed by Hibben, who also trained the crews in the rammed earth methods using framing like that used by Cointeraux and other enthusiasts before them. The first house that was built took the crews five weeks to build,

[51] Easton, *The Rammed Earth House*, pg. 15.

but the last house took them only five days illustrating just how fast the crews could learn the methods.[52]

Elbert Hubbell, from the Turtle Mountain Indian School in Balcourt, North Dakota, also saw the benefits of rammed earth construction. He felt that it could be adapted to benefit those living on Indian Reservations. The work of Hubbell, Hibben, and others influenced the government's Bureau of Standards to create a program called "Building Materials and Structures Reports." Scientists, along with Hubbell, Hibben, and Miller, tested various materials for their strengths, water resistance, and heat transfer properties. The materials tested were asphalt stabilized adobe block, monolithic soil cement, monolithic plain rammed earth, and soil cement block. Their results, published as *BMS 78*, found that these earthen materials were suitable for use in one or two story buildings.[53]

Concurrent with the publication of *BMS 78*, others built their houses of rammed earth at a time when they were outside of the mainstream. Architect Millard Sheets, from Claremont, California, built a rammed earth wall with a reinforced concrete jacket because he was required to do so by the city's code. During later repairs to his house, he found that the concrete jacket was useless as the earth underneath it was just as hard as the concrete.[54] David and Lydia Miller of Greeley, Colorado, also began building houses of rammed earth during the 1940s. Their first house was built in 1945 and they had

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[52] Easton, *The Rammed Earth House*, pg. 16.
[53] ibid, pg. 18.
[54] ibid, pg. 18.

decided to use earth because of a pamphlet they had read in 1937 about building with soil and also because of trips to Eastern Europe, where earth was commonly used for construction. With the help of architect J. Palmer Boggs, the Millers built a second house in 1949, where they lived until the 1980s.[55] Their enthusiasm and experiments with rammed earth was published in *Mother Earth News,* and earned them the title of folk heroes.[56] The Millers founded Rammed Earth Institute International in the 1970s through which they lectured and taught workshops on rammed earth methods and construction.[57]

<u>Rammed Earth during the 1970s and Today</u>

Pisé's popularity surged again during the 1970s when resources were once again limited and there was more of an emphasis on how humans impacted the environment. Rammed earth, as one of the oldest building methods, was seen as a good alternative to the usual building materials for its abundance and its low impact on nature. Various enthusiasts were found on the west coast and in the southwest, including builder Tom Schmidt of Arizona and architect David Easton of California. There were also enthusiasts found outside the United States including Giles Hohnen in Australia and Patrice Doat and Hugo Houben in France. Doat and Houben would go on to found CRATerre, the Center for the Research and Application of Earth. The center has assisted housing ministries and nongovernmental organizations on three continents by designing and implementing earth construction strategies since its founding in the 1970s. They also host conferences on

[55] David and Lydia Miller, *Living in the Earth,* (Hendersonville, North Carolina: Mother Earth News, 1980): 2.
[56] Easton, *The Rammed Earth House*, pg. 18.
[57] ibid, pg. 19.

preservation of earthen architectural heritage as well as low cost housing for developing nations.[58]

Figure 10. Modern rammed earth houses built in France. (Image: David Easton)

Despite its rediscovery during the 1970s, rammed earth is not popular. However, today the ideas of energy efficient building might provide another resurgence. This refers to increasing the efficiency with which buildings use resources, including its materials. Rammed earth has demonstrated its efficiency with using earth as a building material through not only years of strength and durability, but also through effective heating and cooling as well as being economically affordable and abundant.

Today, rammed earth is more popular in Western Australia than it is in the United States. The main reasons are because timber is scarce in Western Australia and there is a large presence of termites in the area so the use of lumber is problematic anyway. Masonry has traditionally been used in Western Australia, thus rammed earth fits in well to the

[58] Easton, *The Rammed Earth House*, pg. 20.

traditional building materials as it is a form of masonry. The look of pisé also fits into the "look" of the Australian self image as rugged and individualists. This differs from the American ideals concerning building materials and practices, which have looked to what is cheaper and easier rather than what will last longer. Since the 1970s, Giles Hohnen and Stephen Dobson have created Stablised Earth Structures (SES) and Ramtec, which have built over one thousand houses, schools, museums, tourist attractions, and other public buildings. Twenty percent of new house construction in Western Australia is rammed earth construction.[59] Perhaps this continual use of rammed earth since the last rediscovery will allow rammed earth to be a viable construction method again.

59 Easton, *The Rammed Earth House*, pg. 22.

Tabby

Another derivative of earthen architecture and pisé used in America is tabby. Tabby is similar to pisé construction in method, strength, cost, and regional use in the southeastern coastal states. The major difference between tabby and pisé is the materials used for construction. Pisé uses earth while tabby employs a mixture of lime, sand, and shells, or gravel. Equal amounts of all the materials are used and mixed with an equal proportion of water to create the tabby mixture. However, after mixing, the tabby is constructed in the same manner as pisé with wooden forms.[60] Also, the lime and shell aggregate that is present in tabby helps to provide more structural strength than is found in traditional pisé.

The word tabby has several sources from the Old World, of which none have been determined to be the true source. Rather, it is likely that tabby came from several sources and languages as settlers moved to the American colonies beginning in the 16th century. Building traditions, languages, and cultures mixed in the New World. Derivations on the word tabby have been found used by the Portuguese in West Africa, the Spanish, and the Phoenicians. The Spanish word, tapia, is most often referred to as the main source of the English word, tabby, but the African word, tabi, was also used. [61] Like most other English words, tabby has resulted from the melting pot nature of America, even from the time of settlement.

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[60] Albert C. Manucy, "Tapia, or Tabby," *The Journal of the Society of Architectural Historians* 11, no. 4 (1952): 32.
[61] Lauren B. Sickels-Taves and Michael S. Sheehan, *The Lost Art of Tabby Redefined,* (Southfield, MI: Architectural Conservation Press, 1999): 2.

The Spanish originally had to ship lime from abroad, but then they began to take advantage of the abundant shells along the southeast coast. This use of shells continued until the 1900s, when lime came bagged and ready for use.[62] The process of burning shells dates back to Roman times and the same process of building a rick, or wooden kiln of sorts with layers of shells and fuel, was used in the early American colonies as well. The burned shells created quicklime, which could be slaked and stored for later use, or used immediately with the water added later. The sand used could come from rivers, pits, dunes, or beaches. In Georgia, river sand was used most and was cleaned of dirt and salt before use. The shell, in addition to being used for lime, was also an aggregate in the tabby mixture. An additional ingredient found in tabby, but rarely mentioned even though it was always present, is ash. Wood was burned as fuel with the shells to make the quicklime, thus meaning that there would be pieces of wood ash in the mixture.[63]

Figure 11. Close view of a tabby wall in Beaufort, South Carolina. (Photo: Author)

[62] Sickels-Taves and Sheehan, *The Lost Art of Tabby Redefined*, pg. 17.
[63] ibid, pg. 31.

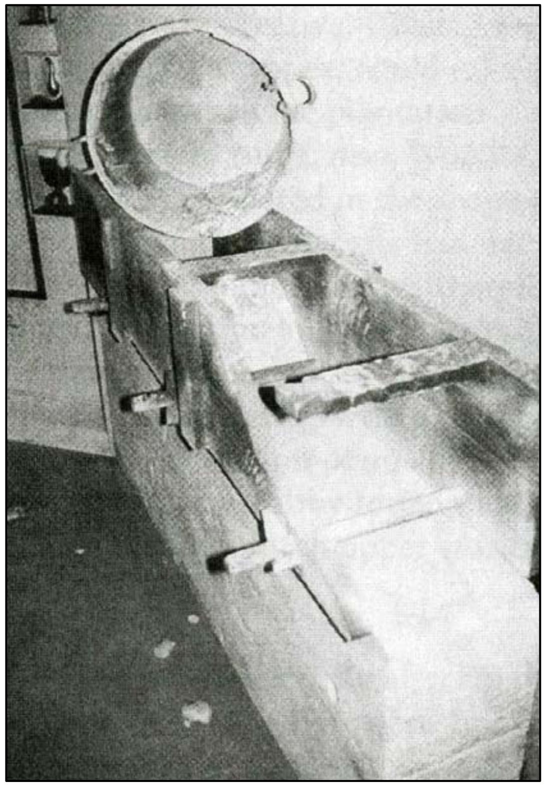

Figure 12. A cradle used to create tabby walls. (Photo: Lauren B. Sickels – Taves)

Tabby is very workable and versatile and can be used for walls, floors, roofs, foundations, and other decorative pieces such as columns. It can be molded, like pisé, into walls using cradles, bricks using forms, and columns using wedge shaped molds. Another way tabby has been used is as tabby mortar. Misnamed oyster shell mortar, it could possibly be the oldest English use of tabby, even before the use of it for foundations and walls. Shells were finely crushed and mixed with lime, sand, and water to make a pasty substance.

Figure 13. Vine damage in a tabby wall. (Photo: Lauren B. Sickels – Taves.)

Figure 14. Damaged tabby wall with previous cement repairs at top. (Photo: Lauren B. Sickels- Taves)

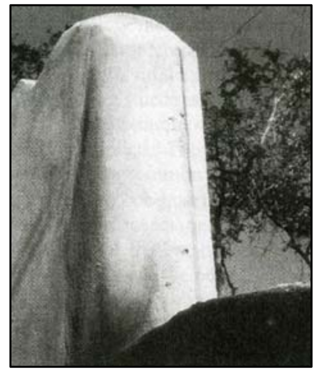

Figure 15. Same wall as in Plate 7 repaired with a new compatible stucco. (Photo: Lauren B. Sickels – Taves)

Tabby is durable and strong, but the biggest threat to its survival is water. Capillary action causes water to rise into the material, which causes erosion and spalling of the exterior render. Also, any water that enters tabby can break down the lime’s strength, which leads to weakening of the structure. Another threat to tabby is plant growth, especially with vines and roots. As with pisé, the best way to protect tabby is to maintain its traditional render, either stucco or whitewash. This helps to decrease the chance for water infiltration as well as slowing any capillary action from the ground.

Early Colonial and American Tabby Use

Found primarily on the eastern seaboard in Florida, Georgia, and South Carolina where shells were abundant and readily found in Indian middens, tabby was first used as early as 1703 in South Carolina. Unlike other areas of the United States, stone was not a plentiful resource for early settlers in these coastal colonies. [64] Fort Prince Frederick at Port Royal, South Carolina, was built in 1732 and became the first large project using tabby.[65] In Spanish Georgia and Florida, it was common to use tabby, or tapia, the Spanish term for tabby, during the 1700s and into the 1800s. The very earliest reported uses of tabby in North America are in the 1580s when a Spanish report described the village of Santa Elena, near present day Beaufort, South Carolina, that had thirty houses of wood and mud covered with lime inside and out with a flat roof of lime and oyster shell.[66] John Bartram, a visitor to St. Augustine in 1765, described common Spanish houses, garden walls, walks, seats, and yard walls as being built in the same manner as pisé walls:

> "Thay raised them by setting two boards on edge as wide as they intended ye wall then poured in limeshel morter mixt with sand in which thay pounded ye oister shells as close as possible & when that part was set thay raised ye planks & so on till thay had raised ye wall as high as wanted, this was strong enough to support A terraced chamber floor & palmato thatched roof."[67]

After filling the forms, the tabby was allowed to harden for two to three days and then the forms were removed and moved up. Two feet could typically be constructed in a week. Another similarity to pisé is that it was commonly constructed during the spring and summer between February and September to avoid the wet months and freeze/thaw cycles. Traditionally, the finished walls were brushed off before stucco or whitewash was

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[64] A midden is a defined as a refuse heap and is where Indians would deposit the shells of oysters and other shellfish after eating.
[65] Lauren B. Sickels-Taves, "Understanding Historic Tabby Structures: Their History, Preservation, and Repair," *Association of Preservation Technology Bulletin* 28, no. 2/3 (1997): 22.
[66] Manucy, *Tapia, or Tabby,* pg. 32.
[67] Colin Brooker, "Survey of Tabby Architecture: Beaufort County, South Carolina," *Historic American Buildings Survey,* pg. 18.

applied. Like pisé, tabby was meant to be covered by an exterior render to prevent any damage.

Unlike the Spanish, the English used tabby for all types of structures and not just those for the lower classes. It is likely that the English learned the tabby method during their time in Spanish Florida. The next documented tabby structures were in Beaufort, South Carolina, the city that has the highest concentration of tabby structures built during the eighteenth century. The Thomas Hepworth House, built in 1710, and the Hext House, built in 1720, were the earliest tabby houses. A short time after their construction, after 1730, tabby building began to take off in Beaufort. In 1732, the largest tabby project to date that was completed when Fort Prince Frederick in Port Royal, South Carolina, was built. The fort has ruins of the walls that survive and are five feet long and twelve to twenty four inches thick.[68] Other early tabby structures include the chapel of ease, circa 1726, on St. Helena Island, South Carolina, the Jean de le Gaye House at Retreat Plantation, and the Beaufort Arsenal, circa 1795. Most early structures were not constructed entirely of tabby, but rather had tabby walls, floors, or foundations. The Jean de le Gaye House, a one and half story house, was the first to be constructed entirely of tabby in 1738.

[68] Manucy, *Tapia, or Tabby,* pg. 33.

Figure 16. Old White Church ruins on St. Helen Island, South Carolina. (Photo: Author)

Figure 17. Tabby foundation in a house in Beaufort, South Carolina. (Photo: Author)

Tabby in South Carolina was popular by the 1780s and the subsequent use of tabby in Georgia came after General James Oglethorpe, founder of the state, stayed at Fort Prince Frederick in Port Royal and the tabby ideas was carried to Georgia.[69] Settlers to Georgia were not able to use the traditional building materials they were used to. Bricks were mostly made in Savannah, so they would need to be shipped anywhere outside of the city. Wood was quickly depleted and there was no readily available stone along the Georgia coast. However, there were many Indian middens, essentially trash piles of oyster and other shells that Oglethorpe knew could be used for construction after learning of tabby in South Carolina. In Georgia, tabby was used mainly during the early years for military construction, including Fort Frederica on St. Simons Island, and there were even times of

[69] Brooker, "Survey of Tabby Architecture: Beaufort County, South Carolina," pg. 6.

tabby's declining popularity, mainly due to there being no need for troops in the area. Tabby that is determined to have been built between 1703 and the 1790s is often referred to as Oglethorpe tabby, as after 1790 there is not much new tabby construction seen in Georgia or South Carolina.[70] Oglethorpe tabby is differentiated from the other eras of tabby by its pour height of twenty to twenty-two inches, visible marks left by the cradle, and by the irregularity of pinhole placement that helped to hold the cradle together.[71]

Figure 18. Tabby Manse, c. 1786, in Beaufort, South Carolina, which is built of Oglethorpe tabby. (Photo: Author)

Tabby's popularity peaked during the early decades of the 19th century like pisé, due to two significant tabby enthusiasts, Alexander Macomb and Thomas Spalding, both from South Carolina. They experimented with using the same construction methodologies as

70 Sickels-Taves and Sheehan, *The Lost Art of Tabby Redefined*, pg. 9.
71 Sickels-Taves, *Understanding Historic Tabby Structures: Their History, Preservation, and Repair*, pg. 53.

rammed earth, but different soil materials to result in durable and strong buildings.[72] Tabby made between the later 1790s and 1875 is often referred to as Spalding Tabby, in honor of Thomas Spalding, and is identified by its pour height of ten to twelve inches and regular pinhole placement.[73] As he grew up at the tabby house built by James Oglethorpe, Orange Hall, Spalding was familiar with the material. When he went into the construction business, Spalding chose to build out of tabby rather than other materials. His first tabby building, which is thought to have sparked a period of tabby reintroduction, was the main house on his native Sapelo Island, Georgia.[74] While Spalding reintroduced tabby to the general public, soon after, there was a high concentration of tabby structures built in Georgia as well. By 1842, tabby construction could be seen from Charleston, South Carolina, all down the southeastern seaboard to St. Augustine, Florida. This revival continued until the Civil War, when tabby was out of favor until the 1880s.

After the Civil War, tabby's popularity declined since it was labor intensive and therefore, was replaced by more affordable materials. Tabby constructed between the 1880s and 1925 is called Tabby Revival. Significant with Tabby Revival is the composition as it changed to include a new material, Portland cement, in addition to the traditional materials. The addition of impermeable Portland cement to the mixture meant the stucco previously used to protect the tabby was redundant. There are high concentrations of Tabby Revival structures found on the coastal islands of Georgia and in

[72] Jeffrey W. Cody, "Earthen Walls from France and England for North American Farmers, 1806 - 1870," *Adobe 90 Preprints, 6th International Conference on the Construction of Earthen Architecture* (1990): 35 - 43.
[73] Sickels-Taves and Sheehan, *The Lost Art of Tabby Redefined*, pg. 55.
[74] ibid, pg. 6.

Florida as many wealthy Americans found solace in these places as winter retreats. Following the Depression of the 1930s, Tabby Revival declined because of new construction techniques along with rising costs of labor and materials.

The last kind of tabby that is found is called Pseudo Tabby and it has been around since after World War II. Rather than creating traditional tabby in cradles and molds, Pseudo Tabby is created in pre fabricated slabs of Portland cement. Whole shells are pressed into it at the end of the process to make it look as if shells were part of the mix. Also, the tabby is no longer load bearing, but rather serves as a veneer.[75] Tabby usage has not been entirely eliminated; rather, it has evolved and adapted to newer materials and methods. However, the traditional methods of tabby have proved to be the strongest and most durable as they have survived hundreds of years.

There were several tabby derivatives found in locations other than the southeastern seaboard. These derivatives played on the tabby mixture and adapted it to other geographic locations. In New Bern, North Carolina, a mixture called shellrock was used that was essentially a naturally occurring earthen rock used instead of shells. Rock tabby, used in Linton, Georgia, employed rock as the aggregate instead of shell and coral tabby in Key West, Florida, used coral. On St. John, in the Virgin Islands, brick pieces, coral, lime, sand, water, and molasses were mixed together to create a unique form of tabby. A later mixture used in Slidell, Louisiana, consisted of cement, broken clam shells, mica,

[75] Sickels-Taves and Sheehan, *The Lost Art of Tabby Redefined*, pg. 14.

and charcoal placed around an iron core. Lastly, in Seguin, Texas, shellcrete or limecrete was an early form of concrete that was made from a naturally occurring cement rock deposit and gravel.[76]

[76] Sickels-Taves and Sheehan, *The Lost Art of Tabby Redefined*, pgs. 143 - 144.

Bousillage

This form of earthen construction was used by the French that settled along the Mississippi River from Missouri down to Louisiana. Only a handful of bousillage structures survive today with the majority of them located in Louisiana. The construction methods of bousillage are compared to pisé construction in the American colonies to better understand the traditions and influences of the African Americans or other laborers that constructed the buildings.

Figure 4. A bousillage wall at the Millet House in Louisiana. (Photo: www.louisianafolklife.org)

Compared to pisé, bousillage uses a wetter mud mixture for wall construction, which is similar to the African method of wattle and daub. This method of construction was used throughout Louisiana from its first days as a settlement in 1699 up until the 1840s.[77] A pit was dug and filled with mud, Spanish moss, or straw and burned shells. Other variations on the mixture were learned from Native Americans. The ingredients were mixed by foot.[78] The mud was placed on a wall formed by clissage, a lattice of bâtons (sticks). [79]

[77] Laura Ewen Blokker. "Building with Bousillage: Ethnicity, Necessity, and Tradition in Louisiana." (working paper for publication in ARRIS), 2009. , pg. 1.
[78] Stanley Schuler, *Mississippi Valley Architecture: Houses of the Lower Mississippi Valley*, (Exton: Schiffer Publishing, 1984): 13.

The wooden slats were also referred to as barreaux and were fitted between the posts, known as bousillage entre poteaux, meaning between posts. The walls could be as thick as two feet while interior walls were often finished with a plaster. The exterior sides of the walls were covered with cypress siding. This construction method was only used on the first floor of a building; the upper floors were built of traditional framing and covered with siding.[80] This type of earthen construction is comparable to wattle and daub used in West Africa (see chapter 3).

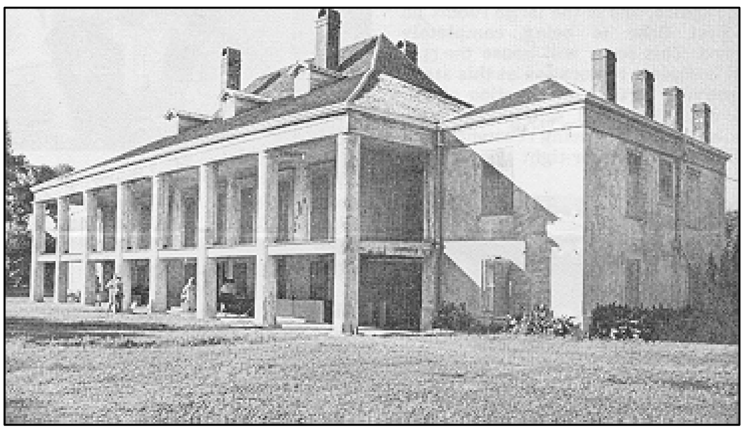

Figure 20. Destrehan Plantation in Destrehan, Louisiana, was built out of poteaux en terre bousillage construction. (Photo: National Parks Service)

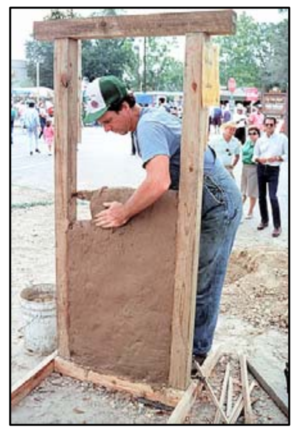

Figure 21. A man demonstrating how a bousillage wall is made. (Photo: www.laheritage.org)

The building method's popularity began to wane in France in the 18th century, but it remained a standard construction method in Louisiana well into the 19th century.[81] Most surviving bousillage structures are in the form of outbuildings or smaller buildings. Some

[79] Jay Edwards and Kariouk Pecquet du Bellay de Verton, Nicolas, *A Creole Lexicon*, (Baton Rouge: Louisiana State University Press, 2004): 32.
[80] Schuler, *Mississippi Valley Architecture: Houses of the Lower Mississippi Valley*, pg. 13.
[81] Edwards Kariouk Pecquet du Bellay de Verton, *A Creole Lexicon*, pg. 32.

structures survive today at Parlange (c. 1750), Destrehan (c. 1787), and Oakland Plantations (c. 1818) in Louisiana and Mississippi as well as at the Bequette-Ribault House (c.1780) in Ste. Genevieve, Missouri.[82]

[82] Blokker, *Building with Bousillage: Ethnicity, Necessity, and Tradition in Louisiana*, pgs. 6 – 9, 18.

Chapter 2

Rediscovery in the 18th and 19th Century and Transmittance of Pisé Ideas

While rammed earth technologies have been used throughout history, its modern use can be traced to a rebirth in 1745 when the first texts were specifically written about pisé in France. After gaining popularity in France, the ideas lauded by the French were passed on to the English and other European countries through translations of influential publications. Eventually, the pisé ideas would reach Austalia, New Zealand, and the United States through friendships, correspondence and written works. The influence reached its peak during the first half of the 19th century, declining in use once cheaper materials became widely available.

Figure 22.Pisé house in Southern France built during the late 18th century. (Photo: David Easton)

Figure 23. Pisé house in Southern France also built during the late 18th to early 19th century. (Photo: David Easton)

France

In 1745, Guillaume – Marie Delorme at the Académie des Sciences, Belle Lettres, et Arts of Lyons, wrote an article about the region's building methods. Twenty years later, Alléon Dulac first illustrated pisé methods in a naturalist work.[83] Then in 1764, Jean-Baptiste Rondelet restored a pisé building, but did not publish his experience with that building until 1812 in his *Traite de l'Art de Bâtir.*[84] The formal rediscovery of pisé came in 1772 with Georges-Claude Goiffon's *L'Art du Macon Piseur* in Abbé Rozier's *Journal de Physique* as well as his own volume.[85] In this work, he wrote how pisé had been used in Lyonnais for many years to build house of two and three stories which were finished with a roughcast render. He also discussed its use in Dauphiné where the earth was so plastic that it set like a polished stone and oftentimes did not need a roughcast.[86]

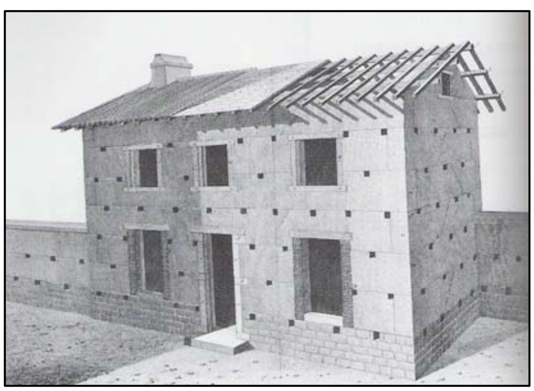

Figure 24. Rondelet's sketch of a pisé house and wall. (Image: Louis Cellauro and Gilbert Richaud)

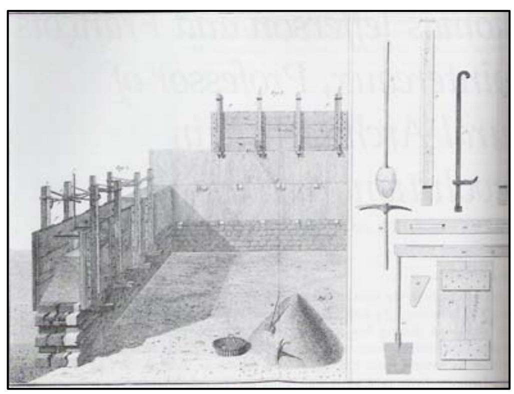

Figure 25. Rondelet's sketch of tools and molds used to make pisé. (Image: Louis Cellauro and Gilbert Richaud)

[83] Louis Cellauro and Gilbert Richaud, "Thomas Jefferson and Francois Cointereaux, Professor of Rural Architecture in Revolutionary Paris," *Architectural History* 48 (2005): 175.
[84] Jean-Baptiste Rondelet. *Traite de l'Art de Bâtir*. Académie des Sciences Belles-Lettres et Arts, 1745.
[85] Claude Goiffon. "L'Art du Macon Piséur." In Abbé Rozier's *Journal de Physique*. (Paris: Société d'Agriculteurs, 1772.)
[86] Miles Lewis, "Origins of Pisé de Terre," pg 3.

Francois Boulard, building inspector for the city of Lyons, wrote an article for Abbé Rozier's *Cour Complet* in which he discussed pisé's use in France. He gave suggestions on soils including that clayey or sandy soils should be avoided as they would crack and not bind respectively.[87] He also added some suggestions that varied from Goiffon's work. Goiffon had recommended cutting out the openings for doors and windows after the walls had been completed, but Boulard felt that the openings should be placed as the walls were being erected and capped off with lintels once the desired height as reached. His other major contribution to pisé was the addition of a set of planks placed at each level to tie the entire building together. Essentially, Boulard's work is Goiffon's work rearranged with sentences and paragraphs copied verbatim with a few of Boulard's suggestions interspersed.[88] This practice of copying a predecessor's work with no citation or reference becomes a common event in the transmittance of pisé information.

Francois Cointeraux

The penultimate writer and practitioner of pisé in France was Francois Cointeraux. Born on September 30, 1740, in Lyons, Cointeraux was always around builders as a child and as a student with classmate Rondelet, he studied perspective in school so that he could paint on the frescoes that often adorned pisé houses in Lyons. After dismantling pisé houses that were over 165 years old in the 1780s, Cointeraux entered a contest in 1784 hosted by the Amiens Academy that entailed answering the question of incombustibility of rural buildings. Three years later, in 1787, Cointeraux won first place with his pisé

[87] Lewis, *Origins of Pisé de Terre*, October 25, 2008., pg 4
[88] ibid.

designs.[89] In addition to being interested in ancien pisé, as Cointeraux termed the traditional methods, he was also interested in nouveau pisé, which was the use of pisé blocks similar to bricks. This method would help him to build arches, columns, and other architectural details not formerly possible.[90]

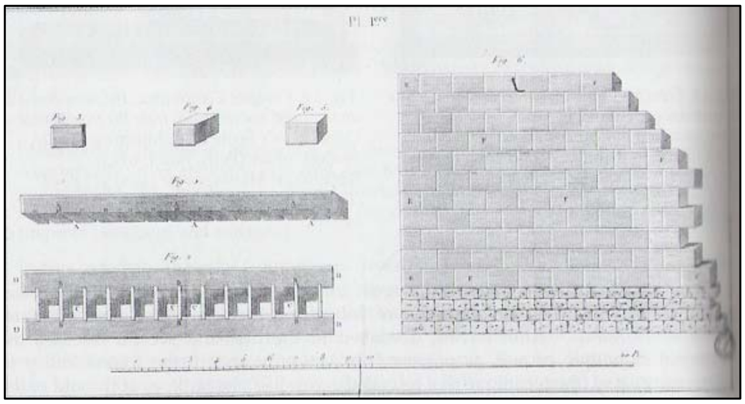

Figure 26. Cointeraux's nouveau pisé. (Image: Louis Cellauro and Gilbert Richaud)

Cointeraux began to experiment with pisé in Northern France after learning the methods in Southern France. He then moved to Paris in 1788 and with the help of the Société Royale d'Agriculture, he created his third unestablished school for rural architecture on the land of the Count of Artois. Here he promoted the use of pisé to build farm structures and buildings that would be fireproof. His motto was "Theory is beautiful, but practice surpasses it," and Cointeraux used this motto to fuel his efforts to make pisé into a patriotic contribution to France during the time of its revolution.[91] He saw pisé as a way to eliminate poverty while providing laborers employment in building the rammed earth

[89] Cellauro and Richaud, "Thomas Jefferson and Francois Cointereaux, Professor of Rural Architecture in Revolutionary Paris," *pg.* 177.
[90] ibid, pg. 178.
[91] Jeffrey Cody, *Earthen Walls from France and England for North American Farmers, 1806 - 1870*, pg. 36.

structures. Not only could using pisé save wood and protect houses from fire, Cointeraux also saw it as protecting the health of the poor and giving them a house that protected them from extreme heat or cold.

Figure 27. The Pavillon de l'Empereur as it still stands. (Photo: Louis Cellauro and Gilbert Richaud)

Figure 28. A watercolor painting of Cointeraux's Pavillon de l'Empereur built in 1791. (Image: Louis Cellauro and Gilbert Richaud)

In December of 1789, Cointeraux won another design competition for a large pisé farm. Two years later, he built the Pavillon de l'Empereur, which was an octagonal shape on the exterior, but circular on the inside. During his years in Paris, Cointeraux was consistently producing designs for houses, schools, and other buildings.[92]

With these ideas in mind, Cointeraux published four influential cahiers, or notebooks, between March of 1790 and November of 1791. His first cahier focused on construction details, the second on soil qualities and more ideas on construction details, the third was a plea to businessmen to incorporate earthen walls into factory construction, and the fourth

[92] Cellauro and Richaud, "Thomas Jefferson and Francois Cointereaux, Professor of Rural Architecture in Revolutionary Paris," pg. 179.

praised a new method of pisé that was more portable and could be molded indoors for later use. While other people were publishing works about pisé, Cointeraux's works were the most popular due to their bright illustrations and clear explanations. One interesting technique that Cointeraux described and practiced was pisé decoré. In this method, he used fresco paintings on the walls to make the buildings look like stone.[93]

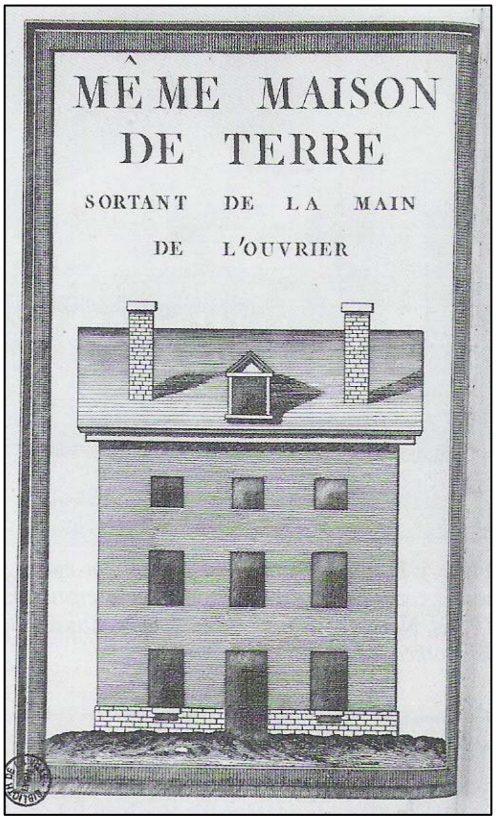

Figure 29. A house design by Cointeraux with no fresco painting, or pisé decorée. (Image: Louis Cellauro and Gilbert Richaud)

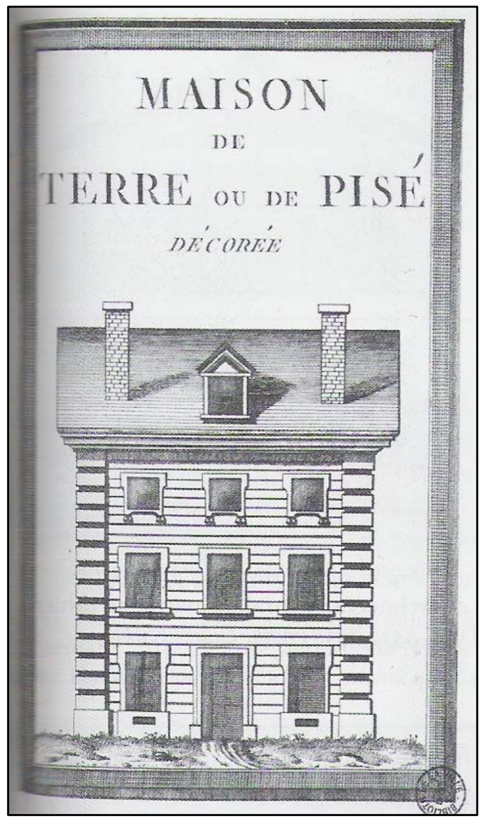

Figure 30. The same house with pisé decorée imitating stone. (Image: Louis Cellauro and Gilbert Richaud)

Some of the specific ideas that Cointeraux wrote about were expansions of Goiffon and Boulard's work. However, he did not just simply copy their work, but rather rewrote the

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93 Cellauro and Richaud, "Thomas Jefferson and Francois Cointereaux, Professor of Rural Architecture in Revolutionary Paris," pg. 183.

methods and construction of pisé. He expanded on Goiffon’s soil suggestions and rather than shying away from a clayey or sandy soil, Cointeraux recommended using a clayey soil with a sandy soil or using a rich soil with a poor soil. He renamed the rammed instrument from a pison to a pisoir, the term that is still applicable today. He suggested tapering the walls to help with water runoff. He also discussed the exterior treatment of the walls, letting them dry for six months, removing any loose dirt with a brush, and then applying a roughcast or stucco. Though he worked extensively in France, only two of his buildings survive today, one of which is the former Hôtel Maccabbes, which today is a service station and is in poor condition.[94]

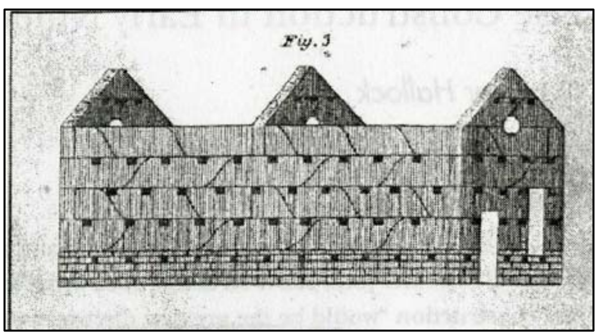

Figure 31. A pisé house showing layers of tamping. (Image: S.W. Johnson)

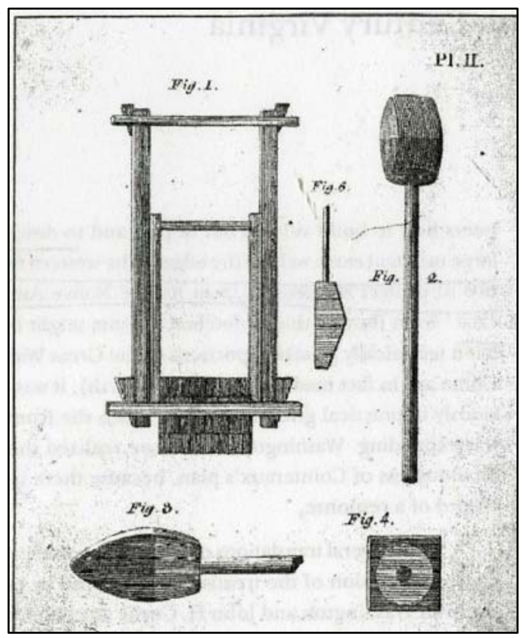

Figure 32. A pisoir and shuttering. (Image: S.W. Johnson)

94 Lewis, *Origins of Pisé de Terre*, October 25, 2008., pg. 6

In 1795, Cointeraux founded his last “school” in Paris and the models he built there remained on site until 1814 for visitors to see. At his “schools,” Cointeraux would build columns, buildings, and large walls that surrounded the entire property.[95] Ten years later, he patented a machine called a crécize, which was used to make his earthen blocks used for nouveau pisé.[96]

Throughout his career in Paris where he wrote many publications disseminating his ideas and methods of pisé, Cointeraux also formed a relationship with Thomas Jefferson, who served as Minister to the Court of Louis XVI from 1784 – 1789.[97] He and Jefferson exchanged letters for years and Jefferson owned all four of Cointeraux’s cahiers, but he thought that the American climate was not suitable for pisé. Cointeraux even asked Jefferson in 1792 to ask President Washington to pay for his family’s passage to America so that he could set up a pisé school in the states. Washington never responded.[98]

The last correspondence between the two was in May of 1808 when Cointeraux sent Jefferson some pamphlets he had written for a conference. Jefferson returned the pamphlets to Cointeraux and wrote of his doubt that pisé would be good for use in the United States. He writes in reference to pisé standing for hundreds of years in Lyons, “But in that country they have but a few inches of rain in the year, and very rarely a frost

[95] Cellauro and Richaud, "Thomas Jefferson and Francois Cointereaux, Professor of Rural Architecture in Revolutionary Paris," pg. 186.
[96] ibid, pg. 190.
[97] “Chiefs of Mission by Country, 1778 – 2005.” United States Department of State. Accessed February 16, 2009. <www.state.gov/r/palholpolcom/10576.htm>.
[98] “Thomas Jefferson to George Washington, 08 November 1792.” Library of Congress, Washington, D.C. Thomas Jefferson Papers Series 1, General Correspondence, 1651 – 1827.

to injure an olive tree. Here, we have between 3. and 4. feet of rain annually and frosts which will make ice of a foot or two thickness. Its duration here then must be doubtful."[99] Despite Jefferson's doubts of the success of pisé in America, Cointeraux's translated works were still influential on American soil. In 1815, Cointeraux entered a hospice and died there on May 13, 1830.[100]

England

The use of pisé traveled from France to England mostly through Francois Cointeraux's personal friendships, his students, and British patrons. His publications were in England, but more is known about the transmittance through personal relationships. In 1791 – 1793, Cointeraux went to the estate of Philip Yorke, the third Earl of Hardwicke, to demonstrate pisé. A few years earlier, two men trained by Cointeraux traveled to the Academy of the Arts in London to show the British how pisé was built. Their demonstration was written about in many publications.[101]

Perhaps one of the most important British architects associated with pisé was Henry Holland during the late 1790s. He served as the architect for the fifth Duke of Bedford, who was a known agricultural promoter and introduced the idea of pisé to Holland. At the Duke's Woburn Abbey Estate, Holland constructed houses for the laborers in 1787 –

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[99] Cellauro and Richaud, "Thomas Jefferson and Francois Cointereaux, Professor of Rural Architecture in Revolutionary Paris," pg. 193.
[100] ibid, pg. 191.
[101] Cody, *Earthen Walls from France and England for North American Farmers, 1806 - 1870,* pg. 37.

88.[102] Essentially, Holland took his experiments with pisé and combined it with an English translation of Cointeraux's work including only what he deemed significant.[103]

After Henry Holland's publication of Cointeraux's work, with a few added suggestions, pisé became more popular in progressive agricultural circles. Many of these publications included pattern books that offered designs for cottages and other residences as well as other rural buildings that could be built out of pisé. The authors of these pattern books recognized the strength, durability, and cheapness of pisé construction and suggested the benefits of rammed earth construction.

In his 1795 *Ferme Ornée,* John Plaw wrote an advertisement page recognizing the newly popular method of pisé. He writes, "That this method is practicable on a small scale, I am well assured by some Gentlemen, who have really built with success in this manner. It is certainly cheap, for the mould or case once formed, it is easily shifted, and the whole process may be performed by common labourers."[104] Plaw also discusses how pisé has some advantages over other materials because a pisé building is ready for someone to live in it as soon as the structure is formed. Throughout the rest of this work, Plaw offers up many different designs for structures that can be built of many different materials including pisé. Some of these designs include fences, cattle sheds, dog kennels, cottages, villas, and barns.

[102] Lewis, *Origins of Pisé de Terre,* October 25, 2008, pg. 7.
[103] Cody, *Earthen Walls from France and England for North American Farmers, 1806 - 1870,* pg. 38.
[104] John Plaw, *Ferme Ornée,* (London: I. and J. Taylor, 1795): Foreword.

Plaw wrote two other pattern books after *Ferme Ornée* entitled *Sketches for Country Houses, Villas, and Rural Dwellings* and *Rural Architecture*. In *Sketches for Country Houses, Villas, and Rural Dwellings*, Plaw references his earlier work as well as discussing Henry Holland's work in the Board of Agriculture's *Communications*. He states that he has learned from several gentlemen who have tried pisé construction that the wall construction cost is one third that of other materials.[105] In the plate section of the work, Plaw discusses what each design is as well as describing which materials would be best for each design. On plates I, VI, VII, and XII, Plaw specifically suggests that pisé could be used to build these buildings.

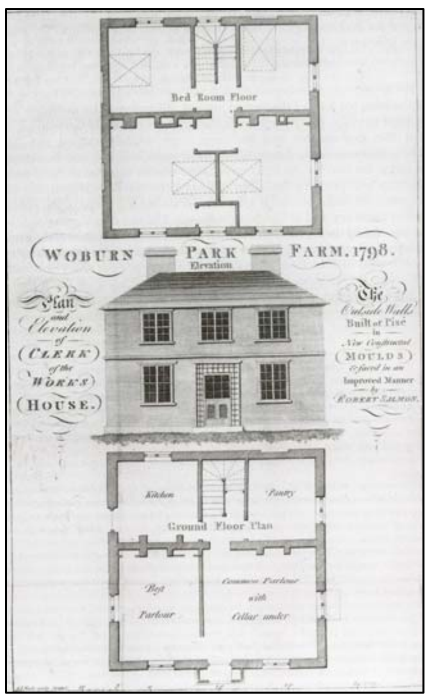

Figure 33. Design of pisé farm building at Woburn Abbey by Robert Salmon. (Image: Louis Cellauro and Gilbert Richaud)

[105] John Plaw, *Sketches for Country Houses, Villas, and Rural Dwellings,* (London: S. Gosnell, 1800): 4.

In addition to John Plaw, John Papworth also published a pattern book in 1818 called *Rural Residences (Consisting of a Series of Designs for Cottages, Decorated Cottages, Small Villas, and Other Ornamental Buildings).*This work was published about ten years after Plaw's last pattern book and his designs are similar to Plaw's. Like Plaw, Papworth describes what materials can be used to build his designs, but he offers up a section of his work to talk about the use of pisé and its exterior coverings. In England, some builders used cob walling made of clay, gravel, and straw for construction, but Papworth advocates for "a more scientific and durable walling," in pisé.[106] He notes that Henry Holland was the one who introduced pisé to England and that it was a very popular construction form in Italy and Southern France. The pattern books, as the main vehicle for disseminating architectural styles, show that pisé was considered a durable form of construction for rural uses during this time.

In addition to the French influence of pisé in England, there was also influence from North Africa. Reverend J.C. Wright traveled to North Africa and saw rammed earth being built there. He brought this knowledge back to England and built a school, garden walls, and outhouses at his rectory in Hertfordshire. Influenced by Reverend Wright, Reverend Langlands built a schoolhouse and dwelling at his rectory before 1835. He published an account of his experience in *The Ecclesiologist* in 1848. The ideas brought over from

[106] John B. Papworth, *Rural Residences,* (London: J. Diggens, 1818): 15.

North Africa led to a small revival of pisé in England of actual pisé in practice rather than only publications.[107]

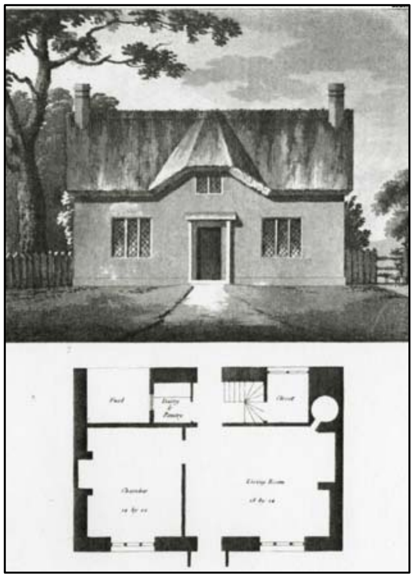

Figure 34. Design for a simple pisé cottage. (Image: John Plaw)

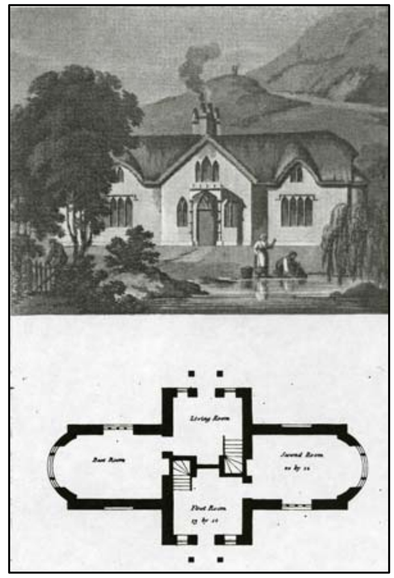

Figure 35. Design for a pisé cottage. (Image: John Plaw)

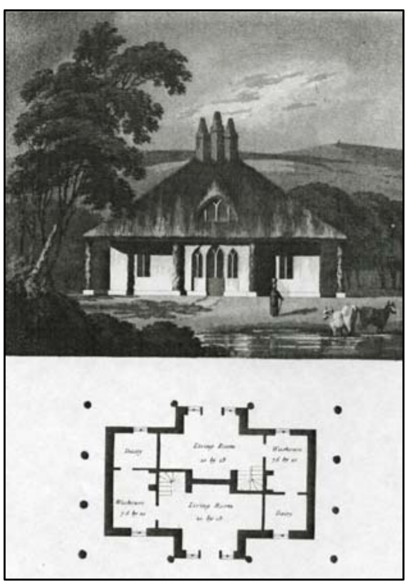

Figure 36. Design for a large pisé cottage. (Image: John Papworth)

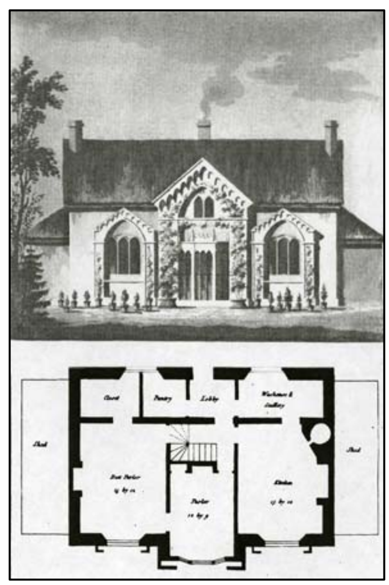

Figure 37. Design for a larger pisé residence. (Image: John Plaw)

[107] Lewis, *Origins of Pisé de Terre,* October 25, 2008. pg 9.

Germany

Germany was one of the first countries where the art of pisé spread. Architect David Gilly translated Cointeraux's work into German in 1793. Ten years earlier, Gilly had founded a private architecture school in Stettin that focused on French rationalist theory and ideas about rural building construction. Stressing construction and materials as the basis of architectural design, Gilly later founded another school based on the same ideas in Berlin in 1793. In addition to translating Cointeraux's work, Gilly also published articles expressing Cointeraux's ideas and he dedicated an article specifically to Cointeraux in 1797. Like Cointeraux, Gilly built experimental buildings as well as permanent structures. One in particular is the Palace Kleinmachnow, which was significantly damaged during World War II, which was not rebuilt.[108]

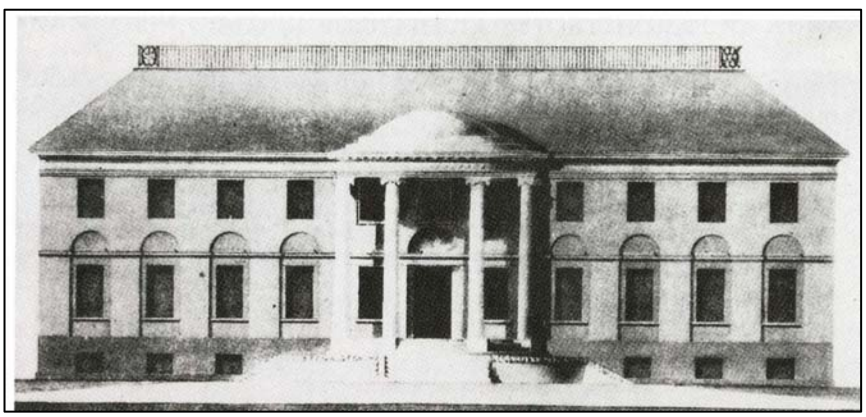

Figure 38. David Gilly's design for the Palace Kleinmachnow. (Image: Louis Cellauro and Gilbert Richaud)

[108] Cellauro and Richaud, *François Cointereaux's École d'Architecture Rurale (1790-91) and its influence in Europe and the colonies*, pg. 130

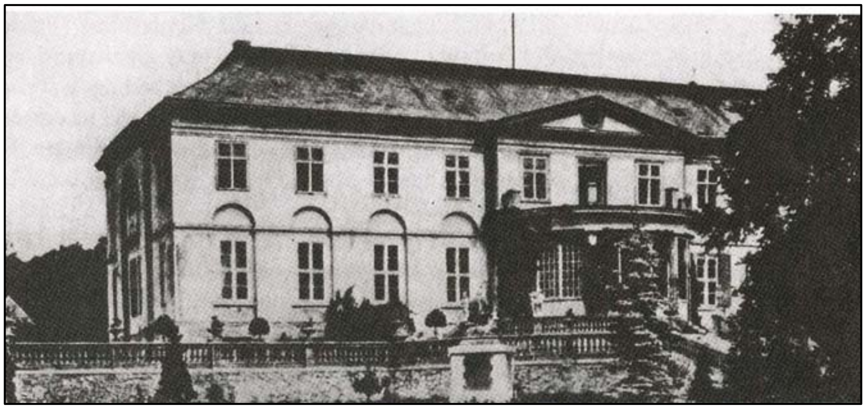

Figure 39. The finished Palace Kleinmachnow in 1919 before sustaining damage during World War II. (Image: Louis Cellauro and Gilbert Richaud)

Other Germans interested and writing about pisé were Christian Ludwig Seebass and Saloman Sachs. However, Wilhelm Jacob Wimpf made the biggest impact. Between 1820 and 1840, he designed industrial buildings, over twenty residences in Weilburg an der Lahn, Germany, and built a seven story apartment building.[109]

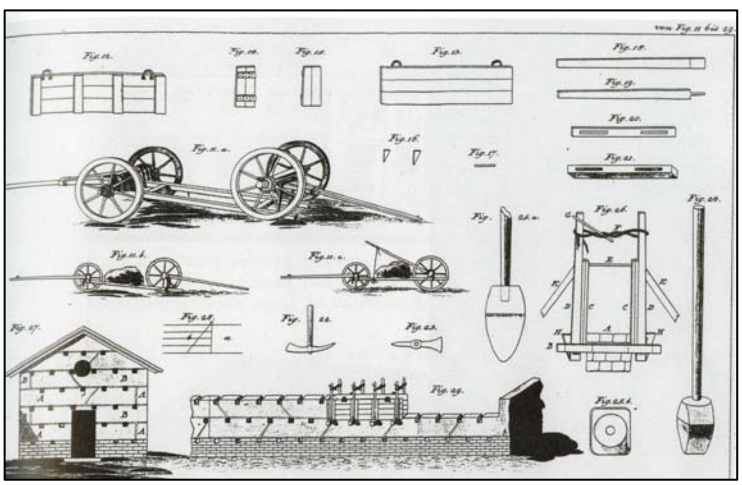

Figure 40. Sketches by David Gilly of pisé tools. (Image: Louis Cellauro and Gilbert Richaud)

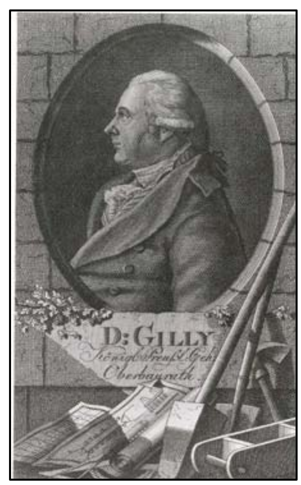

Figure 41. Portrait of David Gilly. (Image: Louis Cellauro and Gilbert Richaud)

[109] Cellauro and Richaud, *François Cointereaux's École d'Architecture Rurale (1790-91) and its influence in Europe and the colonies,* pg. 132.

Figure 5. A townhouse designed and built by Wimpf in Weilburg an der Lahn. (Image: Louis Cellauro and Gilbert Richaud)

Figure 43. A seven story apartment building of pisé on a hillside built by Wimpf. (Image: Louis Cellauro and Gilbert Richaud)

In addition to being translated into German, Cointeraux's work was also translated into Danish and Finnish. In 1796, Klaus Henrik Seidelin's translation was published in Denmark between the while the Finnish translation was published two years later.[110]

Russia

The Russian translation of Cointeraux's work was done by Aleksander Barsov in 1794. This work was known to have influenced Nicolai L'vov and several Scottish architects including Adam Menelaws, John Cochrane, and David Cunnigham, who were sent by Charles Cameron, a Scottish designer, to Russia to work. The group of men began a large

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[110] Cellauro and Richaud, *François Cointereaux's École d'Architecture Rurale (1790-91) and its influence in Europe and the colonies,* pg. 135.

project that involved pisé construction in St. Petersburg building the designs of Charles Cameron at Tsarskoe.[111]

L'vov built the first earth houses in 1793 in Nikolskoe, but none of these structures survive today. He was influenced by Charles Middleton's designs for cottages, farm houses, and country villas written the same year. Appointed by Csar Paul, L'vov and his chief assistant, Adam Menelaws, began to bring pisé into the Russian architectural lexicon. The two men set up the School for Earth Construction in Torzhok and Moscow in 1798. They first built barracks at the school in Torzhok of earth walls and a thatched roof and found the buildings to be hygienic and resistant to dampness, heat, and frost. They believed that the simplicity of the building material did not call for intricate details or decoration. They did not apply any exterior coatings to the exterior and preferred the look of stone for foundations with smooth earth walls.[112] In 1798 – 99, L'vov designed and built the Priorat in Gatchina, which still survives today.[113]

The construction of their buildings began with pure earth cleaned of weeds that was rammed into portable molds. The walls surrounding the yard of the area were made of pre-shaped earth blocks like Cointeraux's nouveau pisé. Interior walls were coated with

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111 Cellauro and Richaud, *François Cointereaux's École d'Architecture Rurale (1790-91) and its influence in Europe and the colonies*, pg. 135.
112 Makhrov, *Earth Construction in Russia: A Scottish Connexion*, pg. 172 - 173.
113 "Priory: History of the Priory Palace." Museum of the Gatchina Palace. Accessed February 16, 2009. <www.history-gatchina.ru/museum/priorat/ehistory.html>.

lime and cow's hair. This rendering method is referred to as the "English" method and was practiced in Scotland for plastering clay walls as well.[114]

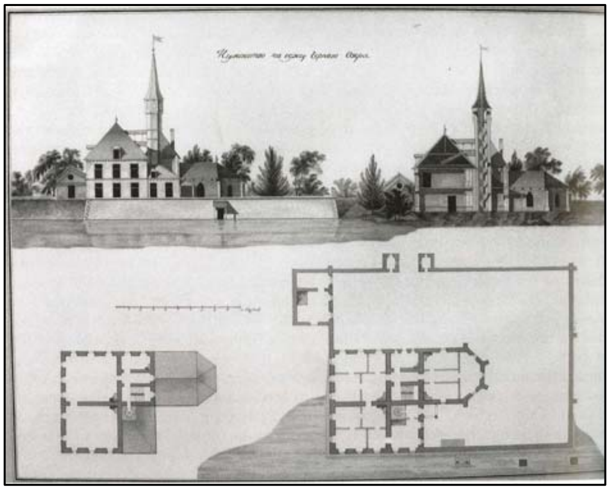

Figure 44. L'vov's design for the Priorat at Gatchina. (Image: Louis Cellauro and Gilbert Richaud)

The school's agenda that L'vov and Menelaws created was to introduce pisé in rural architecture by teaching peasants brought from different regions of Russia for an eighteen month learning period.[115] The building process began with a stone foundation and then layers of earth were placed on top of the foundation. Windows and doors were created by placing thin planks of wood eighteen centimeters above and below where the door or window was to be located. Finally, a ditch was dug all the way around the building to drain water away from the building.

[114] Makhrov, *Earth Construction in Russia: A Scottish Connexion*, pg. 176.
[115] ibid, pg. 179.

The school thrived for a few years, but after Tsar Paul was assassinated in 1801, the school lost its official patronage. The class sizes declined until 1803 when there were no students. The following year, L'vov died and the school officially closed.[116]

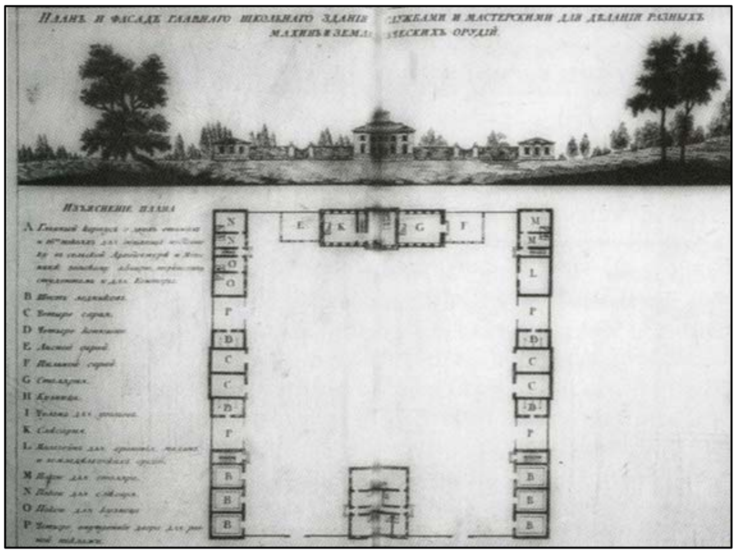

Figure 45. L'vov's design for the main building and school complex at the School of Earth Construction. (Image: Louis Cellauro and Gilbert Richaud)

Australia and New Zealand

Henry Holland's English translation appeared as far away as Australia and New Zealand. The first appearances of pisé discussions were found in Abraham Rees', "The Works of Cointeraux, on Rural and Economic Building," in 1817 and in an article in the Hobart *Town Gazette* on May 3, 1823. The latter article was more detailed than Rees' publication and seems to have been more widely disseminated. Pisé construction was found during

[116] Cellauro and Richaud, *François Cointereaux's École d'Architecture Rurale (1790-91) and its influence in Europe and the colonies,* pg. 139.

the early years on the western plains and in New South Wales, where other traditional materials like wood were not readily available.[117]

During the decades of the 1860s and 1870s, pisé was used by German and Irish immigrants to New South Wales, Australia. Another group of immigrants, French priests from Lyons, built the the Pompallier House, circa 1841 – 42, using Rondelet's treatise to direct the house's construction.[118]

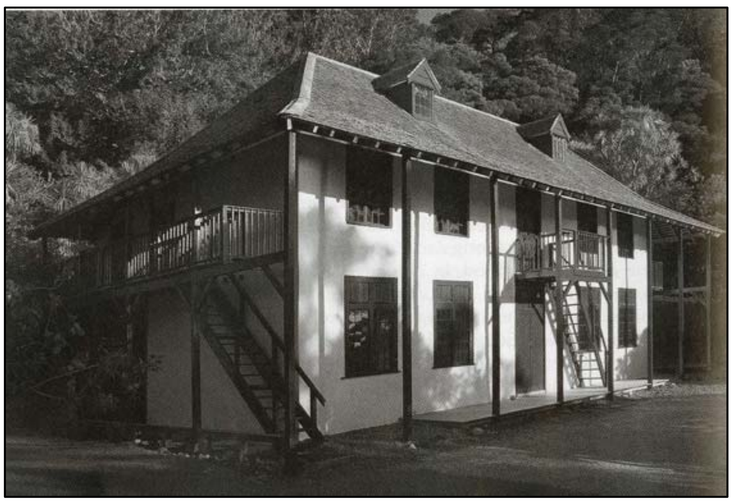

Figure 46. The Pompallier House in New Zealand built by priests from Lyons. (Image: Louis Cellauro and Gilbert Richaud)

United States of America

Despite Thomas Jefferson dismissing the idea of pisé's use in America, some Americans experimented with pisé in the early parts of the 19th century. Stephen W. Johnson had read Holland's work and decided to build a house in New Brunswick, New Jersey of

[117] Cellauro and Richaud, *François Cointereaux's École d'Architecture Rurale (1790-91) and its influence in Europe and the colonies*, pg. 140.
[118] "Pompallier." New Zealand Historic Places Trust. Accessed February 16, 2009. <www.historic.org.nz/Pompallier/pompallier_history.html>.

rammed earth. He published his account of building the house in *Rural Economy* in 1806.[119] In this work, he essentially reiterated Holland's ideas without referencing him, but added his own suggestions, findings, and criticisms. Johnson's work was read and had influence first in the southeastern United States where Justice Bushrod Washington, George Washington's nephew, who inherited Mount Vernon, experimented with pisé outbuildings from 1810 – 1815. His friend, General John Hartwell Cocke used Johnson's work as a guide and built slave quarters of pisé at his plantations in Virginia. Johnson's work was republished in 1821 in *The American Farmer*, a popular agricultural periodical.[120]

Other Americans interested in pisé during this time were John Stuart Skinner, the editor of *The American Farmer*, known for spreading the European knowledge of earthen walls to American farmers during his time with the periodical from 1819 – 1830. He first became interested in pisé in 1820, published Holland's translation in1821, and was particularly interested in Cocke's experiments in Virginia. Cocke wrote to the paper several times, including a letter where he was concerned that the Virginia climate was too moist and damaged the earth walls.[121] Another subscriber to *The American Farmer*, William Wallace Anderson of Stateburg, South Carolina, wrote to Skinner to tell of his experiments with pisé. He built the wings of his house, the Borough House, and ten

[119] Gardiner Hallock. "Pisé Construction in Early Nineteenth-Century Virginia." In *Perspectives in Vernacular Architecture*, Volume 11 (2004): pg. 10.
[120] Lewis, *Origins of Pisé de Terre*, October 25, 2008, pg. 24.
[121] John Hartwell Cocke, "Letter to the Editor," *The American Farmer, Containing Original Essays and Selection on Rural Economy,* Baltimore, August 10, 1821.

outbuildings, as well as later influencing his community to build their new church out of pisé.

Into the 1830s, rammed earth enthusiasts Benjamin Rivers Carroll, Nicholas Herbemont, and Philip St. George Cocke wrote about the economic reasons for building farm buildings, fences, and factories of pisé. Through the work of these men and their predecessors, the interest in pisé began to spread north. *The Genesse Farmer* in Rochester, New York published letters and accounts about pisé. Through the 1840s, rammed earth was adopted by American agriculturalists lead by Henry L. Ellsworth. He served as the first American patent commissioner and in his annual *Reports* between 1843 – 45, he praised unburnt brick as a good method of construction. He also built experimental buildings in Washington, D.C., and Grand Prairie, Indiana. Ellsworth's suggestions and ideas helped influence editors of other periodicals to ask their subscribers for opinions about pisé and its use on the frontier. Another influential editor was John Stephen Wright of Chicago. He worked for *The Prairie Farmer* from 1843 – 55 and made forty references to pisé during those twelve years, the most made by any American publication.[122]

By the 1850s, pisé's use declined as cheaper materials like sawn lumber and fired bricks became available. These new materials were easier to handle, transport, and abundant. The decade of the 1840s proved to be the apex of pisé construction. Some rammed earth

[122] Cody, *Earthen Walls from France and England for North American Farmers, 1806 - 1870,* pg. 40.

construction was seen after 1850, but by the 1870s, there were no justifications to continue using pisé until World War I.

Use in 19th-century America

Frequent publications about pisé solicited by southern plantation owners to document their own experiments in pisé construction were found throughout the early decades of the 19th century. While Thomas Jefferson had dismissed pisé as unsuitable for the wet climate of the eastern United States, Bushrod Washington, John Hartwell Cocke, and William Wallace Anderson built dwellings and outbuildings of pisé at their respective plantations between 1820 and 1840. Washington and Cocke both saw pisé as a way to provide better housing for their slaves. Cocke and Washington's pisé buildings signified local traditions for slave housing rather than Cointeraux's designs, but they followed the methods and guidelines set forth by Cointeraux and translated by Holland and Johnson.[123]

After inheriting Mount Vernon following Martha Washington's death, Justice Bushrod Washington became the first person to construct pisé buildings in the United States. Between 1810 and 1815, he built seven pisé residential and agricultural structures. As a social activist and agricultural reformer, Justice Washington felt that log or frame houses were hard to heat and cool and pisé was a way to improve slave housing.[124] The main influence on Washington comes from St. George Tucker who wrote to him and told him

[123] Hallock, "Pisé Construction in Early Nineteenth-Century Virginia." pgs. 40 – 41.
[124] ibid, pg. 42.

of Johnson's work. In 1810, the first structure, a house for slaves or an overseer, was built, followed by two porter cottages and an above ground ice house in 1812, and two barns, a food boiler, and a greenhouse in 1815. None of these structures remain extant today, with the last structures, the porter lodges, demolished in 1874. The porter lodges and the greenhouse are the only buildings documented as surviving after 1860.[125]

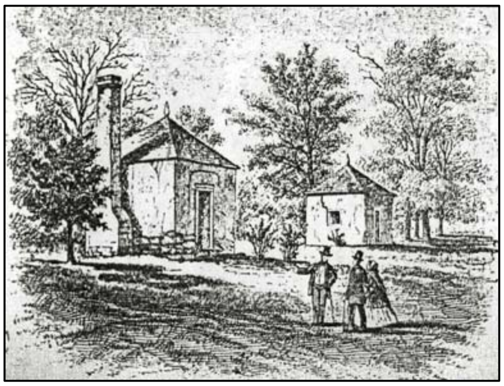

Figure 47. Bushrod Washington's pisé porter lodges in an 1858 *Harper's Weekly* illustration. (Image: Gardiner Hallock)

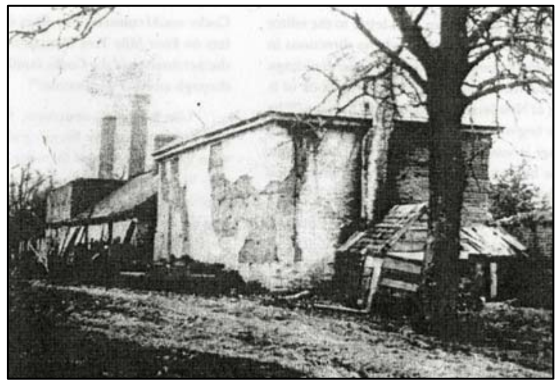

Figure 48. Bushrod Washington's greenhouse made out of pisé. (Image: Gardiner Hallock)

One of the porter lodges, originally situated at the entrance to Mount Vernon, and a cow food boiler, survive archaeologically and demonstrate the agriculturally progressive side of Justice Washington. The cow food boiler was used to break down green fodder by boiling it before it was fed to livestock. He also built his icehouse entirely above ground, relying on the pisé walls to keep the ice cold.[126]

[125] Hallock, "Pisé Construction in Early Nineteenth-Century Virginia," pg 42.
[126] ibid, pg. 43.

Washington altered the composition of the soil that he used. With the first buildings, he used clay and added water during compaction, which is discouraged in Johnson's work. Because of this, the earth cracked and Bushrod decided to add sand to his mixture the next time and found that clay mixed with sand, as advised by Johnson, was better.[127]

Figure 49. Pisé slave quarters at John Hartwell Cocke's Bremo Plantation. (Image: Gardiner Hallock)

Figure 50. Pisé slave quarters at Pea Hill Plantation. (Image: Gardiner Hallock)

General John Hartwell Cocke, a friend and associate of Justice Washington, began to build with pisé at the same time Bushrod was finishing his experiments. On Bremo Plantation on the James River in Fluvanna County, Virginia, Cocke built earthen slave quarters in 1815. Between the years of 1815 and 1821, Cocke built sixteen other pisé buildings on Bremo Plantation, Pea Hill Plantation, and Bremo Recess.[128]

Around eleven buildings, including an overseer's cabin, were constructed at Pea Hill Plantation, which Cocke managed for a friend in Brunswick County, Virginia. The rest of

[127] Hallock, "Pisé Construction in Early Nineteenth-Century Virginia." pg. 43 – 44.
[128] John Hartwell Cocke, "Letter to the Editor," *The American Farmer, Containing Original Essays and Selection on Rural Economy,* August 10, 1821.

the structures, which were of an average size for slave dwellings at the time, were built at Bremo Plantation. They include two double house slave quarters and one single room slave quarter. In 1835, John Cocke's son, Philip, constructed two pisé slave quarters at Four Mile Tree Plantation.[129]

Figure 51. Pisé overseer's cabin at Pea Hill Plantation. It now serves as the entrance to Kennon House Restaurant. (Image: Gardiner Hallock)

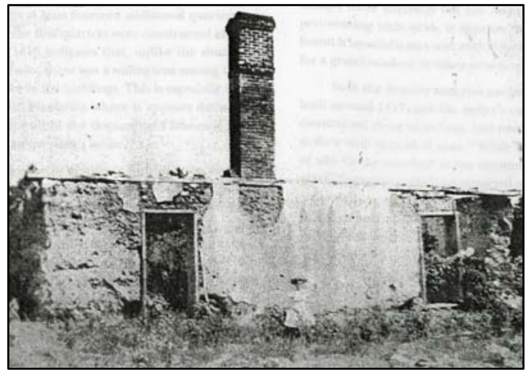

Figure 52. Ruins of pisé slave quarters at Philip Cocke's Four Mile Tree Plantation. (Image: Gardiner Hallock)

Like Washington, John Hartwell Cocke experimented with the soil mixture. He toyed with different binders and aggregates. In one experiment, he used straw, but later removed it from the mixture and replaced it with a gravel binder as the straw would disintegrate and leave voids in the pisé while the gravel binder compacted better and created less cracks when the earth dried. John Cocke also tried different roof forms including flared eaves, shingled gable pent, and gable pent. No publications had mentioned specific roof forms to protect the walls, and Cocke found that the flared eaves directed the rain farther away from the earthen walls. This was an attempt by Cocke to

[129] Hallock, "Pisé Construction in Early Nineteenth-Century Virginia." pg. 45 – 49.

better adapt pisé construction to a wet climate like Virginia.[130] The last contribution Cocke made was to use pisé block construction. In a letter he wrote to the editor of *The American Farmer* on June 4, 1821, Cocke proposed that instead of using forms to create pisé walls, pisé block molds could be created and the pisé blocks could be made like bricks. They could then be laid the same way as typical masonry, but the idea received ambivalent responses.[131]

After Dr. William Wallace Anderson moved to South Carolina in 1789, he built the wings of his house, the Borough House, and ten outbuildings out of pisé starting in 1821. In a letter to *The American Farmer* dated March 15, 1824, Anderson discussed the construction of the first outbuilding, a dairy, in April and May of 1821. Under the direction of *Rural Economy*, Dr. Anderson found that after roughcasting the walls and whitewashing the interior walls, the building survived three winters with no damage. Because of the success of his first experiment, Dr. Anderson built another house for his house servants and found success with its construction as well. He lauded the benefits of pisé including low cost, durability, external appearance, internal comfort, and speed with which a pisé structure can be built.[132]

In addition to the dairy and slave quarters, Dr. Anderson built other outbuildings on his property at the Borough House. The wings of his house were also rebuilt in pisé and had

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[130] Hallock, "Pisé Construction in Early Nineteenth-Century Virginia.", pgs 49 – 50.
[131] John Hartwell Cocke, "Letter to the Editor," *The American Farmer, Containing Original Essays and Selection on Rural Economy.* Baltimore, August 10, 1821
[132] William Wallace Anderson, "Letter to the Editor," *The American Farmer, Containing Original Essays and Selection on Rural Economy.* Baltimore, March 26, 1824

walls eighteen inches thick, ten feet high, and covered with a lime stucco. The library's walls were finished to look like ashlar stone and there was a peristyle. The loom house had walls that were one foot thick with no stone foundation. Even with the earth directly on the ground and rain splashing on the walls, there was not any damage at the time of an inspection in 1926.[133] The lime stucco was also still in good condition after over one hundred years. The tool house had some wasp activity discovered in 1926, but was in overall good condition. The walls were eighteen inches thick and the cornerstone was dated 1821. A leaky roof that had exposed the building for many years had caused some stucco damage, but the earth was unharmed. Of the well house, servants' quarters, and Dr. Anderson's doctor's office, two were torn down by 1926.[134] Today, all the buildings surveyed during the inspection still stand and are in good condition.

Dr. Anderson's interest in and praise of pisé did not end with his own house. In 1850 – 52, when the Episcopal Church of Claremont just down the hill from the Borough House was deciding how to build their new church, Dr. Anderson exerted his influence on the building committee, of which he was the head. While the members vacillated between masonry and stone, Dr. Anderson suggested using pisé as more church could be built for the same price. The other members agreed and the new Church of the Holy Cross was built of pisé.[135]

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[133] Thomas A.H. Miller. *Report on the Condition of Rammed Earth Buildings Built 1820 to 1854 on the Plantation of Mr. W.L. Saunders Located Near Sumter, South Carolina*. United States Department of Agriculture (1926): 7.
[134] ibid, pg. 9.
[135] William Wallace Childs, letter to the editor. *The Evening Star*. Washington, D.C., December 3, 1923.

Figure 53. Dr. Anderson's school. (Photo: Author)

Figure 54. The loomhouse at the Borough House. (Photo: Author)

Figure 55. The Borough House with pisé wings. (Photo: Author)

Chapter 3

Rammed Earth in South Carolina

While pisé's most popular period of publication and practice was during the second quarter of the 19th century, earthen walled structures built of rammed earth and other construction methods were found in the Lowcountry from the earliest days of settlement through the antebellum era. Because it is not commonly found east of the Mississippi River because of humid climate and its effect on the earth's drying process, only a few of these early structures remain. As previously discussed, the only extant rammed earth buildings in South Carolina are located in Stateburg, Sumter County. However, archaeological remains of earth walled structures have been found in the Charleston area on the peninsula and in the surrounding areas on former plantations. When the Judicial Center was constructed in downtown Charleston in 2004, the archaeological dig completed prior to construction unearthed remnants of a colonial earth walled structure.[136] This structure represents the only known earth walled structure on the peninsula and perhaps the largest earth walled structure that had been exposed in the state. A large pit, which was used to harvest the clay, was also discovered next to the structure.

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[136] New South Associates. *A New Look at the Old City: Archeological Excavations of the Charleston County Judicial Center Site*. Stone Mountain: New South Associates Technical Report, 2004: 244.

Earthen architecture had been used at sites in South Carolina and Georgia for housing in African American plantation villages and has been associated with African architecture. The three cultures known for their use of earthen architecture, the English, French, and Yoruban, all contributed construction methodologies to early colonial architecture of the Lowcountry, but the African culture seems to have played a larger part as they had a larger population.

Figure 56. Map of the state of South Carolina. Stateburg is located about ten miles west of Sumter (arrow) (Image: www.student.brittanica.com)

Slaves continued to build earthen dwellings up to the fourth quarter of the 18th century, when slave houses transitioned to frame and wood structures. Slaves also had a sort of negotiating power over their owners due to their extensive knowledge of rice and its cultivation, upon which many plantation owners were dependent.[137] Many rural Lowcountry plantations employed the task system whereby slaves were assigned tasks for each day and once those jobs were done, the rest of the day was left to take care of their own needs. This system awarded slaves a degree of freedom. This system coupled with the slaves' majority population, the continued import of slaves into the area, and isolation from whites all allowed slaves to retain aspects of their West African cultural identity, including their preferred building methods.[138]

In addition to being used by Africans in the Lowcountry, rammed earth was also used at two sites in the central part of the state through the influence of Dr. William Wallace Anderson. After reading S.W. Johnson's *Rural Economy* while in medical school in Pennsylvania, he used the ideas originally set forth by Francois Cointeraux and built the wings of his house as well as outbuildings of pisé.[139] His interest in pisé not only brought the construction method to his own house, but also to the town of Stateburg. Thirty years after building on his own property with pisé, his influence helped to persuade the building committee for the Church of the Holy Cross, across King's Highway from the Borough House, to build their new church out of pisé.

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[137] J. W. Joseph and Martha Zierden, *Another's County: Archaeological Perspectives on Cultural Interactions in the Southern Colonies*, (Tuscaloosa: University of Alabama Press, 2002): 34.
[138] George McDaniel, *Hearth & House: Preserving a People's Culture*, (Philadelphia: Temple University Press, 1982): 33.
[139] Nicholas. *Historical Sketches of Sumter County: Its Birth and Growth, pg.* 444.

African Architecture

African architecture is thought of as simple, but research over the years has shown that there are many complex forms and methodologies in African architecture, including rammed earth. The two case study buildings this thesis focuses on, in Stateburg, South Carolina, were constructed by African American slaves under the guidance of their owner, using *Rural Economy*. While the slaves did not use native or traditional methods to build these structures, it is possible that they or their ancestors knew of rammed earth before it was popularized in America.

The type of house form that persists and flourishes in America derives from a rectangular form seen in West Africa and Haiti. This type is thought to have evolved into the shotgun house seen in Louisiana as well as the derivative boarding house and freedman's cottages that proliferated in the southeast.[140] The slave trade between West Africa, the Caribbean, and the United States continued the house form through its use by slaves and free persons of color.

The French had colonies in West Africa, trading closely with Haiti by sending slaves from Yoruba to the Caribbean. Traditional house forms from West Africa were transported to Haiti where ideas were mixed with French settlers and native Haitians. The Yoruban house was usually composed of two rooms (10 x 21 feet) making a rectangular

[140] Dell Upton and John Michael Vlach, *Common Places: Readings in American Vernacular Architecture,* (Athens: University of Georgia Press, 1986).

building. The shotgun form seen in Haiti developed from this simple plan and a front covered porch was added more to aerate the house. Some of the houses in Haiti were constructed out of the traditional wattle and daub method which used posts with horizontal bands of wood woven between them and then covered with clay.

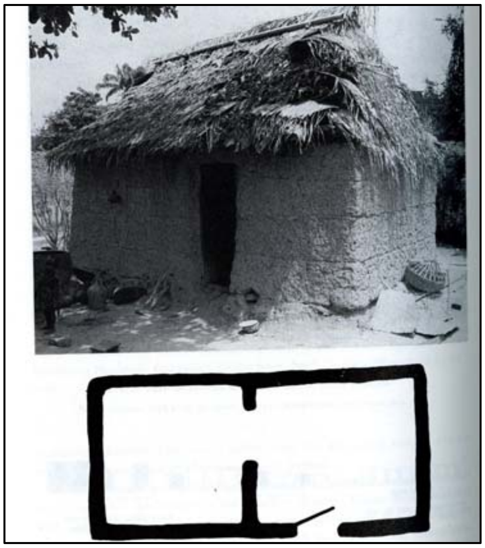

Figure 57. A West African hut architectural form from which the shotgun house evolved. (Photo: Leland Ferguson)

John Michael Vlach asserts that the Africans in Haiti tried to make their new environment resemble something they were familiar with. Thus, the new Africans in Haiti built their dwellings as they were accustomed.[141] This same house form was brought over to New Orleans and other southern colonies by French settlers and free persons of color around the first half of the 19th century. The earliest shotgun house seen in New Orleans was in 1833 and the house form has been associated with African Americans since it was first

[141] Dell Upton and John Michael Vlach, *Common Places: Readings in American Vernacular Architecture*, pg. 71.

seen in America. While the shotgun house form was prevalent in Louisiana, it was also used in the Lowcountry. Remnants found at the Judicial Center Site as well as at surrounding plantations showed the same architectural forms and details as those found in Louisiana, Haiti, and West Africa.[142]

The Judicial Center Site

Not only does the African house form flourish in America, but so does the construction technique to build that house. Many authors describe methods of construction of African houses in colonial America. While European cultures had clay walled structures, the African construction of earth walled buildings is distinctly different from the European colonial sites. African architecture features a trench dug out and then filled with earth to form the foundation of the building. The European cultures laid the foundation directly on the ground.[143] After the trenches were dug, posts were placed in the ground and dirt was infilled around them. A lattice work of branches was woven between the posts and was then plastered with wet clay with lime and animal hair, cow dung, or chopped straw additives. The walls both interior and exterior were finished with a thin mud plaster, which was smoothed and washed to keep a smooth and water repellent surface.[144]

At the Judicial Center site in Charleston, this type of construction was observed. However, the walls of Feature 79 featured no posts, just earth. The mixture of clay and

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[142] New South Associates. *A New Look at the Old City: Archeological Excavations of the Charleston County Judicial Center Site*, pg. 244.
[143] Joseph and Zierden, *Another's County: Archaeological Perspectives on Cultural Interactions in the Southern Colonies*, pg. 37.
[144] McDaniel, *Hearth & House: Preserving a People's Culture*, pg. 40.

additives was poured in the foundation trench and pounded down. The eaves of the roof and covered entry porch would have been extended far over the walls to protect them from rain and other moisture. Several features discovered at the site fit the description by Vlach as being distinctly African. The building is rectangular, with two interior rooms, no hallway, and a covered entryway.[145] These features, seen in shotgun houses, Haitian cailles, and Yoruban houses, are all observed in Feature 79.

The structure measured 32 x 21 feet with walls averaging 1.6 feet thick. The eastern end was open and had a covered porch that was supported by posts. Inside, there was an interior wall composed of posts and clay that separated the structure into two rooms. Many artifacts were recovered from the site spanning the 18th century. Archaeologists believe that the structure was demolished around the 1740s as they noticed that the postholes, which formerly held the roof and interior wall up, were filled in and contained artifacts dating to the 1740s.

Feature 79 was constructed by digging trenches and then filling those with clay. The mixture used was composed of earth, some sand and additives, a binder of Spanish moss, brick fragments, and pieces of wood. Clay actually made up 82 – 86% of the mixture, sand and loam 4 – 6%, and binders 10 – 12 %. Some parts of the wall also contained pieces of wood placed horizontally comparable to the wattle and daub technique.[146] This

[145] Joseph and Zierden, *Another's County: Archaeological Perspectives on Cultural Interactions in the Southern Colonies,* pg. 222.
[146] New South Associates. *A New Look at the Old City: Archeological Excavations of the Charleston County Judicial Center Site*, pg. 244.

particular structure was probably used as a kitchen and dwelling combination as it was larger than a typical kitchen of the day. It also may have been associated with early sugar production as many sugar cones were found near the site.

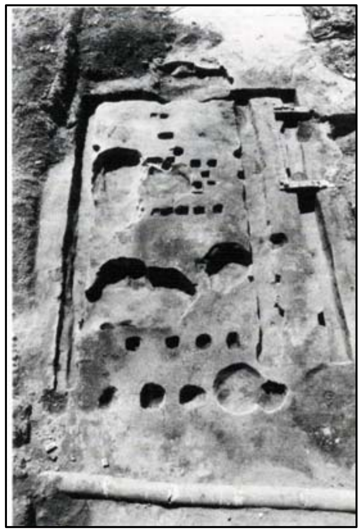

Figure 58. Archaeological remains of Feature 79 at the Judicial Center Site. (Photo: New South Associates)

Other Sites in the Lowcountry

While Feature 79 at the Judicial Site was a rare find on the peninsula, the areas around Charleston contain many other earthen walled structures. Two French plantations, Yaughan and Curriboo, and two English plantations, Mulberry and Quinby Plantations contained earthen slave buildings on their properties that date from the 1740s to the 1820s. Archaeology at Yaughan and Curriboo in the 1970s revealed the earthen structures and firsthand accounts from the 18th and 19th century survive describing the clay buildings at Mulberry and Quinby Plantations.

Patrick Garrow and Thomas Wheaton discovered slave houses in an African style on the Santee River in Berkeley County, South Carolina, at two neighboring French Huguenot plantations called Yaughan and Curriboo. Two slave quarters were found at Yaughan dating from the 1780s to the 1820s and the 1740s to the 1790s while one structure was found at Curriboo dating from the 1740s to 1800. In all, Garrow and Wheaton found 26 structures, most of which were identified as slave houses and outbuildings.[147] Most African style houses were built with post in ground construction and clay infill and the quarters at Yaughan and Curriboo were found to have post in ground construction tying these buildings to an African origin.

Figure 59. View of archaeological remains of an earth walled house at Curriboo Plantation. (Photo: Leland Ferguson)

The structures had wall trenches comparable to clay and cob buildings in West Africa.[148] The buildings, single and double unit structures, were very narrow and had no chimneys. The archaeologists also found pits near the houses, which were probably used to harvest

[147] Leland Ferguson, *Uncommon Ground: Archaeology and Early African America, 1650 - 1800,* (Washington, D.C.: Smithsonian Books, 1992): 64.
[148] Joseph and Zierden, *Another's County: Archaeological Perspectives on Cultural Interactions in the Southern Colonies,* pg. 36.

the clay for construction. After removing the topsoil, the builders mixed the subsoil, added water with their hands and feet, and then laid the clay in lumps similar to laying bricks. Archaeology revealed hearths directly on the floor of the quarters.[149] As with Feature 79 in downtown Charleston, these quarters had African characteristics including rectangular shape, two rooms, room size of around 10 x 10 feet, post in ground construction with clay placed over lattice work. At both the downtown site and on these plantations, many of the associated artifacts found were attributed to Africans including colonoware, a pottery traditionally made by Africans and their descendants.

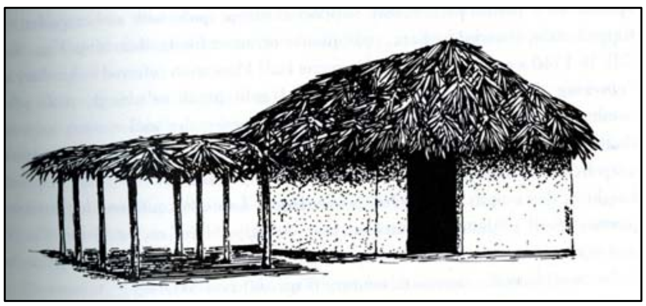

Figure 60. Rendering of what the slave cabins at Curriboo Plantation may have looked like. (Image: Leland Ferguson)

The evidence that survives for earthen structures at Mulberry and Quinby Plantations manifests itself in art through a painting and written letters. Thomas Coram sketched a view of Mulberry plantation looking towards the main house down the slave street.[150] In this view, one can see two sets of slave dwellings lining the street. They appear to be made of clay and are reddish orange in color with thatched roofs similar to those seen in West Africa. Also, slaves are seen in between them performing their daily tasks.

[149] Ferguson, *Uncommon Ground: Archaeology and Early African America, 1650 - 1800,* pg. 67.
[150] New South Associates. *A New Look at the Old City: Archeological Excavations of the Charleston County Judicial Center Site*, pg. 249.

Many experts agreed that these cabins were most likely built of clay based on how they look in images and on other neighboring plantations. Mulberry Plantation (c. 1714) was built at a time when many African slaves were entering colonial America and prior to the shift in slave architecture from earth to wood frame and siding.

Figure 61. Thomas Coram view showing a slave street lined with clay houses in front of Mulberry Plantation. (Image: www.gibbesmuseum.org)

During the Revolutionary War, General Francis Marion wrote a letter to Nathaniel Greene about the Battle at Quinby Ridge. Located on the east side of the east branch of the Cooper River, Quinby Plantation was situated near Quinby Ridge, where a bloody battle took place. The British under General Coates took cover in the slave houses. As the American troops attacked them, General Marion wrote, "the Enemy were posted in houses with Clay Walls which was very Difficult to penetrate without a field piece."[151] Essentially, the houses were so durable that only a cannonball would have pierced the walls indicating the strength and existence of earthen architecture.

[151] Edward Ball, *Slaves in the Family,* (United States: Random House, 1998): 232.

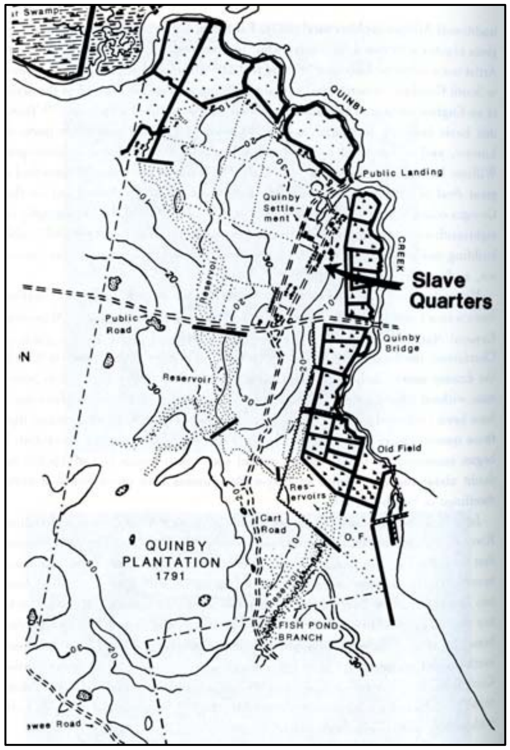

Figure 62. This map of Quinby Plantation shows the location of remains of slave cabins located near Quinby Ridge. (Image: Leland Ferguson)

In addition to these clay slave dwellings at Quinby and Mulberry, it has been thought that earthen dwellings were at Spiers Landing and Middleburg plantation. In 1822, Robert Turnbull wrote an article entitled *A Refutation of the Calumnies*, for an anti-abolition newspaper about slave dwellings in the Lowcountry. He writes, "Their dwellings consist of good clay cabins with clay chimneys, but so much attention has been paid of late years to their comfort in this particular, that it is now very common, particularly on the Sea Islands, to give them substantial frame houses and with brick chimneys."[152] Slave owners were beginning to make the switch to a new kind of slave architecture and away from the

[152] Ferguson, *Uncommon Ground: Archaeology and Early African America, 1650 – 1800,* pg. 79.

African style houses. After the 1820s, earthen or clay walled buildings began to be built less and less and the unique cultural tradition and identity with earthen architecture for Africans was slowly eradicated by 1840. While the two sites in Stateburg were built mainly under the influence of published materials, did any of Dr. Anderson's slaves have knowledge of rammed earth methodologies before they built the Borough House and the Church of the Holy Cross? Perhaps their ancestors were part of the first groups of enslaved Africans brought to the colonies that continued building with traditional African architecture.

The Borough House

The Borough House in Stateburg, South Carolina, formerly called Hillcrest Plantation, is the largest complex of pisé buildings in the United States with portions of the main house and dependencies built out of earth. Constructed in the 1760s and altered in 1821, when Dr. Anderson rebuilt the wings of the house and numerous outbuildings of earth, the Borough House Plantation complex has survived over 180 years and still stands as solid as when it was first constructed.

Figure 63. The Borough House with flanking wings built out of pisé by Dr. William Wallace Anderson in 1821. (Photo: Author)

The Life of the Borough House

In 1758, a land grant was given to William Hooper and he constructed a simple four room wooden frame house in what was then the village of Claremont in the high hills of the Santee.[153] Following the Revolutionary War, Claremont was renamed Stateburg. It is likely that the first floor was originally a hall parlor floor plan with a large great room as there was never a central hall and the stairs are also not centrally located.

In 1792, Hillcrest Plantation was sold to Thomas and Mary Hooper from Boston. Thomas was born in Charleston and Mary was from England, but they had been living in Boston before they moved to Stateburg. Mr. Hooper added frame wings to the original house and Mary added formal English style gardens including a broadwalk that allowed one to see from the rear of the house for a long distance across the property.[154] Hooper also removed the earlier fireplaces from the sides of the house and replaced them with new fireplaces on the rear wall.

Figure 64. One of the fireplaces that was installed by the Hoopers in the 1790s and replaced earlier fireplaces. (Photo: Author)

Plate 65. The Broadwalk installed with Mrs. Hooper's English style garden. (Photo: Author)

[153] Brenda Shipley Moulton, *Sumter Country Historical Vignettes,* (Columbia, S.C.: Sumter County Tricentennial Committee, 1970): 35.
[154] Historic American Buildings Survey. National Park Service. The Borough House Recording Project, Summer 1986.

In 1821, Dr. William Wallace Anderson, who had moved to Stateburg in 1810 to practice medicine, married Mrs. Hooper's niece, Mary Jane Mackenzie.[155] Following Mrs. Hooper's death, the couple inherited Hillcrest Plantation and Dr. Anderson began to make changes. As a medical student in Philadelphia, Pennsylvania, during the first decade of the 19th century, Dr. Anderson read S.W. Johnson's *Rural Economy* and became interested in the methods of pisé. He decided to remove the wood frame wings of the main house and rebuild them in pisé. In addition to the wings of the house, he also built a dairy, loom house, dry well, kitchen house, slave cabin, school, and doctor's office, all of pisé. The school housed a headmaster and children of the local gentry attended classes there. Dr. Anderson's son, William Wallace, would later use the school building as a study. The doctor's office was built at the end of the drive and neighbors and locals were treated there. All of these structures survive today and have undergone very few changes. Dr. Anderson also added a colonnaded façade to the main house at the same time he was building the outbuildings and wings of pisé.[156]

The one outbuilding that had the biggest change is the dairy, which was separated into a small dairy room and a kitchen. In the early 20th century, family stories relay that a tree fell on the kitchen room and caused enough damage that it needed to be rebuilt. The kitchen room was knocked down and rebuilt in pisé while the dairy room was left as it was.[157] The only other major changes made to the property were in the 1880s and 1916.

[155] Nicholas. *Historical Sketches of Sumter County: Its Birth and Growth,* pg. 444.
[156] Moulton, *Sumter Country Historical Vignettes,* pg. 35.
[157] Jason Smith (caretaker of the Borough House Property). Personal Interview with author, January 2009.

During the Victorian period, decorative barge boards were added to the kitchen house and the dry well. In 1916, plumbing was put into the main house.[158]

Figure 66. One of the original pisoirs used by Dr. Anderson's slaves to construct the pisé buildings on site. (Photo: Author)

Plate 67. Dr. Anderson's school that served the local gentry and later became his son's library. (Photo: Author)

[158] Moulton, *Sumter Country Historical Vignettes*, pg. 35.

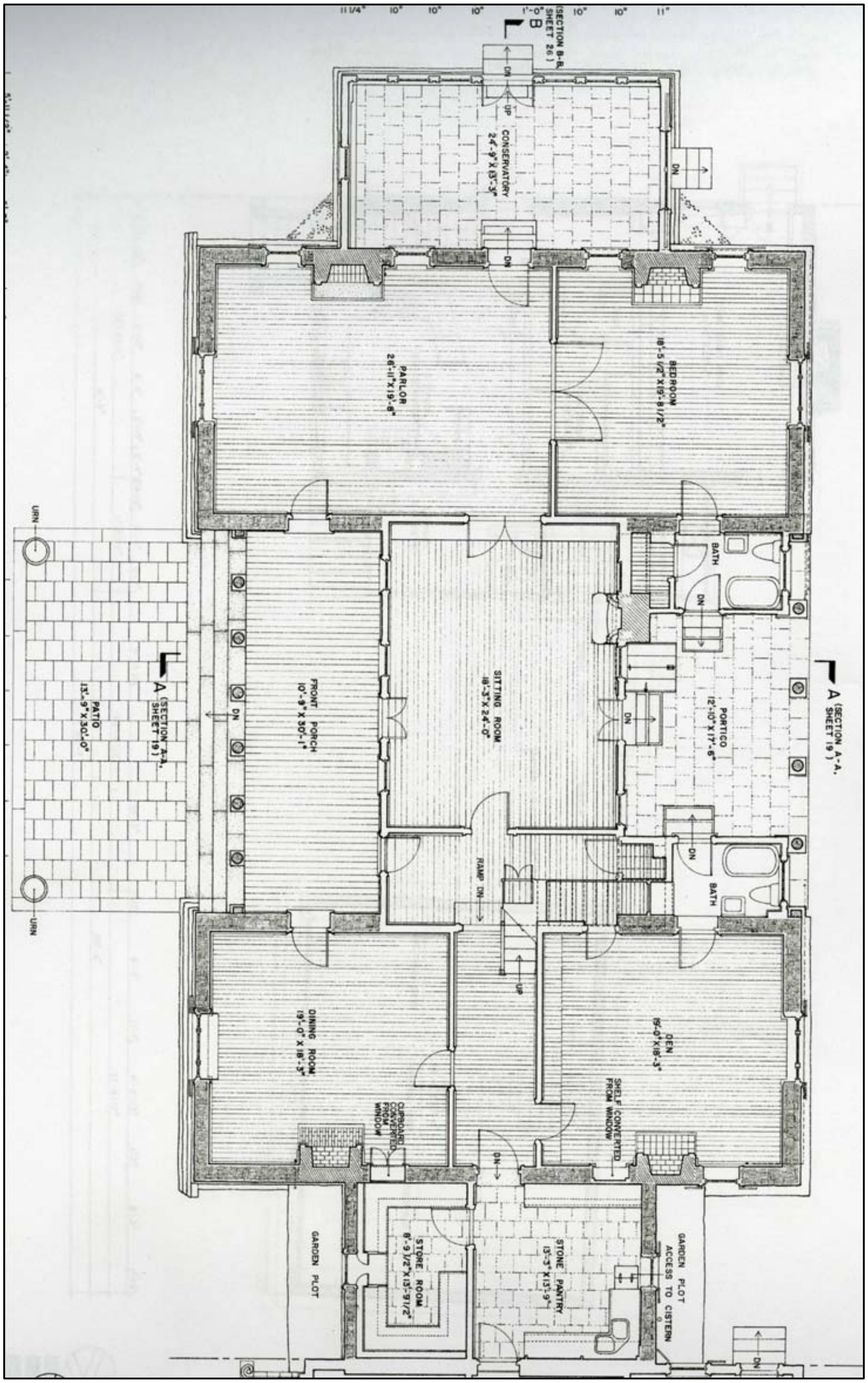

Figure 68. The first floor plan of the Borough House as drawn for HABS. The two wings with darker outlines are built of pisé. The central potrion and the conservatory on the top are built of wood frame. (Image: Library of Congress)

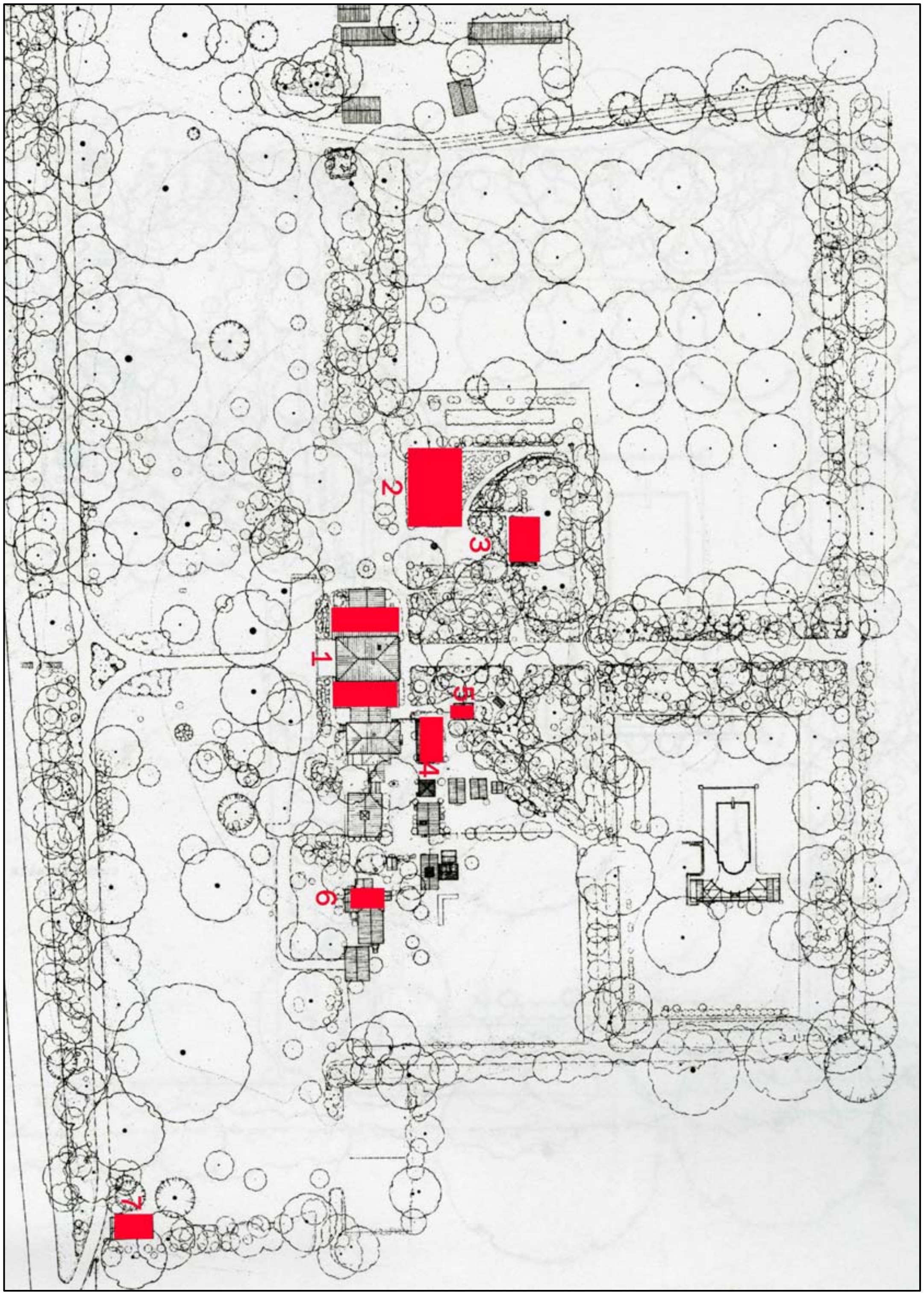

Figure 69.The grounds plan from the HABS drawings featuring the pisé structures on site.

1. Main House Wings 2. Library 3. Loomhouse 4. Dairy/Kitchen 5. Dry well 6. Cook's house 7. Doctor's Office (Image: Library of Congress)

The house and outbuildings remained virtually unchanged until the early 20th century when Mary Virginia White, Dr. Anderson's great granddaughter, renovated in the Colonial Revival style. Most of her alterations were to the grounds as she installed Colonial Revival style gardens to replace the Hooper's earlier gardens. A conservatory was added to one wing of the house while a new two story addition was added to the other wing. The family needed more space for visiting family and friends and they commissioned an architect from Columbia to design a two story addition.

Unfortunately, there was some sort of miscommunication because when the family returned to Hillcrest to see their new addition, it was vastly different from the drawings they had approved. This new addition contained a modern kitchen and dining room and a small upstairs apartment consisting of a bedroom, living room, kitchen, and bathroom. It was attached to the main house by a porte cochere and had a three car garage built with it to house the family's cars. Other changes included planting pecan orchards, installing a swimming pool and adding electricity into the house.[159] The family was recycling parts of the buildings throughout all of the changes that were made on site. Old doors, locks, latches, lumber, and other salvaged materials were used during the restoration in the 1920s and for previous repairs.[160]

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[159] John R. Poindexter, *Sumter County: A Photographic Chronicle, 1845 - 1955,* (Sumter, S.C.: Sumter County Museum, 1989): 87.
[160] Jason Smith (caretaker of the Borough House Property). Personal Interview with author, January 2009.

After the 1920s restoration, the property was mainly used as a vacation house for the Whites and subsequent owners like the Saunders, who lived on the property in 1926 when a survey was done by Thomas Miller for the United States Department of Agriculture to inspect the conditions of the pisé structures. During this time, people were looking for cheap and durable methods of construction and pisé was looked upon as a good alternative during this period that led up to the Great Depression. Miller also surveyed the Church of the Holy Cross.

Figure 70. Photograph from the 1910s of Dr. Anderson and his wife on the front lawn of the Borough House. (Image: John Poindexter)

In 1974 – 1975, Dr. Anderson’s great grandson Richard Kerfoot Anderson and his great great granddaughter, Mary Greenleaf White Anderson moved into Hillcrest Plantation permanently. Mary’s mother was Mrs. Mary Virginia White and it was she who decided to begin calling the property the Borough House. They did some restoration work on the house and outbuildings, but it mainly consisted of redoing plaster and whitewash. The pisé walls were still in excellent condition. The house and property has been in the same family since 1792. Today, Mrs. Mary Anderson owns the property and lives there part time. Currently, there are efforts being made to open the property and the house to the public as a house museum.

<u>The Family</u>

On April 19, 1789, William Wallace Anderson was born in Montgomery County, Maryland. He attended medical school at the University of Pennsylvania and headed south in 1810 to Stateburg, South Carolina, to practice medicine. Eleven years later, he married Mary Jane Mackenzie and they moved to Hillcrest Plantation, the house of Mary's aunt. Together, they had seven children: Richard Heron, Edward Mackenzie, William Wallace, Mary Heron, Mary Hooper, Franklin, and John Benjamin.

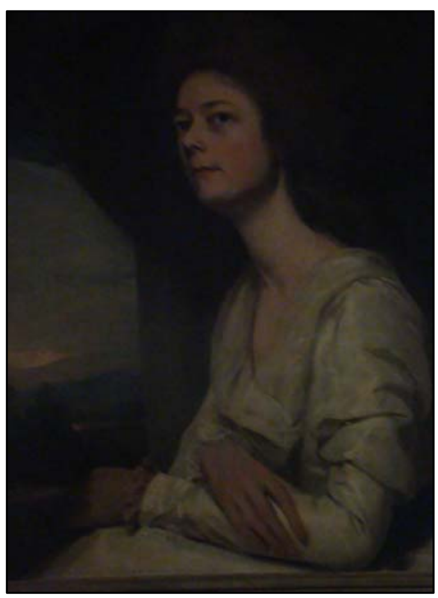

Figure 71. Portrait of Mrs. Thomas Hooper. (Photo: Author)

Richard Heron would earn the nickname "Fighting Dick" during his service in the Civil War as a Confederate general in several battles including Antietam, Fredericksburg, Chancellorsville, and Gettysburg.[161] Edward Mackenzie Anderson followed his older brother into service for the Confederacy and was killed at the Battle of Williamsburg. William Wallace Anderson became a doctor like his father and served as a medic in the Civil War and became a Major Medical Inspector following the war. He inherited the Borough House at his father's death. The first Dr. Anderson married a second time to a woman named Elizabeth Waties, but no children came from this union.[162]

Figure 72. Portrait of Dr. William Wallace Anderson (father). (Photo: Author)

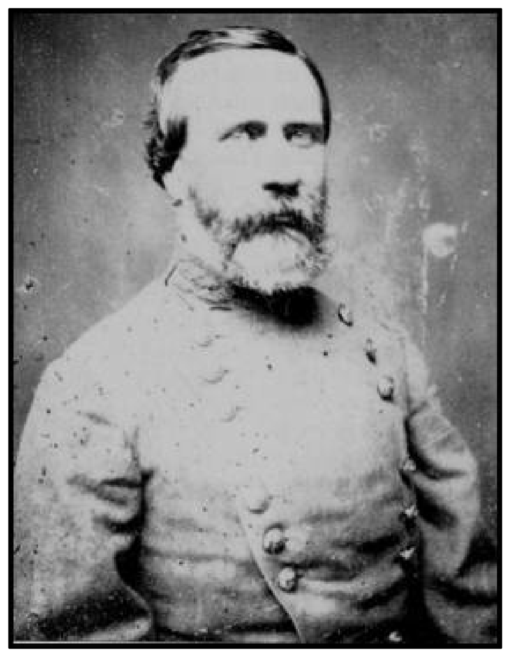

Plate 73. Photograph of General Richard Heron Anderson, known as "Fighting Dick." (Photo: www.aphilcsa.com)

[161] Nicholas. *Historical Sketches of Sumter County: Its Birth and Growth*, pg. 444.
[162] ibid.

Plate 74. Photograph of Dr. William Wallace Anderon (son) during his service as Major Medical Inspector. (Photo: Author)

Important Events

The Borough House has been involved with several important events, mostly connected to battles and warfare. During the Revolutionary War, Lord Cornwallis used the house as a headquarters for a short period of time and in 1781, American General Nathaniel Greene stayed at the house and his troops camped on the grounds. During their occupation of the house, the continental army literally left their mark on the house. The story goes that one night as the men were having a raucous party and they fire branded the letters "CA" on the rear door several times. The marks are still there today. There is also a local legend the General Thomas Sumter hanged Tory spies from an oak tree on the property, but this story is a legend and without evidence.[163]

[163] Jason Smith (caretaker of the Borough House Property). Personal Interview with author, January 2009.

Figure 75. Firebranded marks left by the
Continental Army from the summer of 1791.
(Photo: Author)

During the Civil War, when Union troops moved into the area, they attempted to find the valuables in the Borough House. They broke into a sideboard by stabbing it with their bayonets. Unsuccessful, they left large holes in the piece of furniture.[164]

[164] Jason Smith (caretaker of the Borough House Property). Personal Interview with author, January 2009.

Current Condition of the Borough House and its Dependencies

Table 1 Criteria for Assessing Condition at the Borough House and the Church of the Holy Cross				
	Excellent	**Good**	**Fair**	**Poor**
Missing Elements	None	Less than 25% of elements missing	25 – 50% of elements missing	50 – 100% of elements missing
Exterior Render	Intact	Small areas of loss less than 2" x 2"	Areas of loss between 2" x 2" and 6" x 6"	Areas of loss greater than 6" x 6"
Pitting/Holes in Pisé	None	Holes less than 1" wide	Holes between 1" and 3" wide	Holes greater than 3" wide
Cracking in Pisé	None	Minimal surface cracks	0 – 1 cm wide and less than 6" long	Cracks greater than 1 cm wide and 6" long
Cracking in Render	None	Minimal surface cracks	0 – 1 cm wide and less than 6" long	Cracks greater than 1 cm wide and 6" long
Wooden Elements	Intact and stable; no infestation	Minimal deterioration not affecting stability	Significant deterioration weakens the wood's strength	Structurally unstable, deteriorated, and needs replacement; active infestation
Crumbling	None	Minimal	Significant loss of adhesion with areas of loss greater than 2" x 2"	Large areas of crumbling pisé greater than 2" x 2"
Render Discoloration	none	Minimal	Distinct color difference areas	Completely different color and staining causing deterioration

This table defines excellent, good, fair, and poor when used to describe the Borough House, its dependencies and the Church of the Holy Cross. In discussion to follow, judgments should be referred back to this chart. Some elements of buildings are assessed individually, such as the interior plaster work of the loomhouse, while others are classified as an entire building.

The Borough House is in excellent condition as compared to the Church of the Holy Cross across the road. The pisé at the Borough House has been protected through regular maintenance and repairs and there is no structural damage to the wings or outbuildings. There has been minimal termite damage to the property but termite monitors are installed on site and are checked regularly. Over the years, the exterior render has been reapplied with the last coat being placed on the walls in the 1920s. The traditional pebble dash finish, with less cement in the mixture than that used on the Church of the Holy Cross, was applied using traditional methods by slinging it on the walls with a broom. Today, the caretaker said that the majority of the repairs he makes are small patches of pebble dash.

Figure 76. The northern pisé wing of the Borough House. (Photo: Author)

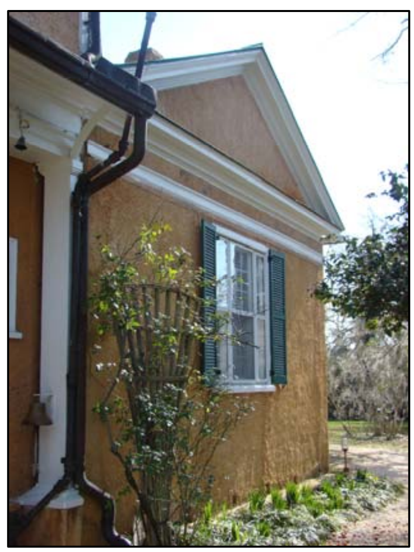

Plate 77. The southern pisé wing of the Borough House. (Photo: Author)

The wings of the main house built by Dr. Anderson in 1821 are in excellent condition. There has not been any significant damage to them since they were built and they are structurally sound. There have been several roof leaks near the wings, but the majority of the water has come into the house through the wooden frame parts. Leaks that did occur over the pisé wings were limited and were fixed in a suitable amount of time to prevent damage.

Of all the pisé buildings on site, the dairy has been most significantly altered. The right half was destroyed by a falling tree and rebuilt. Today, the dairy is in good condition with some minor plaster cracking due to moisture that was continually on the west side of the building as wood was stacked on the opposite side of the wall for many years. The original pisé wall can be seen inside the dairy as well as a previous render of tar and sand.

Figure 78. The east façade of the diary/kitchen building. (Photo:Author)

Plate 79. The west and south facades of the dairy/kitchen. (Photo: Author)

Figure 80. The west façade of the dairy/kitchen building. (Photo: Author)

Plate 81. The north façade of the dairy/kitchen building. (Photo: Author)

The library, which formerly served as a school, is in excellent condition. The pisé walls are protected by a peristyle around the entire building and the only repairs that have had to be made were because of risks taken during construction and later human intervention. Originally, the foundation of the library was also built out of pisé, while the majority of pisé buildings employ masonry foundations. The pisé foundation was replaced in the middle of the 20th century because moisture caused it to deteriorate. It was replaced with a concrete foundation and has had no major problems since. The other issue with the library is that in order to protect the books, which date all the way back to the 1790s, a humidifier was installed inside during the middle of the 20th century. A drain hose was run from the inside of the library under the building and stopped just short of the original pisé foundation. This was an important error as all the excess water from the humidifier was pooling up at the base of the foundation. Fortunately, this is no longer an issue as the drain was removed and the caretaker empties the humidifier a few times a week by hand.

Figure 82. The library in 2009. (Photo: Author)

Dr. Anderson's office, situated at the end of the main drive, is in good condition. It was built to resemble the temple of Aesculapius and looks like a small Greek temple. The only deterioration on the structure is underneath an air conditioning unit where water has continually dripped down and eroded the pebble dash finish. Even with the erosion, the pisé is still sound and has not deteriorated much.

Figure 83. Loss of pebble dash on the eastern wall of the doctor's office due to water leaking from the air conditioning unit. (Photo: Author)

Figure 84. A closer view of the pebble dash loss where some of the earth has also deteriorated. (Photo: Authot)

Figure 85. Garden folly in England modeled on the Temple of Aesculapius. (Photo: Catena Historic Garden Archive)

Figure 86. The doctor's office at the Borough House based on the design of the Temple of Aesculapius. (Photo: Library of Congress)

The dry well exposes unfinished pisé walls offering a glimpse at the building's masonry foundation and putlog holes as well. The other pisé buildings on site have interior walls with plastered or whitewashed walls. The dry well's pisé walls are in good condition while the wooden staircase, in poor condition, is not structurally sound. The stairs lead down to the well, which is one of the only ones left in the Stateburg area, and is about twenty feet below the surface.

Figure 87. The original pisé walls of the dry well, which were left unfinished. (Photo: Author)

Figure 88. The visible foundation of the dry well constructed of locally made bricks. (Photo: Author)

Figure 89. The exterior of the dry well with decorative barge boards added in the 1880s. (Photo: Author)

Figure 90. Dr. Anderson’s signature on the inside of the dry well door. (Photo: Author)

The cook’s house, as it is described on the HABS drawings, was originally built as a large slave cabin for Dr. Anderson’s house slaves. It consists of a pisé first floor and a wooden frame upper story. The lower part was used as a summer kitchen and the upper story as living quarters. When Captain Richard K. Anderson and Mary Anderson moved in permanently in 1974 – 1975, they added a wing to the cook's house for a relative to live in and have more space. A front door and portico was also added. Over the years, it has become the caretaker's house and is in good condition.[165]

Figure 91. The cook's house, which now serves as the caretaker's house. It originally consisted of two stories, the bottom of pisé, and the top of wood. The wing to the left and an ell addition to the rear were built in the 1970s. (Photo: Author)

The loom house is also in good condition, but the actual looms are in poor condition. The looms were repaired during the 1990s and one of them was working for several years, but today, they are not in use. The other half of the loom house serves as a storage room and was historically a sewing room as the building served to make clothing for those people

[165] Jason Smith (caretaker of the Borough House Property). Personal Interview with author, January 2009.

living on the property. The interior plaster work is in fair condition as there are significant cracks on the sewing room's walls due to the oak tree that is planted outside the building. It is a large oak and its roots have reached the building and have dislodged the western wall. There is also some staining from rain splash on the lower portions of the loomhouse exterior walls, but it has not led to any deterioration of the render.[166]

Figure 92. The loom house with dark staining along the base of the building due to rain and dirt splash. (Photo: Author)

Figure 93. Closer view of the staining. (Photo: Author)

[166] Jason Smith (caretaker of the Borough House Property). Personal Interview with author, January 2009.

General Conservation Issues with Pisé

As with most building materials, the biggest enemy to pisé is water. Since pisé is dirt, water easily penetrates the material, which can lead to render delamination and structural weakening from wood brace rot and loss of dirt material. Pisé is also weakened from insect, plant, and animal activity, and settlement.

During construction, too much water in the clay used to form the pisé can cause problems once the earth is compacted. Water infiltration is even more significant when it soaks into the base of the wall, which bears the most weight. The lower areas of pisé walls are susceptible to water infiltration from rain splash so proper protection is necessary and explains why most pisé buildings have a high plinth base and wide eaves to shed the water as far away from the pisé as possible.[167]

Surface finishes protect the pisé and must be continuously renewed. Repairs must be made with compatible materials similar to the original render. Incompatible renders cause more harm than protection. A cement render, for example, has waterproofing properties that do not allow water to infiltrate the render. However, this also means that if any water does get behind the render, it will not have a way out and results in damage including spalling and delamination of the stucco or roughcast finish.

[167] John and Nicola Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth,* (Great Britain: English Heritage, 1988), pg. 98.

Insects such as masonry bees burrow into soft, thick walls like pisé and if many bees inhabit a pisé wall, it threatens the structural integrity of the wall. Rodents, especially rats, have been known to burrow through earth walls to create paths. This can also be detrimental to the structure of the building.[168] Other material eating insects like termites can also destroy a pisé building. While termites are not attracted to the pisé, they are attracted to wood used in the construction of the building. Plants can also deteriorate pisé by invasively attaching to the wall. Some pisé garden walls are purposely built to allow creeping plants to grow. However, the unmonitored growth leads to destruction. Once a plant's root system is attached to the wall, freeze-thaw spalling becomes more prevalent since water adheres to the roots. Water can also more readily enter the building through the invasive roots. An easy solution to this problem is to provide a frame or trellis for the plants to grow on instead of the actual pisé wall.[169]

Grand settlement leads to the pisé losing its vertical alignment, which is dangerous since the material is only strong in compression, being very weak resisting tensile stresses created by lateral loads. Settlement causes extra stresses to occur at the ground level or around window or door openings, which leads to cracking and other damage. These problems can be fixed by using tie rods, similar to earthquake rods that tie buildings back together. Buttresses can also be used, but they tend to exacerbate the problem as they add

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[168] John and Nicola Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth,* pg. 98.
[169] ibid.

weight to the soil that has already caused the building to settle. Extra weight on that same area could cause more settlement and more damage.[170]

Figure 94. The layers of stucco on pisé walls are similar to this photograph of an exterior render on a clay lump wall. (Photo: John and Nicola Ashurst)

Extreme drying of the earth can also be a problem. The moisture content that is present in the earth allows the clay to hold together. If it is too wet, cracking and shrinking occurs, but if it is too dry, the earth will not compact and bind together properly. Also, the materials used to construct fireplaces and hearths in pisé buildings must be of stone or brick to absorb the heat rather than allowing the heat to be drawn out to the walls. In

170 John and Nicola Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth,* pg. 99.

modernized pisé buildings, radiator placement should be carefully considered. Placing the radiators directly next to a pisé wall will dry it out and weaken that area. If heat sources are to be placed near the pisé walls, precautions should be taken. A lime plaster with a haired undercoat in addition to heat insulation boards can be placed behind a heat source to absorb the heat and stop it from entering the earthen walls. This will protect the pisé and keep the moisture content at a constant.[171]

Any significant areas of loss of pisé that are bigger than one inch square could be fixed with patches, but the patches need to be of compatible materials. Some patches have been made previously using bricks and mortar repair compounds. This method should be avoided since it is aesthetically inappropriate and the materials do not bond well with the pisé. They have different properties of expansion and contraction and some of the mortars contain Portland cement which impedes water evaporation.[172]

The preferred method for patching areas of pisé loss greater than one inch square is filling in with new pisé. The area of loss and damage is cut out to form a square or rectangular area. The surface of the backs and sides of the area is lightly wet with a spray bottle and temporary shuttering is constructed. A compatible mixture of pisé is made. In the case of the Church of the Holy Cross, dirt can be taken from the same source as

[171] John and Nicola Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth,* pg. 99.
[172] ibid, pg. 100.

theriginal pisé, which is located just 150 yards from the actual church.[173] The earth is compacted firmly in the temporary shuttering and the final part of the fill is done by applying the mix to the face. The shutter marks can then be scraped away to make a smooth finish. This method could be used to repair areas at the church where loss has occurred due to the measures taken to remove termites from the building.[174] Figure 95 and Figure 96 illustrate the rebuilding of a cob wall, which is constructed similar to pisé in forms and can be rebuilt similarly.

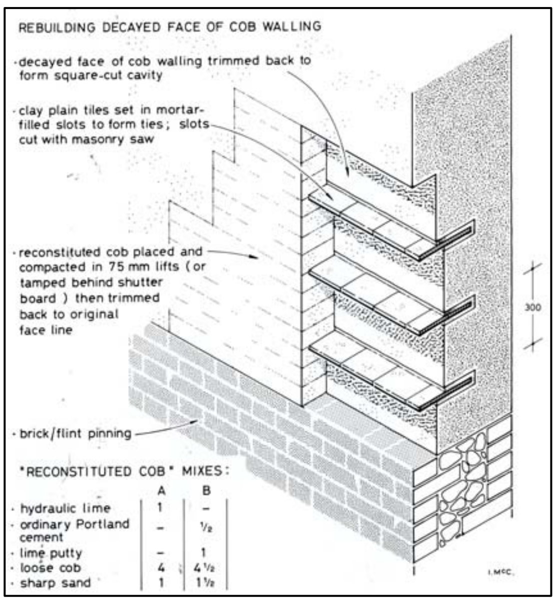

Figure 95. Illustration showing how to repair a cob or pisé wall with cutting out, temporary shuttering, and filling in. (Image: John and Nicola Ashurst)

Figure 96. A cob wall being repaired and filled in with temporary shuttering. (Photo: John and Nicola Ashurst)

[173] Thomas A.H. Miller. *Report on the Condition of Rammed Earth Buildings Built 1820 to 1854 on the Plantation of Mr. W.L. Saunders Located Near Sumter, South Carolina*. United States Department of Agriculture (1926): 7.
[174] John and Nicola Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth*, pg. 102.

An in situ repair previously used for cob, but also suitable for pisé, used to treat cracks and areas of loss is stitching, bonding, and grouting. This process helps to bond new repair work with the original pisé construction with the use of brass or metal gauze that is cut into strips. Cuts, or chases, are made in the pisé across a fracture line. The metal gauze is cut to fit the chase and after wetting the chase, it is filled a third of the way with lime mortar. The gauze strip is then placed in the chase and the rest of the chase is filled with mortar. To aid in tying the building back together, tie rods and plates, similar to earthquake rods, can also be used. Following the stitching and bonding process, the cracks should be filled with a liquid mortar.[175]

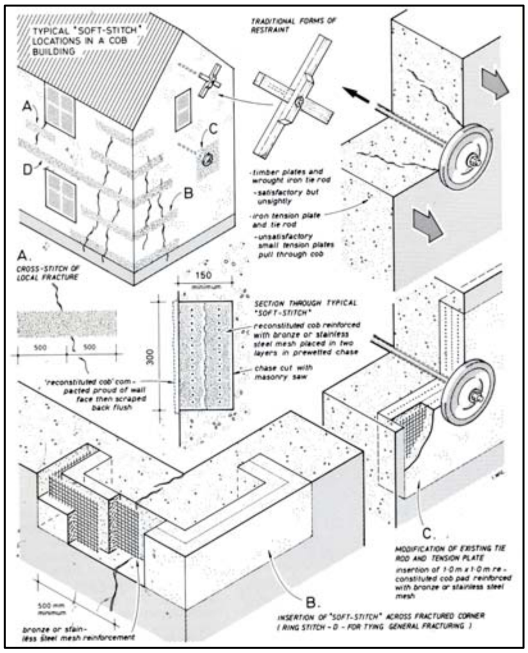

Figure 97. Illustration showing the stitching, bonding, and grouting process used to repair cob walls. (Image: John and Nicola Ashurst)

175 A liquid mortar is can include a caulk, a liquid foaming agent, or an admixture that more like a liquid than traditional mortars.

As with the stitching, the surface should be slightly wet and then hand filled with mortar. After the mortar has cured, a hydraulic lime is used to fill the rest of the crack.[176] These repairs have been successful in repairing cob walls, but have not been tested on pisé walls. There are some concerns with using this method on pisé walls, especially since the surface needs to be wet several times and water can deteriorate the clay binder in the earth. If either the cutting out and filling in or stitching method is to be used on pisé walls at the Church of the Holy Cross, it is suggested to skip the wetting of the surface and instead of using lime mortars, that a compatible earth mixture be used.

Even though there are important maintenance and conservation issues with pisé, a well cared for pisé building can survive many years without physical or structural damage. S.W. Johnson offers such an example of a pisé with a church in Montbrison, France (c. 1710), with eighteen inch thick walls and a roughcast finish. Eighty years after its construction, it was destroyed by fire and the pisé was exposed to the elements for about a year. Most people expected the walls to be damaged and in a state of disrepair and they decided to take the walls down. When they tried, they found the walls to be very hard and the demolition was cancelled. The people of Montbrison realized that the only required repair was to apply a new roughcast to the exterior every twelve to fifteen years.[177]

[176] John and Nicola Ashurst, *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth* pg. 105.
[177] Johnson, *On Pisé Building As Recommended by the Board of Agriculture in Great Britain, with Improvements by the Author,* pg. 3 – 4.

The pisé buildings at The Borough House and the Church of the Holy Cross are still standing today with little to no visible damage to their structure. The Borough House and its dependencies have been continuously maintained over the last 180 years with new roughcast renders and no extreme interventions were made. The Church of the Holy Cross is also in good condition with most of its issues coming from the other materials used in its construction, not the pisé.

Conservation Efforts at the Borough House

The methods described above could also be employed to conserve pisé at the Borough House. Fortunately, the Borough House and its dependencies have not experienced the loss and damage of original pisé like the Church of the Holy Cross has. Rather, the pisé walls have been routinely protected and maintained with maintenance consisting mainly of patching areas of pebble dash loss. The Borough House has been fortunate to have been safe from extensive termite damage like the church. There have been areas of minimal termite damage in the dry well, but it is localized and not nearly as damaging as that at the church. Also, there are a couple areas of plaster loss inside the dairy and on the exterior wall.

Figure 98. Interior wall showing some plaster loss inside the dairy/kitchen. (Photo: Author)

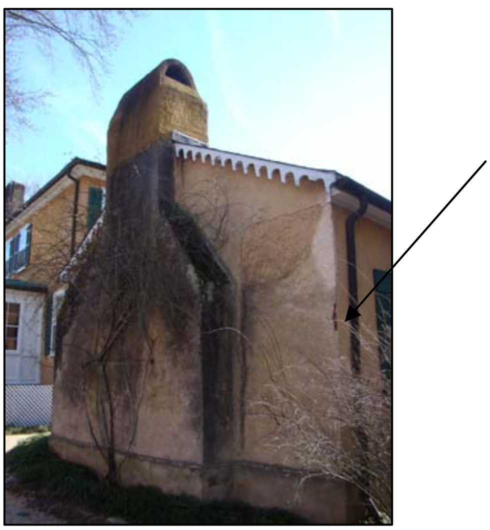

Figure 99. South wall of the dairy/kitchen with a small area of pebble dash loss. (Photo: Author)

Figure 100. Closer view of area of pebble dash loss (about six inches in length) (Photo: Author)

In 1926, Thomas Miller, with the United States Department of Agriculture, wrote a report on the condition of the pisé structures on the property. He also inspected the Church of the Holy Cross. He examined the main house, the library, the loom house, the tool house (the dairy/kitchen), the dry well, the servants quarters (the cook's house) and Dr. Anderson's office. He found that the wings of the house have eighteen inch thick walls and are ten feet high. They were covered with a lime mortar stucco and are still covered toady with a stucco of the same type of mixture. The library's exterior walls were finished to look like ashlar stone, rather than the pebble dash used on the other structures, and the colonnade on all four sides has kept the pisé in good condition.[178] The loom house has walls that are one foot thick and nine feet high and do not have a traditional masonry foundation, but rather the pisé sits right on the ground. This meant that water had splashed on the wall since its construction, but still there was not any damage to the pisé (figure 5.5). The lime stucco that was on the loom house at the time was also in good condition with only minimal areas of loss despite it being 106 years old.

Figure 101. The loomhouse in a 1980 HABS photograph when the earth walls did not have an exterior render on them. (Photo: Library of Congress)

[178] Thomas A.H. Miller. *Report on the Condition of Rammed Earth Buildings Built 1820 to 1854 on the Plantation of Mr. W.L. Saunders Located Near Sumter, South Carolina*, pg. 7.

The tool house, or the dairy/kitchen, also had walls that are eighteen inches thick and nine feet high. On this building, Dr. Anderson had installed a corner stone with its construction date, 1821. This building suffered from a leaky roof for many years, but like the rest of the pisé on the property, had not been significantly damaged. Mr. Miller noted that the stucco was in very bad shape on the tool house.[179] The rest of the pisé structures: the dry well, the cook's house, and Dr. Anderson's office, were not explicitly described like the other buildings, but were all listed as being in fair condition.[180]

Figure 102. The cornerstone on the north wall of the dairy/kitchen put in by Dr. Anderson when he began building his pisé structures. (Photo: Author)

Today, much like the conditions seen at Mr. Miller's inspection, the pisé walls of the main house and outbuildings are in good condition thanks to routine maintenance and the use of traditional renders that do not contain large amounts of cements. The last pebble dash render was placed on the house during the early 1920s when the restoration (see

[179] Thomas A.H. Miller. *Report on the Condition of Rammed Earth Buildings Built 1820 to 1854 on the Plantation of Mr. W.L. Saunders Located Near Sumter, South Carolina*, pg. 8.
[180] ibid, pg. 9.

chapter 8) was being done. Since then, any areas of loss have been patched and have been kept to a minimum. The biggest problems that have occurred at the Borough House have been with roof leaks, but these leaks have caused more extensive damage to the wooden portions of the buildings rather than the pisé parts. In fact, the loom house was left without a render for several years following the property's restoration and there was little to no damage on the building even though it was exposed to the elements.

Figure 103. Large crack in the plaster of the loom house where a live oak's roots have disrupted the eastern wall of the structure. (Photo: Author)

Another problem that the caretaker of the property has found is that the vegetation growing around the loom house has caused cracking of the plaster and potentially disruption of the pisé wall. The only way to remedy this issue is to remove the tree, which is a very old live oak. One final conservation issue found at the Borough House is that the pisé walls have been found to pull away at the upper corners of the structures. It is likely that these buildings do not have extensive reinforcement in the corners besides some wooden members, and after 188 years, they have settled and the stresses are causing the walls to bend. The problem is not extensive and is not significant, but it is something to think about for the future of the pisé walls on the property. Perhaps some sort of reinforcement can be applied when the current render is replaced with a new one.

Comparing the current conditions at the Church of the Holy Cross to those at the Borough House reveal how routine maintenance and the reapplication of traditional renders using traditional materials can effectively preserve pisé walls. The biggest enemy to most building materials is water and if that can be properly avoided, the pisé will survive.

The Church of the Holy Cross

Designed by the Charleston architect, Edward C. Jones, but constructed in 1850 – 52 under the supervision of Dr. Anderson, the church replaced an earlier wooden structure that had served as the Episcopal Church of Claremont (later Stateburg). Over the years, the church has survived earthquakes, tornadoes, and damage from insects and man. In contrast to the Borough House, the church has been closed for the last eight years due to termite damage, and while it is still a true architectural beauty, it has needed significant repair to return it to a stable condition. The restoration and stabilization work that is currently underway will help to return the church to its parishioners and prepare this rammed earth rarity for the future.

The Life of the Church of the Holy Cross

The Church of the Holy Cross, built in 1850 – 52, has survived many years in the high hills of the Santee. While the current church is of a Gothic design, there were two churches built before of simpler design. The very first church, built circa 1770, was located around ten miles south of the current church on the lands of Peter Mellette. The location was near a town called Manchester, now long gone.[181] Eighteen years later, the parishioners grew tired of traveling to attend services and applied for a charter to build a new church. The Episcopal Church of Claremont was built on land donated by General

[181] Mrs. Richard Kerfoot Anderson. *Church of the Holy Cross Bicentennial Book*. 1988. (Sumter: The Church of the Holy Cross, 1988): pg 33.

Thomas Sumter in 1788.[182] The building was constructed of wood and measured 37' x 15' x 17' tall and was rectangular in form. Money for the church's construction was raised by selling pews to parishioners, a practice done at many Episcopal churches in South Carolina.

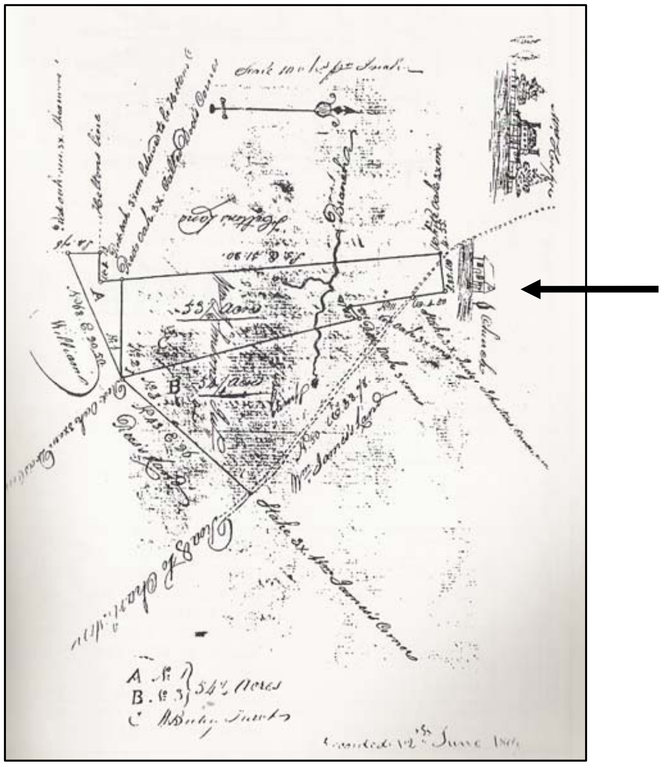

Figure 104. Early map of the area surrounding the Church of the Holy Cross. Arrow points to building marked church, the earlier Episcopal Church of Claremont. (Image: Mrs. Richard Kerfoot Anderson)

In 1849, the congregation was outgrowing the small church and decided to build a new church, which they named the Church of the Holy Cross. Funds for the church's construction were raised by selling slaves, including a boy named Litchfield, and totaled

[182] Church of the Holy Cross, Stateburg, Informational Sheet. Sumter: The Church of the Holy Cross, 2003.

$2,637.74.[183] Architect Edward C. Jones of Charleston was hired to design the new church, but the construction supervision of the church was entrusted to the building committee, headed by Dr. William Wallace Anderson. After building his own house and outbuildings of rammed earth thirty years earlier, Dr. Anderson convinced the building committee to build the new church of rammed earth as well as they could build a bigger church for the same price. Slave labor built the church as directed by Dr. Anderson and the finished church was consecrated on July 14, 1852 by Bishop Francis Huger Rutledge, the Bishop of Florida as the Bishop of South Carolina was sick.[184]

The total cost of the Church of the Holy Cross was $11,358.74.[185] A rammed earth wall was also built around the churchyard with a pointed top, but the last parts of the wall fell down and were replaced with a wire fence in 1908. Pews were sold to raise money for the church and this practice continued until 1868. Following the Civil War, the Church of the Holy Cross offered pews in the back of the church to freed slaves at a reduced rental rate. African Americans were always a presence at the Church of the Holy Cross as they not only built the church, but also worshipped there throughout the church's history.[186]

As the years went by, the Church of the Holy Cross survived many natural disasters, renovations, and alterations. Only a few years after the church's construction, much to the opposition of Dr. Anderson, two wooden stoves were installed as the congregation

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[183] Mrs. Richard Kerfoot Anderson. *Church of the Holy Cross Bicentennial Book*, pg. 41.
[184] ibid, pg 37 – 39.
[185] ibid, pg. 41.
[186]

complained of the cold. The stoves necessitated creating holes through the rammed earth walls and chimneys erected on the exterior, both of which created leaks that went undetected until 1974. The 1886 earthquake, which destroyed much of Charleston and the surrounding area, affected the church as well. The church's tower was disrupted and a crack was formed between the tower and the main structure. Seventeen years later, a hurricane knocked a tree into the tower and the tower fell onto the roof of the nave. Parts of the north wall had to be built in concrete. A few years later, red cement tiles replaced the original cypress shingles.[187]

Figure 105. HABS photograph of the Church of the Holy Cross prior to the steeple being restored. (Photo: Library of Congress)

Figure 106. HABS photograph of the rear of the church and graveyard before restoration of the steeple. (Photo: Library of Congress)

[187] Mrs. Richard Kerfoot Anderson. *Church of the Holy Cross Bicentennial Book*, pg 43.

Figure 107. HABS photograph of a sketch done by the architect Edward C. Jones after it was built. (Photo: Library of Congress)

The next alterations came in 1950 when the steeple was restored. The new steeple was constructed of reinforced concrete and finished with a pebble dash that was not similar to the original crepe finish. The biggest alterations occurred in 1974 when roof leakage and seepage around poorly installed flashing led to the collapse of a portion of the south wall of the nave and transept. There was also damage in the roof trusses due to the collapse. The addition of the heavy cement roof tiles led to sagging of the roof. The wall was speedily rebuilt with concrete block and steel was used to mend cracked beams and termite damaged trusses. The collapse of the wall led to the discovery of extensive termite damage. The vestry of the church formed a Restoration Committee to oversee the repairs and to identify other areas of concern. The committee applied for a grant to restore the church and was given $87,000 through the National Historic Preservation Act. The committee raised an additional $292,000 to fund the restoration.[188]

[188] Mrs. Richard Kerfoot Anderson. *Church of the Holy Cross Bicentennial Book*, pg 45 – 47.

Cuttino Builders, from Columbia, and architect Henry S. Boykin, from Camden, were hired for the design and construction. They replaced the tile roof with cement, fire proof composite shingles. The wainscoting throughout the church had been damaged by termites, so all but a small portion of the wainscoting was taken out and replaced. The windows over the altar were also termite damaged causing the lead in the stained glass to sag. These were replaced during the restoration with termite resistant frames by a studio in New Jersey. The pews were repaired, the interior repainted, new carpet was installed, door hardware was repaired, and the church was rewired for speakers and lighting. On the exterior, shrubbery near the foundation was removed and the flowerbeds were regraded so that water flowed away from the building. The entire building and surrounding area were treated for insect infestation.[189]

Figure 108. HABS photograph of the exterior of the Church of the Holy Cross after the 1974 restoration. (Photo: Library of Congress)

Figure 109. HABS photograph of the nave of the Church of the Holy Cross after the 1974 restoration. (Photo: Library of Congress)

[189] Mrs. Richard Kerfoot Anderson. *Church of the Holy Cross Bicentennial Book,* pg 47 – 49.

After two years of construction, the church was officially reopened in 1976. Two years later, it became a national historic landmark. Just over twenty years later, termite damage was found again in the church and since then, the church has been closed and the parishioners have held services in the parish hall for the last eight years. Currently, the church is being repaired to a condition where services can once again continue.[190]

Figure 110. The Church of the Holy Cross in 2008 during the current restoration. (Photo: Author)

Figure 111. The nave of the Church of the Holy Cross in 2008 after the stained glass and furnishings had been removed. (Photo: Author)

The Church of the Holy Cross includes some interesting details. Around the top of the walls, there is an oak leaf motif in the plaster. This is traced back to the Druids who worshipped mistletoe, which grew on the oak tree. As Christianity developed, mistletoe became the symbol of Jesus and the oak leaf was symbolic of his heavenly father, God. Minton tiles make up the floor in the chancel and there are five areas of detailed tiles.

[190] Church of the Holy Cross, Stateburg, Informational Sheet. Sumter: The Church of the Holy Cross, 2003.

These five areas are meant to symbolize the five wounds Jesus endured during the crucifixion. One final detail is the church's bell. It was donated in 1956 in honor of Mary Virginia Saunders White. Cast in Holland by H. Van Vergen, the bell has Mary Virginia cast into the metal and is one of the few named bells in the United States.[191]

This high style rammed earth building shows that earthen construction can be ornately detailed and ornamented. Depending on the building's use and designer, varying degrees of style can be achieved ranging from the popular architectural styles, like those used in pisé pattern books of the 19th century, to the simple vernacular seen in African influenced rammed earth structures.

<u>The Influence of Dr. Anderson</u>

Dr. William Wallace Anderson may not be known on the national level, but he and his family have been important members of the community of Stateburg and Sumter County for two hundred years. The biggest legacies Dr. Anderson left behind are the Borough House and the Church of the Holy Cross. In 1821, he removed the original wings of his house and replaced them with wings of pisé. He would go on to build ten other smaller buildings on his property including a dairy, laundry, slave cabins, kitchen house, library, and a doctor's office designed to look like a miniature temple of Aesculapius.[192]

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191 Mrs. Richard Kerfoot Anderson. *Church of the Holy Cross Bicentennial Book,* pg 57, 65.
192 Nicholas. *Historical Sketches of Sumter County: Its Birth and Growth, pg.* 444.

His influence on the community was seen when the building committee of the Church of the Holy Cross was meeting in 1850 to decide on what material to build their new church out of. In a letter from Dr. Anderson's grandson in 1923, it is written that Dr. Anderson's wife encouraged him to keep out of the meeting as she knew he would suggest pisé as the material. The meeting began to take too long for Dr. Anderson and as he left his house to head down to the church, his wife told him, "Now Doctor, don't you say anything about pisé." To this statement, the doctor replied, "Not a word, not a word. I'll just step down there and see what's keeping them so long."[193] However, when Dr. Anderson arrived at the church, the building committee was at a standstill in their discussion as a material could not be agreed upon. At a break in the discussion, Dr. Anderson simply said, "Gentlemen, what do you say to pisé?"[194] The building committee agreed with Dr. Anderson and the church was constructed of pisé. While the story may not be how it went exactly, Dr. Anderson did have enough influence in the church to convince the building committee to choose pisé. Today, the Church of the Holy Cross and the Borough House and its dependencies still stand as a legacy to Dr. Anderson.

Current Condition of the Church of the Holy Cross

For the past eight years, the Church of the Holy Cross has been closed due to termite damage. Extensive structural repairs are being corrected by Charleston structural engineer Craig Bennett of 4SE with the architectural firm of Cummings & McCrady.

[193] William Wallace Childs, letter to the editor. *The Evening Star*. Washington, D.C., December 3, 1923.
[194] ibid.

Work has slowly proceeded as the church has raised funds. Termites were first detected in the building prior to the 1974 restoration. The termite control company and the church entered into an agreement in which the termite company would inspect for insect activity each year and the church would pay a yearly fee for this service. However, in the thirty years since the agreement was created, the termite company failed to inspect the church. Currently, litigation is under way between the Church of the Holy Cross and the termite company.

The extensive termite damage today includes roof trusses, floor boards, wood used in the original pisé walls, the modern wainscoting, and all other locations where wood was used, such as the mantelpiece in the sacristy. The heavy cement roofing tiles exacerbate the weakened structure with their weight. However, the cost to remove the tiles and replace them is significant. Similarly, the incompatible render on the exterior will be left in place since it is not in the budget to remove it at this time.

The focus material, rammed earth, is in good condition. Currently, the pisé portions of the walls are exposed as all the wainscoting has been removed to look for and treat termite damage. There are some loose bits that have fallen out of the wall or have just been loosened in place, but overall the pisé is stable and firm. The portions that failed in the past have been replaced with concrete and concrete block and as all of the walls are removed, it is easy to see where these repairs are. There are some areas of concern especially where the original bond timbers have extensive termite damage and this weakening of the wood support could cause portions of the pisé to fail. This has not been observed as happening yet, but it is possible. The damaged bond timbers will have to be replaced and a compatible wood will need to be used as the expansion and contraction rates of new wood are different from old wood and rammed earth.

Much of the original pisé is under extra stress since the termite damaged wood in the trusses has failed carrying loads. This means that more weight and compressive stresses are being placed on the earthen walls and brick buttresses. Overall, the pisé is in good condition indicating that the loads remain stable and vertical and there are not significant areas of loss at the Church of the Holy Cross. While in good condition, the pisé is vulnerable to lateral forces like those from wind and earthquakes in its current state. The other materials in the church are suffering due to their susceptibilities to insect damage and these issues are directly affecting the condition of the rammed earth.

The following photographs illustrate termite damage currently in the church on a mantelpiece in the sacristy, floorboards under the choir area, wood supports in the pisé walls, and areas where the termite damage is being monitored. Also, there are several photos of cracking due to the weakening of the structure because of termites.

Figure 112. Termite damage on the mantle in Sacristy. (Photo: Author)

Figure 113. Termite trails on the baseboard in the Chancel. (Photo: Author)

Figure 114. Termite trails on original support beams in the pisé wall. (Photo: Author)

Figure 115. Termite trails on original support beams in the pisé wall. (Photo: Author)

Figure 116. Termite trails on original support beams in the pisé wall. (Photo: Author)

Figure 117. Severe termite damage on floorboards under choir area. (Photo: Author)

Figure 118. Holes cut in plaster to monitor termite damage. (Photo: Author)

Figure 119. Holes cut in plaster to monitor termite damage. (Photo: Author)

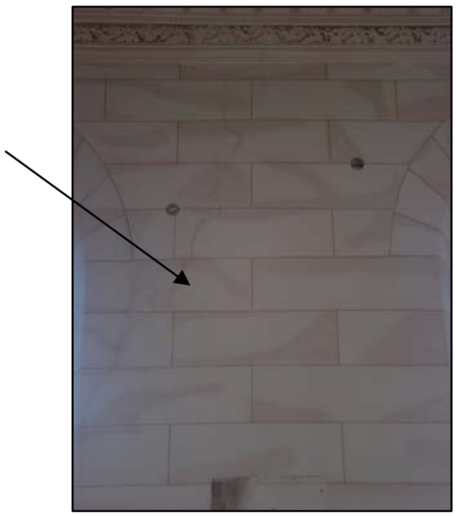

Figure 120. Arrows point to cracks due to weakened structure. (Photo: Author)

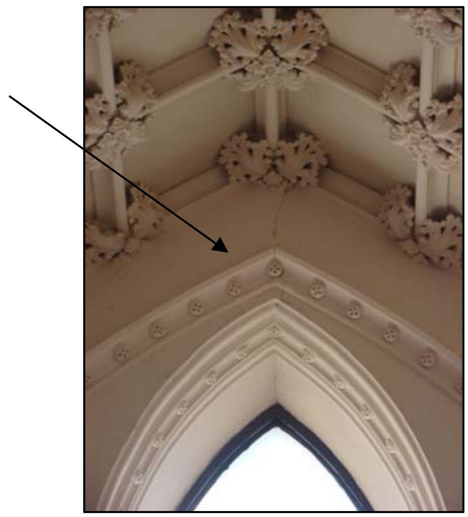

Figure 121. Arrows point to cracks due to weakened structure. (Photo: Author)

Figure 122. Holes cut in the Chancel ceiling to inspect and monitor termite damage. (Photo: Author)

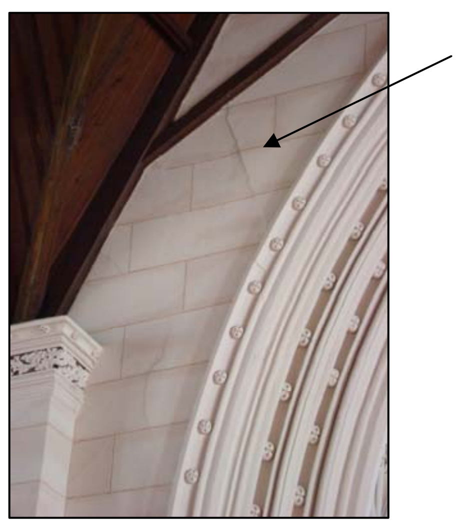

Figure 123. Arrows point to cracks due to weakened structure. (Photo: Author)

Conservation Efforts at the Church of the Holy Cross

The pisé walls at the Church of the Holy Cross are in fair condition after 150 years. [195] In the last thirty years since the restoration in 1974, the pisé walls have been exposed to new stresses as the result of termite damage to the wood structural supports. This is a significant concern since if the stresses exceed the strength of the pisé walls and brick buttresses, the structure will fail. This section suggests pisé conservation methods that could be used at the Church of the Holy Cross.

Figure 124. View of the current cement tile roof on the northern transept. (Photo: Author)

At the Church of the Holy Cross, there are excess stresses due to the extensive termite damage in the structural supports and other wooden members. The damaged trusses that are located above the chancel and nave area need to be replaced with compatible wood. Pre-treated wood could be used to prevent later termite damage, but it is recommended that a maintenance plan or new agreement with a termite extermination company be set

[195] See chart on pg 95.

up. This new plan or agreement should be followed through so as to ensure that yearly inspections are done. By replacing the termite damaged wood, extra stresses that have been placed on the pisé walls and brick buttresses will be decreased significantly.

Termites and other insects can cause considerable damage to historic properties by eating through wooden supports and other parts of buildings including window frames, floor joists, door frames, rafters, staircases, and trim. At the Church of the Holy Cross, termites had eaten their way through the wooden supports that butt up against the rammed earth walls. The deterioration of the supports has placed extreme stress on the earthen walls and masonry supports. The termite damage experienced at the Church of the Holy Cross is not a rarity; many historic structures have experienced termite infestations and in the last few years, studies have been performed to find the best method of removing the termites with minimal intervention.

A new baiting system called Sentricon Termite Colony Elimination to control the termites (Formosan subterranean) can be used to eliminate termites and can be applied to a property without any additional liquid components. This method has also been used at other historic properties, including Perseverance Hall in New Orleans.

Plastic bait stations are placed about ten feet apart from each other in the soil and two pieces of wood are placed in the station. The stations are covered and the termites find the wood and feed on it. After a few weeks, the stations are checked and any termites found in the stations are removed. They are put into a tube that contains hexaflumoron, an insect growth inhibitor, and re-released in the station. The termites go back to their colonies and because termites feed through trophallaxis, feeding by the mouth from another termite, the hexaflumoron is passed to the other termites in the colony. Hexaflumoron acts slowly and cannot be detected by the termites causing the colony to slowly dwindle in size. Fortunately, unlike other termiticides, hexaflumoron's toxicity is extremely low and does not pose threats to other animals or humans.[196]

The bait stations were found to be more effective than liquid termiticides and the low toxicity of hexaflumoron made it feasible to use around humans and other animals. Also, because it did not do harm to mammals, it also did not pose a threat in doing any sort of harm to the historic structure.[197]

In 1998, the National Pest Control published a work to that included alternative treatment methods for termites and problems associated with them. The main treatments include soil treatments and foundation treatments. The foundation treatments are discussed according to the material used for the foundation's construction.[198] Termiticides, the actual substance used to attack and kill the termites, can be used in soil treatments, foundation treatments, and wood treatments. This could be helpful at the Church of the

[196] Edward D. Freytag, Michael K. Carroll, Edgar S. Bordes. "Control of Subterranean Termites in Perseverance Hall in New Orleans, Louisiana." *APT Bulletin* 31, no. 2/3 (2000): 72 – 73.
[197] 71 – 75.
[198] "Tools and Methods of Control." National Pest Control Publication, 1998: pg 18.

Holy Cross to treat the soil surrounding the church as well as near the brick foundation and as actual treatment on the individual wood pieces.

Figure 125. Arrow points to cracking in roof truss due to termite damage and weakened strength. (Photo: Cummings and McCrady Architects)
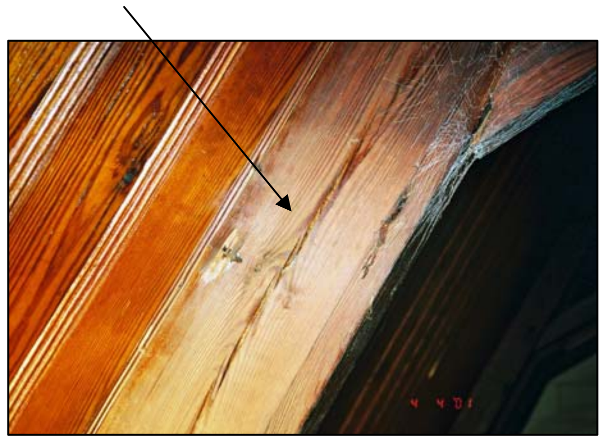
Figure 126. Cracking and separation of wood in roof truss due to termite damage. (Photo: Cummings and McCrady Architects)

Figure 127. The screwdriver illustrates how soft the wooden roof trusses had become due to extensive termite damage. (Photo: Cummings and McCrady Architects)

Figure 128. The arrow points to the area where the roof truss has pulled away from other wooden members because of weakened structure. (Photo: Cummings and McCrady Architects)

Figure 129. This is a view through a hole cut in the Chancel ceiling showing extensive termite damage in the roof structure. (Photo: Cummings and McCrady Architects)

Figure 130. The piece that was cut from the Chancel ceiling shows termite trails on the wooden lath. (Photo: Cummings and McCrady Architects)

Figure 131. Another view through the hole cut in the Chancel ceiling reveals a wooden member that used to be a solid piece of wood. (Photo: Cummings and McCrady Architects)

Another way to remove unwanted stresses from the pisé and brick buttresses is to replace the current cement tile roof with a lighter, historically accurate material. Originally, the roof was made of cypress shingles, but these were replaced with red clay tiles and later, cement tiles. The structure of the church was not designed to hold an extremely heavy roof. Since the roof structure has already been weakened by termite damage, the extra weight of the roof tiles is placing excessive weight on the lower parts of the pisé and buttresses, which are causing the maximum loads. Repairs made need to include replacing the roof as a system of both the tiles and the framing so that loads will be evenly dispersed throughout the structure.

Figure 132. Cracking on the exterior render due to excess stresses from termite damage. (Photo: Cummings and McCrady Architects)

Figure 133. More cracking on the exterior render running along the brick buttress. (Photo: Cummings and McCrady Architects)

A properly executed exterior render is vital to the longevity of pisé construction. Pisé walls were not meant to be exposed and the application of a render is the essential step to the protective coating. Strong renders are to be avoided because of their incompatibility with historic fabric and the strongest render that pisé can withstand is one part lime to two and a half parts sand to one part lime to three parts sand. Another mixture that was often used, but not in the 20th century, is of lime putty and fresh cow dung in equal proportions or whiting and dung.[199]

At the Church of the Holy Cross, an exterior render with cementitious components replaced the previous render in 1974. This was probably chosen because cements create a more waterproof render. While this is a desirable characteristic in theory, it ultimately causes the render to fail because water that becomes trapped behind the render is not able to evaporate and instead is trapped in the wall. It is suggested, when a restoration campaign occurs, that the cementitious render is removed. A test area should be done first to see if removing the render does any damage to the previous renders or pisé walls. If no damage is done to the pisé walls, then the render can be removed. There is an area on the church that is covered with Plexiglas and reveals the original pebble dash finish. It is recommended that the render be removed to this layer if possible. This way any future renders can be placed on top of the original render as it was intended to be renewed every ten to fifteen years.

Figure 134. View of the current cementitious exterior pebble dash render. (Photo: Author)

[199] John and Nicola Ashurst. *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth,* pg. 107.

Figure 135. The original render on the Church of the Holy Cross. (Photo: Author)

Until the money for the restoration are secured, it is suggested that the exterior render be sounded and tested to find areas of damage. If there are any voids found from a hollow sound, these areas should be removed and repaired with a mixture that is compatible with the 1974 render so that the materials do not have differing properties of expansion and contraction. After the render is restored, a maintenance plan should be put in place to inspect its condition every year and renewed every ten to fifteen years. This has been done at the Borough House since its construction and this regular maintenance has kept the pisé and renders in a satisfactory condition.

If a limewash protective coating was used on a pisé building instead of another exterior render, it would need to be renewed every few years. Limewashes are composed of several coats. The first coat adheres to the soil and forms a sort of slurry. As the first coat dries, the earth will crack. The second and third coats will hide these cracks and help to create a solid color to the limewash.[200]

Figure 136. Area on north wall where a plaque used to be showing how modern conveniences have been isntalles through the pisé walls. (Photo: Author)

Figure 137. View of eastern pisé wall from inside the Sacristy. The hole that the metal pipes are going through goes all the way through the wall. (Photo: Author)

A final way to help preserve loose pisé at the church is through the use of consolidants. They have been used on many different materials in building conservation, and there have been instances of using them on clay walls. Ethyl silicate can be sprayed directly onto exposed areas of earth and it helps to make the earth more water resistant. However, unlike waterproofing methods, ethyl silicate allows the earth to let water evaporate and does not affect the porosity of the original earth.[201] Areas of loose earth on the lower portions of the pisé walls at the Church of the Holy Cross due to the removal of the

[200] John and Nicola Ashurst. *Practical Building Conservation: Volume 2 – Brick, Terracotta, and Earth,* pg. 107.
[201] ibid, pg. 108.

wainscoting can be repaired with a consolidant. Following the application of the consolidant, the wall would need to be properly covered and the render monitored.

Figure 138. Area where the memorial plaques to Dr. Anderson and his two sons were previously located. Arrow points to the hole seen in plate 104. (Photo: Author)

To repair the pisé and renders at the Church of the Holy Cross, a step by step methodology should be followed. Necessary stabilization needs to be done to ensure that the building is stable enough for laborers to work inside of it and ensure their safety. The termites need to be exterminated and monitors installed like those used in the Sentricon system so that any future termite problems can be prevented. Termite damaged wooden elements need to be replaced with compatible materials to those originally used. Areas of pisé loss greater than 1”x 1” need to be patched with a compatible earth mixture, preferably taken from the same area as the original dirt. Materials analysis can be done of a sample taken from the ditch nearby to see if it has the same components as the original pisé. After patching the pisé, the plaster work on the interior also needs to be patched and the cracks repaired. The exterior render needs to be checked for any hollow areas due to loss or water damage with sounding and areas that sound hollow need to be further investigated for damage. It is preferable that the cementitious exterior render be removed and replaced with a more historically accurate pebble dash finish like that used at the Borough House. Lastly, a maintenance plan needs to be set up by which the pisé walls and interior and exterior renders are monitored and inspected yearly to assess their conditions.

Based on the chart on page 95, the Borough House, its dependencies, and the Church of the Holy Cross, have been assessed and grouped based on their conditions. Some of the buildings have been assessed as a whole, while others have been assessed based on interior and exterior elements, as these were in differing conditions. Following this chart is a list of specifications to be followed when repairing and replacing pisé at the Borough House and the Church of the Holy Cross.

Table 2. Conditions of dependencies at the Borough House and the Church of the Holy Cross

Excellent	Borough House wings, Library
Good	Dairy/Kitchen, Doctor’s Office, Loomhouse pisé and exterior render, Cook’s house, Dry well, Church of the Holy Cross exterior render
Fair	Loomhouse interior plaster, Church of the Holy Cross interior plaster,
Poor	Church of the Holy Cross wooden supports (framing, ceiling joists, bond timbers), Dry well wooden stairs

Specifications for Repair and Replacement of Pisé at the Borough House and Church of the Holy Cross

Materials

A. Replacement dirt, containing gravel, sand, silt, and clay, to be taken from the same pit as the original dirt, located 150 yards to the north of the Church of the Holy Cross.

B. Wood such as oak or pine, preferably from local sources, to be used for replacement bond timbers and other termite damaged members.

C. Water, clean and potable.

Execution

1.01. Inspection/Preparation

   A. Take a 35 – 40 gram sample from original pit as the original dirt and test for materials components with a sieve test. Sample composed of 25% gravel, 40% gravel and sand mixture, 25% sand, and 10% silt and clay.

   B. Inspect pisé walls for areas of loss greater than 1” x 1” and document their locations.

1.02. Surface Preparation

   A. Brush the walls clear of any crumbling dirt to create a smooth, stable surface.

   B. Assemble temporary shuttering out of wood and place against the wall where repair or replacement is to be done.

   C. Wet the surface of the wall with a gentle mist.

1.03. Repair and Replacement

A. For small areas between 1” x 1” and 6” x 6”, patch the areas of loss by hand by taking some of the dirt mixture and putting it into the hole. Make sure to pack the dirt tight and smooth off the top layer.

B. For areas of loss larger than 6” x 6” use the temporary shuttering to hold dirt near the area of loss and use a small implement with a flat end to pack the dirt.

C. When finished repairing or replacing areas of loss, brush the surface to remove loose dirt and allow it too cure for 24 hours.

D. Work done in mild temperatures between 50 degrees Fahrenheit and 75 degrees Fahrenheit with humidity between 30 and 60%.

Chapter 4

Rammed Earth as a Concrete and Materials Analysis

For many years, researchers have tried to come up with a satisfactory definition of concrete. This is a troubling endeavor as the traditional and publicly understood definitions are too specific and only include what we, as people in the 21st century, understand as concrete. Long before modern reinforced concrete was invented, there were early forms of unreinforced and reinforced concrete that was not limited to Portland cement, sand, and water. Molded in forms and consisting of earth, stones, mortar, quicklime, rubble, and other varying ingredients, the mixture was very similar to a concrete. Rammed earth methods and materials are certainly early expressions of concrete even though it does not meet our modern day definitions of concrete.

This chapter explores varying definitions of concrete, to explain how rammed earth can be viably considered concrete. Also, the varying forms of rammed earth, including different mixtures, are discussed to show that pisé is not just earth in a mold, but earth and other additives that form durable walls that are just as long lasting and strong as historic and modern concrete. Lastly, a sample of rammed earth obtained from the Church of the Holy Cross was analyzed to see what its specific components were and if its mixture could be classified as a concrete.

Definitions of Concrete

There are various definitions that exist for concrete, but some of them are all encompassing while others are more specific. The Oxford English Dictionary defines concrete as, “a heavy duty building material made from a mixture of broken stone or gravel, sand, cement, and water, which forms a stonelike mass on hardening.”[202]

David Cornelius, an architect who is currently editing Charles E. Peterson’s research papers on concrete, explored the various definitions of concrete in two of his articles, both written for the Association of Preservation Technology *Bulletin*. [203] He notes that the Army Corps of Engineers defines concrete as being “composed of sand, gravel, crushed rock, or other aggregates held together by a hardened paste of hydraulic cement and water.”[204] After being mixed, these substances create a product that can be molded into various shapes and dries as hard as stone. Our modern definitions do not look into the history of concrete, but rather focus on what it is today.

Charles Peterson, a leader in early American building technology, researched concrete for years trying to truly find a more suitable definition. For him, concrete referred to monolithic construction that consisted of earth, lime, and/or cement, including rammed

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[202] *Shorter Oxford English Dictionary,* (Oxford: Oxford University Press, 1973)
[203] Charles Peterson has been called the “godfather of preservation” and has written numerous publications on preservation topics. One of his interests was concrete and cement and he wrote many articles on the subject as well as notes, which David Cornelius is currently studying.
[204] David Gregory Cornelius, "Cast in Concrete: Binders, Definitions, and Development," *Association of Preservation Technology Conference 2008,* pg. 2.

earth.[205] Other criteria that Peterson listed for monolithic construction included the use of formwork and the continuity of the pieces created.[206] The definition of the word "concrete" to Charles Peterson needed to be broadened to include the "heritage of monolithic construction" and would include pisé, cob, tapia, and other forms of rammed earth that were regionally localized.[207]

Rammed Earth's Influence on Early Concrete

The earliest known reference to rammed earth's similarities to concrete is seen in Pliny's *Natural History*. In it he writes, "Have we not in Africa and in Spain walls of earth, known as "formacean" walls? From the fact that they are moulded, rather than built, by enclosing earth within a frame of boards, constructed on either side. These walls will last for centuries, are proof against rain, wind, and fire, and are superior in solidity to any cement. Even at this day Spain still holds watch-towers that were erected by Hannibal."[208] This link, seen so many years ago by Pliny, has also been recognized by modern researchers and historians who look to rammed earth solely for its methods. Other researchers have looked at rammed earth and its various forms as direct precursors and derivatives of concrete in a material sense. While differing on how rammed earth relates to concrete, both schools of thought recognize a significant link between the two.

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205 David Gregory Cornelius, "Cement and Concrete, Creativity and Community, and Charles E. Peterson," *Association for Preservation Technology Bulletin* 37, no. 1 (2006), pg. 19.
206 Cornelius, *Cast in Concrete: Binders, Definitions, and Development,* pg. 4.
207 ibid, pg. 5.
208 Pliny the Elder. *Natural History, IX*. Loeb Classical Library (Cambridge, MA, 1942), pg. 385.

Until this point in this project, rammed earth has referred to simply an earthen mixture that contained what was naturally found in the local soil used for construction. The only variations described have been those that have experimented with straw and other biological additives, which did not fare well. A main tenet of rammed earth is that it employs what is local and readily available. In some cases, the local soil is lacking or includes extra constituents such as stone. Researchers who have studied rammed earth as a precursor to concrete describe rammed earth as encompassing various soil mixtures including tabby, tapia, cob, and pisé. Also, there are varying forms of tabby and do not just include what the Spanish called "oyster rock," i.e. what is known as American tabby seen in coastal Florida, Georgia, and South Carolina.[209] Tabby or tapia, the Spanish word for tabby, can also include varying types of soil mixtures that will be further discussed as being ancestors to modern concrete.

Marion Blake, a researcher who studied Roman concrete from its beginnings, Peter Collins, author of *Concrete: The Vision of a New Architecture*, and Charles Peterson were three researchers who felt that the methods of pisé which used framing and shuttering as the molds helped create the technology that was later used for concrete. Blake is quoted as saying, "Another kind of masonry which may have contributed to the development of Roman concrete construction was Phoenician in origin."[210] Rammed earth was first described by several ancient historians as originating in Phoenicia, now in

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[209] Thomas F. Glick, "Cob Walls Revisited: The Diffusion of Tabby Construction in the Western Mediterranean World," in *On Pre-Modern Technology and Science*, eds. B. Hall and D. West. (Malibu: Undena Publications, 1976), pg. 155.

[210] Marion Elizabeth Blake, *Ancient Roman Construction in Italy from the Prehistoric Period to Augustus,* (Washington, D.C.: Carnegie Institution of Washington, 1947), pg. 325.

modern day Lebanon, where towers and walls were built of earth. This rammed earth has also been referred to as tapia made of stones, mortar, and rubble that constituted a sort of "African or Phoenician concrete."[211]

Collins and Peterson both thought that concrete should include monolithic construction methods and Collins, in particular, found that the methods that rammed earth used led directly to how concrete was molded. Collins saw that the methods of rammed earth were good, but that mere of just earth could be improved upon by adding such things as a mortar and aggregate to produce béton, the French word for concrete.[212] He also viewed Cointeraux and other French counterparts as being integral in introducing the ideas and methods of rammed earth to others so that they could improve upon the traditional materials including Francois-Martin Lebrun and Francois Coignet.[213] Their experiments with unreinforced and reinforced concrete were paralleled with experiments in England. After the invention of Portland cement in 1824, many cement factories were built throughout England.[214] Different companies experimented with mixtures to find the most durable concrete and these ideas were passed on through publications and word of mouth to America and other countries. Thus, while the materials and mixtures may have changed from when Francois Cointeraux was practicing rammed earth, his methods that were reintroduced during the early 19th century were carried on with concrete of the day.

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211 Glick, *Cob Walls Revisited: The Diffusion of Tabby Construction in the Western Mediterranean World*, pg. 147.

212 Peter Collins, *Concrete: The Vision of a New Architecture*, (Montreal: Mc-Gill Queens University Press, 2004), pg. 21.

213 Peter Collins, *Concrete: The Vision of a New Architecture*, pg. 25.

214 ibid, pg. 36.

While rammed earth construction techniques were influential on concrete development, the materials and composition of rammed earth also evolved from simple earthen mixtures to become increasingly more like what is known today as concrete. Not all concretes are made from ground rock, sand, gravel, cement, and water. Other materials have produced walls and other structural elements that are just as strong as "concrete." Charles Peterson felt that some of the materials that rammed earths have been made from are also candidates for being called concrete. African and Spanish precedents have included hydraulic lime binders or at least a binder with hydraulic properties and Peterson felt that this alone helped qualify them as concrete, rather than the presence of cement.[215]

Particular examples of rammed earth other than "oyster rock" or American tabby that feature hydraulic lime binders include structures found in Morocco. At Tarifa, Peterson saw the Almohad walls of Rabat (c.1130 – 1269 CE) that were built out of tapia. The tapia mixture used consisted of 50% local red clay and 50% lime that was burned from shells on a beach just across the river from the Almohad walls.[216] Everything was local and the presence of the quicklime[217] gave the earthen walls extra durability. The walls were uncovered, suggesting that exterior renders were perhaps regional to areas that experience more rainfall. As water wet the walls, the hydraulic lime would carbonate and cure making it the wall very hard, comparable to concrete's hardness. In more modern

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[215] Cornelius, *Cast in Concrete: Binders, Definitions, and Development,* pg. 5.
[216] Cornelius, *Cement and Concrete, Creativity and Community, and Charles E. Peterson,* pg. 19.
[217] Quicklime is dry lime that is not mixed with water before use.

periods, when repairs are made or entire new walls built in Morocco, some Portland cement is incorporated into the mixture to provide extra strength.

Figure 139. The Almohad walls in Tarifa, Morocco. (Photo: David Cornelius)

Knowledge of the construction mixture like that used in Morocco likely got there through the Spanish and Islamic influences as well as possibly the Romans' influence. Tracing the origins of tapia (including rammed earth and tabby) from the Old World to the New World (America), Thomas Glick found that the origins go back to North Africa. North African earthen construction had influenced not only the Spanish and Romans, who brought it to much of Europe including France, but also had been a direct influence on the British (see chapter 5). Pisé and tapia were brought across the Mediterranean by the Carthagians to Rome while other tapia methods were exchanged directly between North Africa and Spain. The closeness of the two areas helped foster an exchange of ideas, including construction methods.[218] Glick also agreed that whatever soil was local and available was used. The mixture did include sand and clay in addition to an optional

[218] Glick, *Cob Walls Revisited: The Diffusion of Tabby Construction in the Western Mediterranean World,* pg. 148.

aggregate, and a binder that was either quicklime, like at the Walls of Almohad, or biological binders like straw.[219]

In North Africa, Glick proposed that the tapia methods from North Africa, beginning around the 10th century, were Islamic in nature and were passed to Spain, which was also under Islamic rule at the time. Forts in Spain and North Africa were built of a tapia mix similar to that in Morocco with clay soil and lime. During the next few centuries, these mixtures and methods were continued and historical documentation of tabby buildings exist throughout the 13th century.[220] One citation in particular is helpful in showing that tapia construction, both in material and method, was essentially concrete. In Valencian documents, a mixture called argamassa, a type of mortar, made of earth, quicklime, and an aggregate, is described. Concrete is also described in these documents with no clear distinction made between argamassa and concrete. The argamassa was referred to in this document as being very close to concrete in its properties. Glick postulates that argamassa was identical to concrete.[221]

These methods used in North Africa and Spain flourished and were passed on to other parts of Europe, including France and England, through the Romans and by other routes. African methods were carried by the enslaved to the West Indies and then North America. The Spanish started building tapia structures in their settlements in the New

[219] ibid, pg. 151.
[220] Glick, *Cob Walls Revisited: The Diffusion of Tabby Construction in the Western Mediterranean World,* pg. 151
[221] Glick, *Cob Walls Revisited: The Diffusion of Tabby Construction in the Western Mediterranean World,* pg. 151.

World in Florida, and these ideas were then used by the English in Georgia and South Carolina. When the Spanish reached America, they once again employed what was locally available – shells. These were burned and used for lime and they began to use different materials for the aggregate of their tapia. However, instead of calling this tapia as they knew it, they termed it "oyster rock." The term "tabby" was retained and used by other groups of people to describe this regional construction. The term tabby is slightly ambiguous as it means something entirely different historically than it does today.

The work done by the aforementioned researchers shows that rammed earth, which includes pisé, cob, and tabby, is defined as earth tamped in a mold. With these clarifications, rammed earth's role in the evolution of concrete is better understood.

Therefore, the modern definition of concrete as consisting of cement, crushed rock, sand, gravel, and water, is too limiting as the material's history includes more materials than just cement. The research done over the last century has brought forth ideas that support some rammed earth mixtures as being not only a forerunner of concrete through its methods, but also a distinct concrete through their materials.

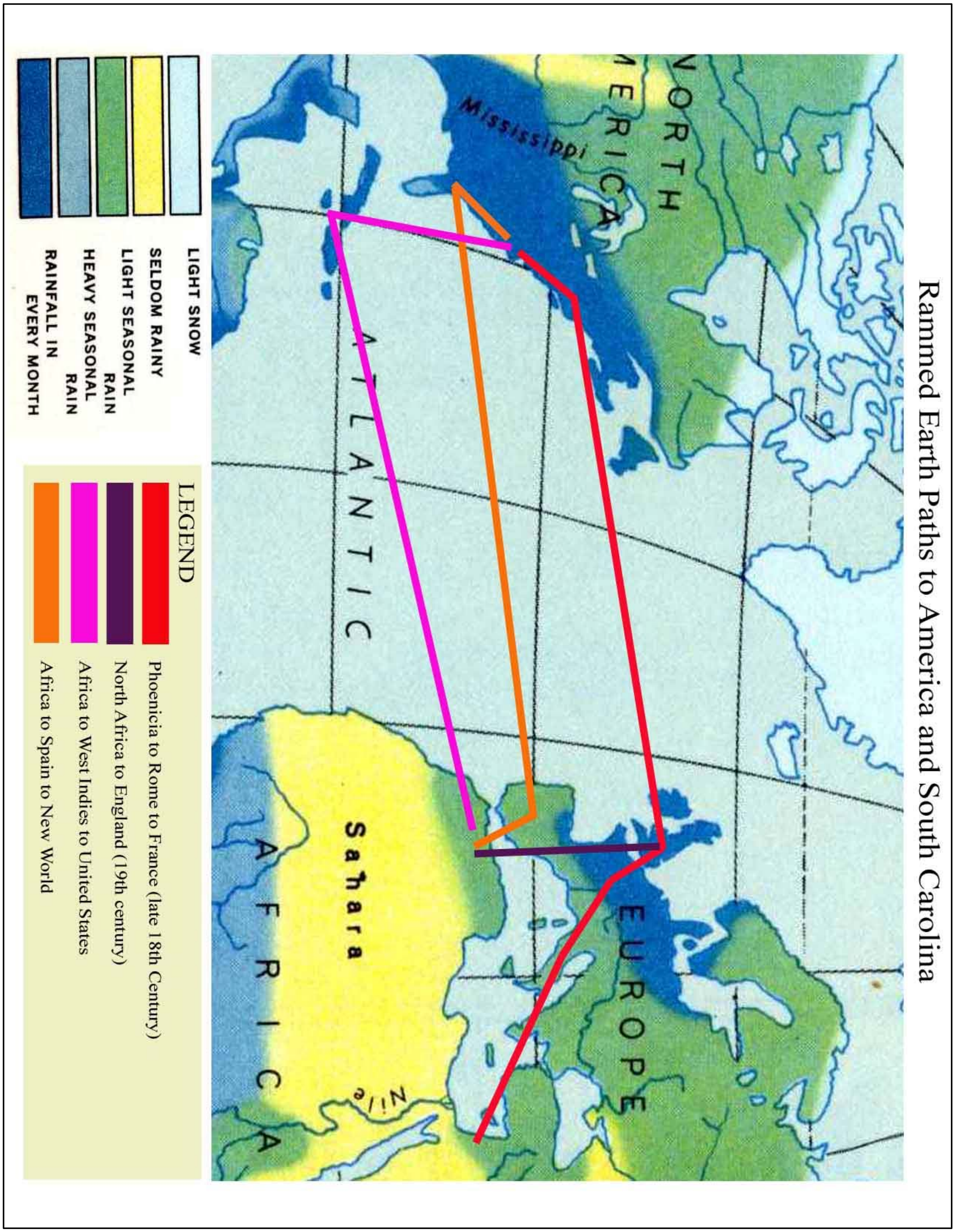


Figure 140. Map showing the paths that rammed earth took to arrive in the United States and South Carolina. (Image: Reader's Digest, Author)

Rammed Earth's Routes to America and South Carolina

Figure 35 shows the paths that the knowledge of various forms of rammed earth, including pisé and tapia, traveled to get to the United States and eventually South Carolina. Over the course of thousands of years, the methods and materials of rammed earth were exchanged between various countries and cultures to create regional forms of rammed earth that employed the same methods of framing and tamping.

One path (in red), already discussed in chapters four, five, and six is that of pisé. After learning the methods from earlier cultures, the Romans introduced the practice to France. The rediscovery in the 18th and 19th century brought pisé back into the public eye and it was then passed on through publications and personal contacts to England and the United States.

Methods learned in North Africa also ended up in North America. One way (in purple) was through British clergymen who visited North Africa and saw the earthen walled houses. Taking back these techniques with them to England, these men not only taught their fellow countrymen about pisé, but they also published pamphlets that were read by Englishmen and Americans alike. North Africa's proximity to Spain encouraged tapia methods to be exchanged between the two Islamic countries during the 10th to 13th centuries. The Spanish brought these ideas with them to the New World during the 16th and 17th centuries where the traditional tapia was altered to exploit the availability of oyster shells. The English, who also inhabited the early colonies, learned these new tabby techniques and built structures throughout Georgia and South Carolina as seen by the orange path.

The last route (in pink) was discussed in chapter seven. Also coming out of Africa, this path followed the enslaved West Africans to the West Indies, including Haiti, and on to the American colonies. Their methods were unique to their homeland, but still employed the use of framing to produce small shelters such as houses and other outbuildings at Lowcountry plantations and early downtown settlements.

In addition to showing the routes that rammed earth methods traveled, this map shows regional variations of rammed earth that are based on climate. The gradation in blues and greens shows differing levels of rainfall. The areas where rammed earth began such as North Africa, Spain, and ancient Phoenicia (Lebanon) are dry with only light seasonal rains. In these locations, the earthen structures were often left unprotected by an exterior render like pebble dash or stucco. The other locations of rammed earth including France, England, the West Indies, and the United States, have rainfall in every month and necessitate an exterior render to protect the earth. Even in these moist climates, unprotected rammed earth walls can survive many years without damage, but the extra protection does help preserve the original material.

Materials Analysis of Rammed Earth from Church of the Holy Cross

From samples extracted from the pisé at the Church of the Holy Cross, materials analysis was performed including gravimetric analysis and sieving. These two experiments can help assure that future repair work on the pisé walls of the church is done with earth compatible to the original materials. The analysis also helps researchers better understand the composition of this pisé and where this particular building fits into the timeline of early American concrete structures.

Experiment 1: Gravimetric Analysis and Acid Digestion

For this experiment, a sample of rammed earth was weighed, ground with a mortar and pestle, and then acid was poured onto the ground earth to digest any binders. Muriatic acid was used and as the acid was poured onto the earth, there was no visible reaction as would be expected with a lime binder. It was not known if the earth had a lime binder or any other calcareous components and if there was an observable significant reaction, then it could have been assumed that there was some sort of calcareous component to the earth from the Church of the Holy Cross. After stirring for twenty four hours, the acid was filtered and the fines of the earth were deposited on the filter paper leaving the main parts of the aggregate in the beaker. The aggregate and fines were dried in an over for twenty four hours and then the aggregate was sieved in a sieve stack. Each of the stack samples was weighed and the weights were used to calculate what percentage of the entire sample weight that each stack sample comprised.

Table 3. Weights of Experiment Components		
Experiment Components	**Weights**	**Weight:Weight Percentage**
Container Weight	8.4 grams	n/a
Original Sample Weight	45.2 grams	n/a
M_1 (powdered sample) = (45.2 grams – 8.4 grams)	36.8 grams	n/a
M_2 (filter paper)= 1.8 grams	1. 8 grams	n/a
M_3 (dry fines)= (4.4 grams – 1.8 grams)	2.6 grams	5.8%
M_4 (dry aggregate)= (42.4 – 8.4 grams)	34 grams	75.2%

Table 4. Rammed Earth Characteristics Before Acid Digestion	
Layer Structure	Matrix, no visible layers
Texture	Rough with subangular and subrounded particles
Inclusions	Clay, silica
Particle Shape	Subangular, subrounded
Particle Size	Fine to medium; contains silica, small dirt clumps, small sand clumps
Sorting	1; particles of all sizes are present

Table 5. Rammed Earth Color Before Acid Digestion	
Munsell Colors	5YR 5/4, 4/4; 7.5YR 5/4

Table 6. Rammed Earth Color After Acid Digestion	
Munsell Colors	5Y 8/2, 8/4, 7/2, 7/3, 6/2, 6/3

The results in Table 4.1 help to show that the dry aggregate after filtering plus the dry fines equals 81% meaning that 19% of the rammed earth sample was dissolved during the acid digestion. It is possible that small percentages of the sample were lost during the experiment, but it is unlikely that 19% of the sample was lost due to the experimenter's error. These results show that some part of the earth sample contained calcareous materials such as pieces of limestone. The earth that was used to build the Church of the Holy Cross naturally has some sort of calcareous components.

Several observations were made including those seen in Table 4.2, 4.3, and 4.4. All of the samples and experiment parts like the filter paper that filtered the fines from the acid were weighed to help provide accurate weights and weight:weight percentages seen in Table 4.1. Table 4.5 contains the information obtained from sieving the dry aggregate and retained sample percentage.

Experiment 2: Sieving and Microscopic Observations of Pisé Sample

This experiment was performed to compare some results with the gravimetric analysis done in experiment 1. Also, the findings of the sieving of the rammed earth sample help to better understand the components of the rammed earth and how much of each different component is present in the earth. A sample of rammed earth was weighed, ground up, and sieved in a sieve stack. The weights of containers used to hold the sample were also taken so that accurate measurements of the sample weights would be taken. Using these weights, the net sample weight could be calculated.

Container Weight = 8.7 grams

Sample weight = 50.1 grams

Net sample weight = (sample + container) – container = (50.1 grams) – 8.7 grams = 41.4 grams.

After sieving the sample, each stack sample container and sample were weighed and the percentages of retained sample weight were deduced using the following formulas.

Retained Sample Weight = (retained sample + container) – container

Percentage of Retained Sample Weight = (retained sample/net sample weight) x 100

Percentage of Sample Lost = (retained sample weight/net sample weight) x 100

These results can be seen in Table 6. After all of the individual stack sample percentages were figured out in Table 7, the overall percentage of the sample lost was also computed.

(40.3 /41.4) = .97 and 1 - .97 means that less than 1% of the sample was lost during the experiment.

Following the sieving and weighing, each stack sample was observed using visual microscopy to look at the characteristics of the sieved pisé including size, shape, color, and sorting. This process helped to better identify each sample as being of a coarser particle or finer material like sand. By knowing what each component is, a compatible earth could be found if pisé repairs are needed in the future at the Church of the Holy Cross. Fortunately for the church, documentation of where the original earth was from was done and survives to help guide future conservation efforts.

Table 7. Dry Aggregate Sieving Results

Stack	Weight	Weight/Sample Weight	Percentage Retained
10	8.45 grams – 8.4 grams = .05 grams	.05/45.2 grams	.1%
20	11.7 grams – 8.4 grams = 3.3 grams	3.3/45.2 grams	7.3%
40	20.6 grams – 8.4 grams = 12.2 grams	12.2/45.2 grams	27.0%
60	15.7 grams – 8.4 grams = 7.3 grams	7.3/45.2 grams	16.2%
100	12.4 grams – 8.4 grams = 4.0 grams	4.0/45.2 grams	8.8%
200	12.6 grams – 8.4 grams = 4.2 grams	4.2/45.2 grams	9.3%
Pan	10.0 grams – 8.4 grams = 1.6 grams	1.6/45.2 grams	3.5%

Table 8. Small Container Weights for Sieve Stack Results	
Stack	**Weight (grams)**
10	3.9 grams
20	3.7 grams
40	3.9 grams
60	3.6 grams
100	3.6 grams
200	3.9 grams
Pan	3.7 grams

Out of the 41.4 grams original sample, 40.3 grams remained at the end of the experiment. The following lists results that revealed what the components of the rammed earth sample were:

1.2% = coarse gravel

21.5% = less coarse gravel

41.3% = medium gravel and sand mixture

16.2% = medium to fine sand

8.2% = fine sand

6.8% = very fine silt

2.2% = super fine silt/clay

The majority of the earth is a medium gravel and sand mixture, but it also contains sands and clays. The clay portions of the earth help to bind the earth together and help to make it a stable method of construction once rammed into the shuttering. Also, the gravels of the earth used at the Church of the Holy Cross are more beneficial to the earthen mixture than rounded gravel as the subangular and subrounded gravel particles do not leave small air pockets once compacted nor do they move after compaction. All of these components helped to make the earth used to construct the Church of the Holy Cross a strong building material that has survived over 150 years.

Table 9. Sieved Pisé Weights

Stack	**Initial Weight**	**Retained Sample Weight**	**Percentage of Retained Sample Weight**
10	4.4 g – 3.9 g = .5 g	.5 grams	(.5/41.4) x 100 =1.2%
20	12.6 g – 3.7 g = 8.9 g	8.9 grams	(8.9/41.4) x 100 = 21.5%
40	21.0 g – 3.9 g = 17.1 g	17.1 grams	(17.1/41.4) x 100 = 41.3%
60	10.3 g – 3.6 g = 6.7 g	6.7 grams	(6.7/41.4) x 100 = 16.2%
100	7.0 g – 3.6 g = 3.4 g	3.4 grams	(3.4/41.4) x 100 = 8.2%
200	6.7 g – 3.9 g = 2.8 g	2.8 grams	(2.8/41.4) x 100 = 6.8%
Pan	4.6 g – 3.7 g = .9 g	.9 grams	(.9/41.4) x 100 = 2.2%
		Total of RSW= 40.3 grams	

Table 10. Microscopic Observations of Sieved Pisé					
Stack	**Particle Size**	**Particle Shape**	**Color**	**Sorting**	**Magn**
10	Coarse; gravel like	subangular	5YR 7/6, 8/4; 10R 4/1	2	10x
20	Coarse; gravel like	Subangular, subrounded	7.5YR 5/4, 5/6	4	10x
40	Medium; gravel and sand	Subangular, subrounded	7.5YR 5/4, 5/6	4	10x
60	Medium to fine; sand	Subangular, subrounded	7.5YR 6/4, 5/4	4	10x
100	Fine; sand	Subangular, subrounded	5YR 5/4; 7.5YR 6/4, 5/4	4	45x
200	Very fine; silt like	Subangular, subrounded	7.5YR 6/4, 5/4	4	45x
Pan	Super fine; silt/clay	Subangular, subrounded	7.5YR 6/6, 5/6	5	45x

With the testing completed, the information gathered should be used for replacement or repair to the church's pisé walls. Knowing that the dirt used for construction came from 150 yards away from the church, the same pit should be used for replacement dirt.[222] Retrieve the dirt that is located several feet down as there is overgrowth of plants and likely many layers of top soil that are not suitable for construction. Take samples of dirt

[222] Miller, pg. 7.

from several feet down where the dirt is reddish in color and perform the same gravimetric analysis and sieving. If the results are similar in percentages of sands, gravels, and silts, then dirt from that are is suitable for patching the church's walls and will be compatible with what is currently in place.

This sample testing was done to answer the question of whether the earth used at the Church of the Holy Cross was a cement. 19% of the sample was a calcareous material and was dissolved through the acid digestion, but it is likely that this percentage of material was a natural calcareous rock instead of hydraulic lime. Based on the Moroccan tapia, which contained 50% quicklime, and the scholarly research and definitions proposed by Charles Peterson and David Cornelius, the Stateburg rammed earth is not concrete because it does not contain significant amounts of hydraulic lime. Variations in rammed earth mixtures created different materials with some that are more closely related to rammed earths and tapias used in Morocco and on the southeastern seaboard, and others like that used in Stateburg, which consisted mainly of local sands, gravels, and silts.

Conclusion

As two of the only surviving rammed earth structures in the United States, the Borough House and the Church of the Holy Cross represent an ancient construction method that has proven to be as durable as concrete and can be placed in the same category. Concrete is not only cement, but may also include earthen mixtures that contain hydraulic limes. As with many building materials, rammed earth can be composed of a variety of mixtures including tabby with crushed oyster shells and lime, tapia used in Morocco with 50% clay and 50% quicklime, or unaltered earth taken from a local ditch. Modern constrictive definitions of concrete are too limiting and fail to take into account the long history of concrete and rammed earth and their similarities. This study sought to research rammed earth's background and its parallels in earthen construction and examine two specific case studies to determine if rammed earth is an early concrete. The tests concluded that the earth in Stateburg was not concrete, but the accessory research did demonstrate that rammed earth has, in the past, been referred to as concrete and has verified its comparable durability to concrete. The solidity and general good conditions of the structures analyzed demonstrates a step toward modern concrete through its survival and overall strength versus previous earthen construction methods that were less temporary. After surviving for 188 years and 157 years, the Borough House and the Church of the Holy Cross illustrate the durability, with proper maintenance, of earthen construction in the southern United States.

Appendices

Appendix A

Francois Cointeraux's Sketches

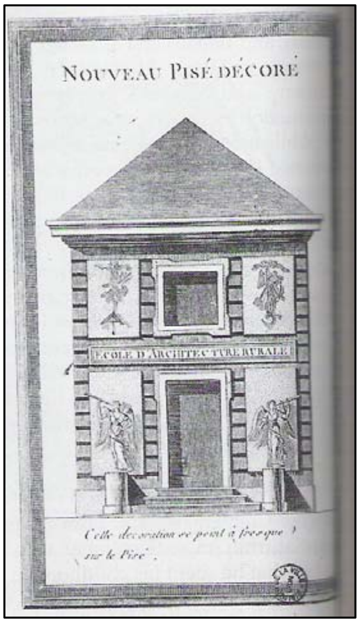


Figure A1. A design for a house to be finished with pisé decorée. (Image: Louis Cellauro and Gilbert Richaud)

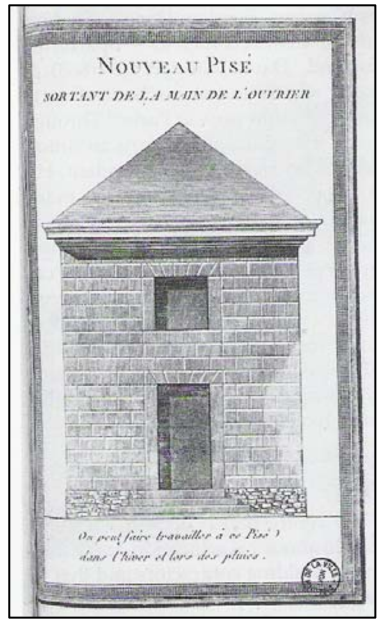


Figure A2. A design for a simple pisé house with a scored stucco exterior. (Image: Louis Cellauro and Gilbert Richaud)

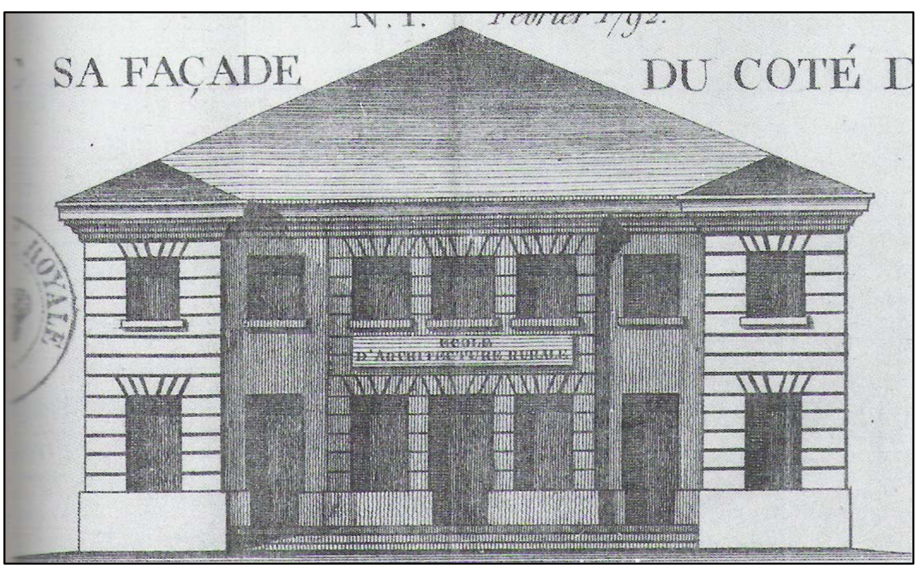


Figure A3. Cointeraux's design for his third "school" in Paris. (Image: Louis Cellauro and Gilbert Richaud)

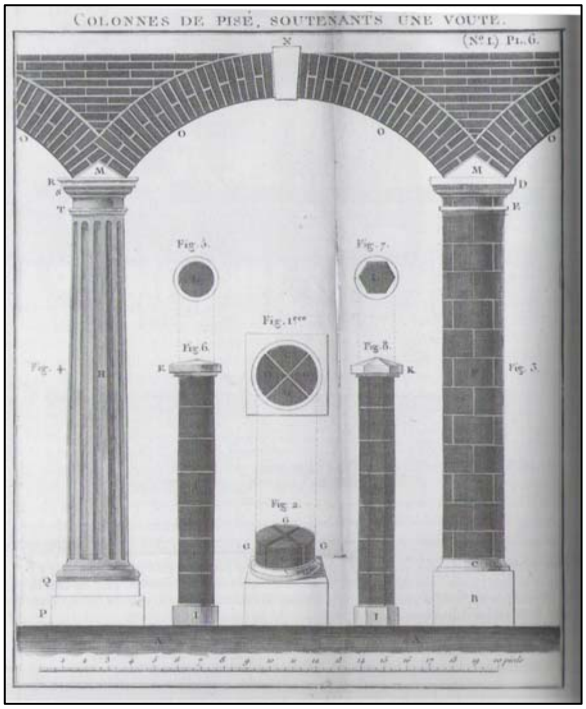


Figure A4. Designs for pisé columns. (Image: Louis Cellauro and Gilbert Richaud)

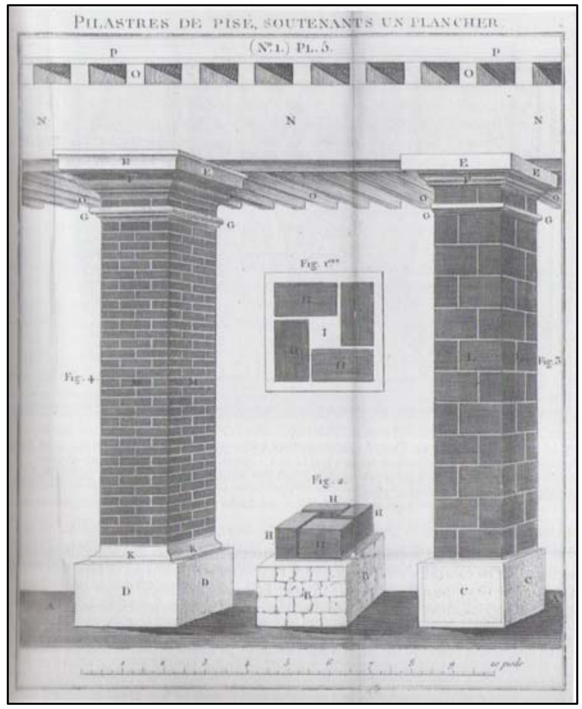


Figure A5. Designs for pisé block pilasters. (Image: Louis Cellauro and Gilbert Richaud)

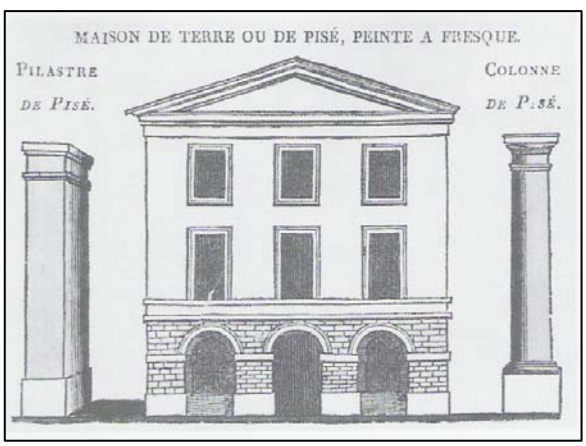


Figure A6. Design for a house, pilaster, and column of pisé. (Image: Louis Cellauro and Gilbert Richaud)

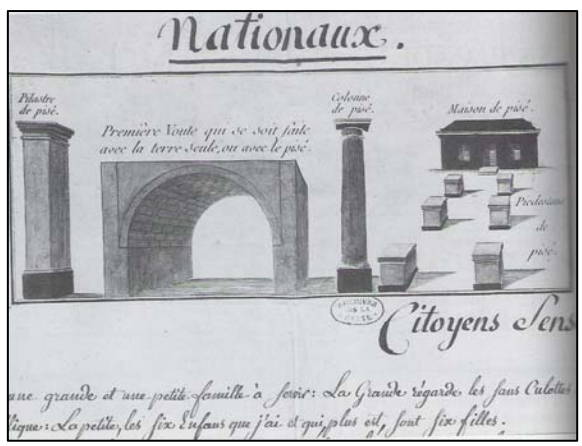


Figure A7. Design for columns and an arched vault built of pisé blocks. (Image: Louis Cellauro and Gilbert Richaud)

Appendix B

The Borough House

Historic American Building Survey Photographs from 1985

Plate A1. The Borough House.
(Photo: Library of Congress)

Plate A2. The conservatory located on the western side of the house.
(Photo: Library of Congress)

Plate A3. The doctor’s office southern (principal) and eastern elevation.
(Photo: Library of Congress)

Plate A4. The addition made to the cook's house in the 1970s. Arrow points to the original portion of the cook's house. (Photo: Library of Congress)

Plate A5. 1920s addition on the eastern side of the Borough House. (Photo: Library of Congress)

Plate A6. The northern elevation of the dairy/kitchen. (Photo: Library of Congress)

Plate A7. Interior of the loomhouse showing the looms that are currently in poor condition. (Photo: Library of Congress)

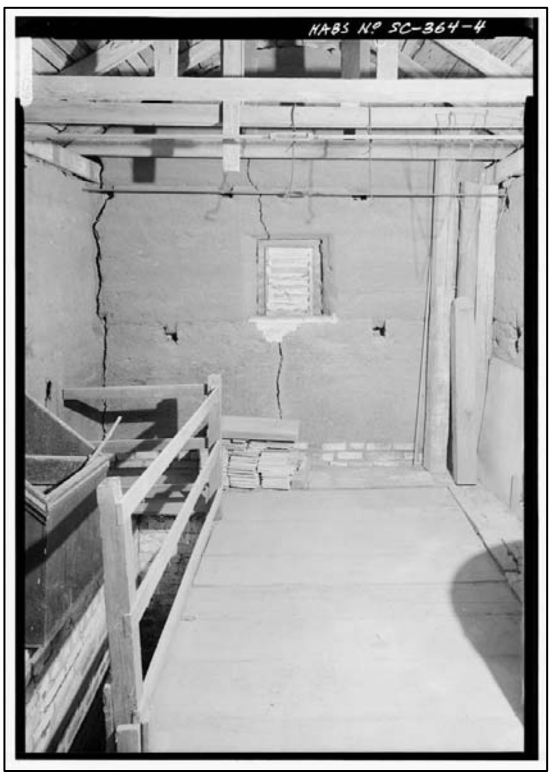


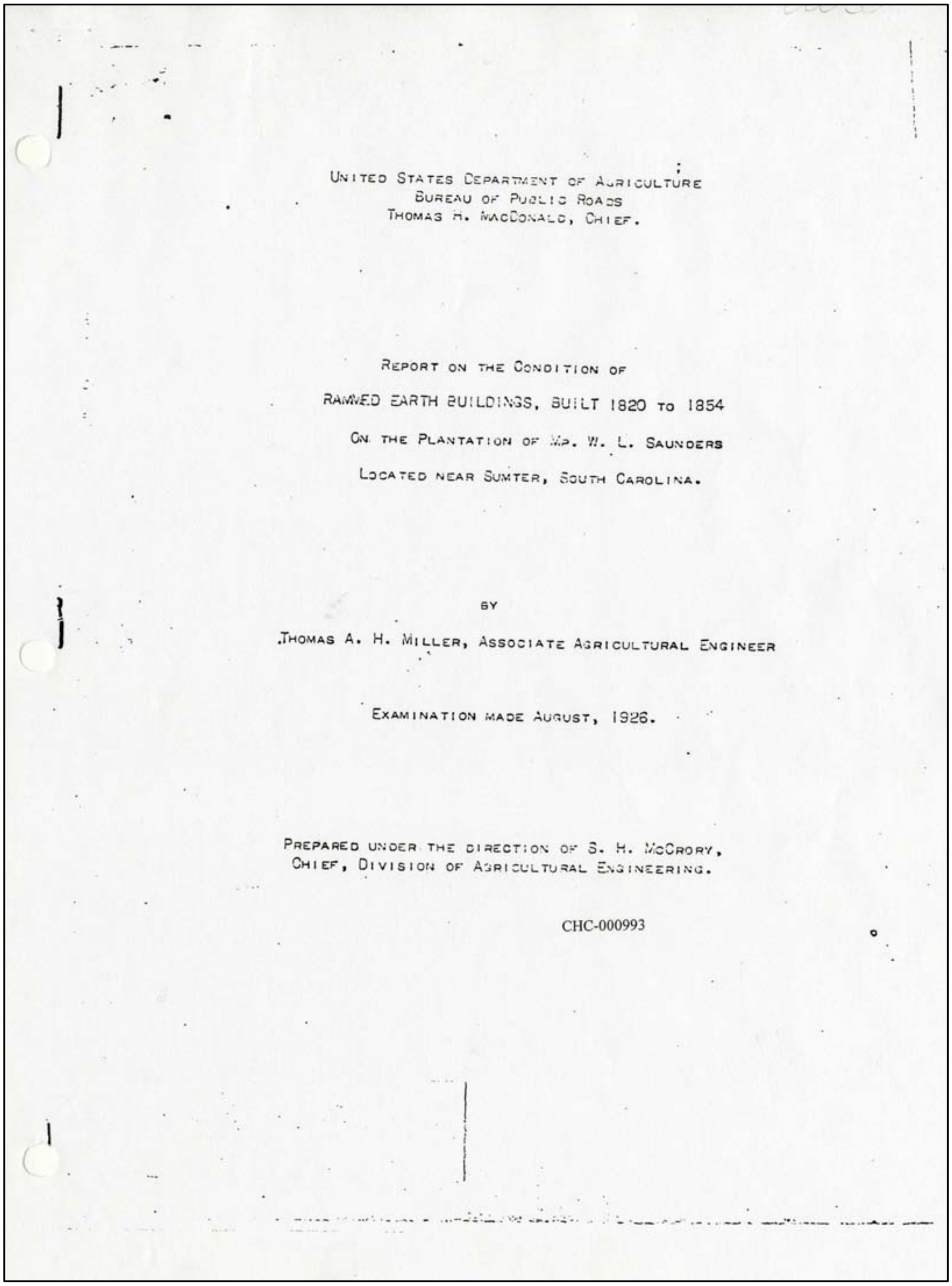
Plate A8. Interior of the dry well building with unfinished pisé walls. The stair to the left goes down to the well. (Photo: Library of Congress)

Plate A9. Interior of the main parlor, which is constructed of frame and was built in the 1760s. (Photo: Library of Congress)

Plate A10. The main staircase. The parlor is located to the left and the 1920s addition is located to the right. (Photo: Library of Congress)

Plate A11. Aerial view of the Borough House property from 1985. (Photo: Library of Congress)

Thomas Miller's 1926 Survey



UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS
THOMAS H. MACDONALD, CHIEF.

REPORT ON THE CONDITION OF
RAMMED EARTH BUILDINGS, BUILT 1820 TO 1854
ON THE PLANTATION OF MR. W. L. SAUNDERS
LOCATED NEAR SUMTER, SOUTH CAROLINA.

BY

THOMAS A. H. MILLER, ASSOCIATE AGRICULTURAL ENGINEER

EXAMINATION MADE AUGUST, 1926.

PREPARED UNDER THE DIRECTION OF S. H. MCCRORY,
CHIEF, DIVISION OF AGRICULTURAL ENGINEERING.

CHC-000993

Figure A8 – A18. 1926 survey by Thomas Miller of the Borough House and the Church of the Holy Cross for the United States Department of Agriculture. (Image: Cummings and McCrady Architects.)

An excellent opportunity to study the durability of rammed earth construction was presented to the Division by W. L. Saunders, who called to seek advice regarding repairs needed to structures on his plantation which is located near Sumter, South Carolina. A representative of the Division was sent to inspect the structures, suggest methods of repair and prepare a report regarding the buildings.

These structures, besides withstanding the ravages of the ordinary elements, have resisted the Charleston Earthquake (August 21, 1886), a three day hurricane (1895) and a cyclone (February 16, 1903).

Rammed Earth Structures at "Hill Crest Plantation", near Sumter, South Carolina

Dr. W. W. Anderson who built these rammed earth structures lived near Rockville, Maryland, and was graduated from the University of Pennsylvania, in medicine. About this time S. W. Johnson (also well known in Philadelphia) built his house of rammed earth at New Brunswick, New Jersey and in 1806 published a very clear description of the method of using this material in his "Rural Economy". A copy of this book is in the plantation library. The stucco and other building details suggest that the directions outlined in this treatise were followed.

Dr. Anderson went to Sumter County, South Carolina, in 1810 and soon after his marriage in 1818 he rebuilt the wings of the dwelling on Hill Crest Plantation, making the walls of rammed earth. In all about 10 plantation buildings were erected and a large church.

Figure 1 shows the general plan and cross-section of the church which is the most imposing and ambitious structure of the group, Figure 2, the north and west exposures and Figure 3 the interior.

Started January 3, 1850, it was offered for acceptance January 24, 1852. The church was designed by Mr. E. C. Jones, designer of the State House at Columbia and built by Dr. W. W. Anderson.

Dr. Anderson decided to build the walls of rammed earth and his descendents attest that apparently there was considerable opposition to this type of wall. Their opposition was withdrawn when Dr. Anderson assured the congregation that a larger and handsomer edifice could be had if earth walls were used — and besides at this time the rammed earth buildings on his plantation were 30 years old.

Much of the work was executed by plantation labor, the cost of which apparently was not recorded, for the old parish register records the cost of the church as follows:

To cash paid for materials, as lumber, brick, etc......	$2,963.15
" " " " labor	6,074.55
" " " " E. C. Jones - bill for pulpit, altar, etc.	500.00
" balance E. C. Jones' bill and account	1,316.17
For windows	1,003.00
Interest for two years	62.00
Total	$11,923.91

It is conservative to say the church could not be duplicated today for less than $60,000.

The principal dimensions of the church are indicated on the plan, Figure 1. The side walls are 15 feet above the foundation and the point of the gables 36 to 40 feet.

The foundation is composed of flagstones, superimposed by 5 courses of brick to the bevel, which sets out 8 inches from the main wall and one course of brick above the bevel, in line with the main wall. The top of this last course is 24 inches above the flagstones. All masonry is laid in lime mortar.

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The stucco is of lime mortar rough cast, coated with coarse sand and varying in thickness from 1/8 inch to 3/4 inch. The original color of this finish was a dull red, but later the stucco was white-washed. The whitewash has been covered recently with a cream-colored commercial waterproofing preparation.

The roof framing is most unusual, the trusses, outlined in Figure 1 are 4 inch by 6 inch yellow pine, located 8 feet on centers with three purlins on each side of the roof between trusses. On these purlins $1\frac{1}{2}$ inch ceiling boards extend from the ridge to the plate in one length. On the exterior and spiked to this finished ceiling are $1\frac{1}{2}$ inch by 6 inch roofing slats. The original wooden shingles were replaced in 1917, by pressed cement tile, colored red. The overhang at the side walls is about 6 inches and at the gables about 6 inches.

The present tower and part of the north wall, as shown in plan, are concrete. This tower is now 40 feet high but the first tower was 40 feet high and of rammed earth superimposed by a spire 20 feet high. The part of the plan indicated as concrete shows the portion of the building blown down by the cyclone. A horizontal line extending from the first window jamb to the buttress, shown on the north wall, Figure 2, marks the upper part as concrete and the lower as rammed earth. The tower fell across the roof which was shoved two feet off the south wall but it was slid back into place without the necessity of rebuilding the trusses. Residents report that the earthquake of 1886 caused a decided crack between the tower and the main building and that seepage of water into the crack started at this time. The crack was exposed to the elements for 17 years.

THE FLOOR IS OF CONCRETE LAID ON AN EARTH FILL AND SHOWS NO SIGNS OF DAMPNESS; NOR IS THERE SIGN OF CONDENSATION ON THE WALLS.

THERE ARE NO SIGNS OF LINTELS OR BONDING TIMBERS IN THE WALLS NOR ARE THE WALLS OVER ANY OF THE OPENINGS OF THE CHURCH CRACKED. THE LARGEST WALL OPENING, IS THE CHANCEL WINDOW, 16 FEET 5 INCHES WIDE AND 20 FEET HIGH DIVIDED INTO THREE PARTS BY TWO BRICK COLUMNS. THREE PAIRS OF WINDOWS 8 FEET 3 INCHES WIDE AND 16 FEET HIGH ARE LOCATED IN NORTH, WEST AND SOUTH WALLS, THE TOWER DOOR IS 7 FEET 6 INCHES WIDE AND 9 FEET TO THE APEX.

THE CHURCH IS STRUCTURALLY SOUND AND IN GOOD CONDITION THOUGH SEVERAL BAD CRACKS CAN BE SEEN IN FIGURES 7 AND 8. THESE CRACKS, ACCORDING TO REPORTS, HAVE NOT WEAKENED THE BUILDINGS. FIGURE 7 IS A "CLOSE UP", OF THE WEST CORNER OF THE NORTH TRANSCEPT (JUST OVER THE TOMBSTONE IN FIGURE 5) AND FIGURE 8 OF THE EAST CORNER SAME SIDE.

FIGURE 6 SHOWS A PORTION OF THE WALL BELOW THE CHANCEL WINDOW ON THE EAST SIDE OF THE CHURCH BELOW A TEMPORARY CORRUGATED METAL SHELTER. (SEE FIG. 4). THIS SHELTER AFFORDED SOME PROTECTION TO THE EXPOSED EARTH, FOR SEVERAL YEARS, FROM RAIN WASHING DOWN FROM THE CHANCEL WINDOW AND WALL.

THE BRICK FOOTINGS SHOW THE STUCCO FALLEN OFF IN SPOTS AND THE SOFT BRICKS BADLY DISINTEGRATED. THE SQUARE HOLES EXTEND THROUGH THE WALLS AND WERE LEFT AS VENTILATORS (OR WEEP HOLES AS THE FLOOR IS DIRECTLY ON THE GROUND). THESE WERE FORMED BY THE PUTLOGS USED IN THE FORMS. THE MOTTLED STUCCO ON THE RIGHT IS THE ORIGINAL RED FROM WHICH THE WHITE-WASH HAS DISAPPEARED, THE WHITE TO THE LEFT IS THE WHITEWASHED SURFACE, AND THE GRAY THE CREAM-COLORED WATERPROOFING, WHICH PEELS OFF VERY MUCH AS

DOES ZINC PAINT. THE TEXTURE OF THE EARTH CAN BE READILY NOTICED. A CEMENT-STUCCO PATCH CAN BE SEEN IN THE UPPER PART OF THE PICTURE AND, AS WILL BE NOTICED, THE LOWER EDGE IS LOOSE, READY TO SLAB OFF, AS DOES MOST OF THE CEMENT PATCHING WHICH HAS BEEN TRIED. WHETHER THIS IS DUE TO IMPROPER HANDLING OF THE CEMENT STUCCO OR NOT COULD NOT BE DETERMINED. THE LOCAL IMPRESSION IS THAT PORTLAND CEMENT MORTAR WILL NOT STICK TO EARTH WALLS. RATHER THAN RISK A FAILURE THAT PORTION OF THE GABLE BETWEEN THE CENTRAL AND CHANCEL ROOF, FIG. 4, WERE COVERED WITH METAL LATH AS A BASE FOR THE CEMENT STUCCO. THIS WAS DONE WHEN THE ROOF WAS COVERED WITH TILE. THE WRITER TRIED A SMALL CEMENT MORTAR PATCH ON THE WEST FRONT, USING A 1:3 MIXTURE AND SPLASHED THE STUCCO ON THE WALL WITH A BRUSH. THE EARTH WAS WETTED BEFORE APPLYING THE STUCCO AND THE STUCCO WAS WETTED SEVERAL TIMES AFTER THE CEMENT HAD HARDENED. THE PATCH HAS BEEN IN PLACE TWO MONTHS AND I AM ADVISED SHOWS NO SIGNS OF CRACKING OR FALLING FROM THE EARTH WALL.

FIGURE 6 FURTHER DETAILS THE FAILURE OF THE STUCCO AT THE LOWER SECTION OF THE SAME WALL (FIG. 5). INCIDENTALLY TWO OF THE PUTLOGS CAN BE SEEN; ONE OF WHICH IS IN A FAIRLY SOUND CONDITION AFTER HAVING BEEN COVERED BY THE STUCCO FOR 72 YEARS.

FROM ALL EVIDENCE, FAILURE OF THE STUCCO BELOW THE CHANCEL WINDOW WAS BEGUN BY WATER FINDING ITS WAY BEHIND THE STUCCO, UNDER THE WINDOW SILLS. IT WILL BE NOTED THAT THE RIGHT AND CENTRAL SILLS HAVE FALLEN AWAY; ALSO METAL FLASHING HAS BEEN USED AT THE JUNCTION OF THE WOOD WITH THE BRICK-STUCCOED SILL. THIS FLASHING WAS NOT USED WHEN THE CHURCH WAS BUILT AND INDICATES THAT APPARENTLY SOME ONE WAS CONSCIOUS - TOO LATE - THAT SUCH CRACKS WOULD PROVE A SOURCE OF TROUBLE.

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ALL EVIDENCE POINTS TO THE FACT THAT CRACKS IN THE STUCCO ARE AN INDICATION OF CRACKS OR OTHER DEFECTS IN THE WALL UNDERNEATH FOR WHERE THERE ARE NO CRACKS THE STUCCO IS SOLID AND APPARENTLY AS GOOD AS THE DAY IT WAS PLACED, EVEN THOUGH ONLY OF LIME MORTAR. WHERE CRACKS OCCUR THE STUCCO, FOR VARYING WIDTHS ON EITHER SIDE, IS LOOSE; THE WIDTH DEPENDING UPON HOW MUCH THE CRACK HAD OPENED. NO STUCCO HAS FALLEN WITHOUT AN EVIDENCE OF THERE FIRST HAVING BEEN A CRACK.

THE CAVITY BELOW THE RIGHT HAND PIER WHICH IS 6 INCHES DEEP IS THE ONLY ONE DUE TO EROSION AND MAY POSSIBLY HAVE BEEN ACCELERATED BY THE EARTH AT THIS POINT RECEIVING A CONCENTRATED LOAD FROM THE BRICK PIER, SHOWING THE NECESSITY OF DISTRIBUTING SUCH LOADS. THE OTHER CAVITIES WERE PICKED WITH GREAT EFFORT AS IS INDICATED BY THE PICK MARKS. IN PICKING, THE EARTH FRITTERS RATHER THAN FALLS OUT IN CHUNKS - THOUGH CHUNKS WERE MADE WITH CHISEL AND HAMMER. THIS IS A GOOD EXAMPLE OF THE DURABILITY OF RAMMED EARTH. THE LITTLE WHITE PATCHES ARE MORTAR AND BRICK SPALLS STUFFED IN THE PUTLOG HOLES.

ALTHOUGH THIS PICTURE SHOWS A BAD CONDITION AND ONE WHICH IN TIME WOULD HAVE PROVEN SERIOUS - THE EARTH ITSELF SHOWED NO SIGNS OF DISINTEGRATION, BY SOFTENING (OR ROTTING). THE EARTH COULD BE DUSTED AWAY WITH THE HAND FREELY EITHER THE ORIGINAL SURFACE OR WHERE THE SURFACE HAD BEEN PICKED AWAY. THIS IS SURPRISING IN VIEW OF ITS RESISTANCE TO A PICK OR CHISEL. THE EARTH AT THIS POINT AND AT THE FAILURES ON THE NORTH WALL HAS BEEN EXPOSED TO RAIN FOR SEVERAL YEARS BUT SHOWS NO SIGN OF WEAKENING; THE RAIN SEEMING TO AGRADE RATHER THAN SOFTEN.

THE EARTH USED IS A RED SANDY CLAY LOAM ALMOST FREE FROM STONES AND WAS TAKEN FROM A ROAD BED ABOUT 150 YARDS AWAY. APPARENTLY THE SOIL WAS NOT GRADED AND IT CONTAINS SMALL ROOTS AND SOME STRAW, AS ONE WOULD EXPECT IN SOIL LYING NEAR THE SURFACE. THIS VEGETATION WAS NOT USED AS A BINDING MATERIAL BECAUSE IT DOES NOT OCCUR WITH REGULARITY NOR IN SUFFICIENT QUANTITIES. IT IS VERY SOUND AND TOUGH SHOWING THAT WOOD ENTIRELY EMBEDDED WILL NOT ROT. THE GRASS PARTICLES WERE VERY TOUGH AND ONE ROOT 3/8" IN DIAMETER WAS SEASONED HARD WITH THE BARK STILL ADHERING.

FIGURE 9 SHOWS THE FRONT OF THE HOME OF MR. SAUNDERS, PRESENT OWNER OF THE PLANTATION.

THE CENTRAL PORTION IS OF FRAME, STUCCOED TO MATCH THE WINGS. THE TWO LOW WINGS ARE 22 x 48 FEET AND OF RAMMED EARTH, WALLS 18 INCHES THICK, 10 FEET HIGH, STUCCOED WITH LIME MORTAR. THE CONSERVATORY ON THE LEFT IS STUCCO OVER WOOD LATH. THE CENTRAL FRAME STRUCTURE WAS BUILT BEFORE THE REVOLUTIONARY WAR AND THE WINGS ABOUT 1820. THE EARTHWORK IS IN EXCELLENT CONDITION, NONE OF WHICH IS EXPOSED TO THE WEATHER. NOTE THE CRACKS OVER THE WINDOW; (THERE IS NO EVIDENCE OF A LINTEL OVER ANY OF THE WINDOWS AND THE FAILURE IS STRAIGHT UP INSTEAD OF IN THE FORM OF A TRIANGLE - AS IS CHARACTERISTIC OF MASONRY FAILURES).

THE LIBRARY WALLS (FIG. 10) ARE 18 INCHES THICK AND THE CEILING 11 FEET ABOVE THE PORCH LEVEL. THE PORCH IS 6 FEET 3 INCHES WIDE AND WINDOWS 3 FEET 3 INCHES WIDE. THE STUCCO IS OF LIME BUT UNLIKE THAT ON THE OTHER BUILDINGS IS TROWELED SMOOTH AND MARKED OFF AS ASHLAR. THE PROTECTION AFFORDED BY THE PORCH, WHICH IS ON ALL FOUR SIDES, HAS KEPT THE WALLS IN PERFECT CONDITION. THERE IS A CRACK ON EACH OF THE WALLS.

THIS MAY POSSIBLY BE DUE TO THE ABSENCE OF TIES (EITHER SHORT PLANKS EMBEDDED IN THE WALL OR QUOINS FORMED BY ALTERNATING THE LAYERS). SEVERAL OF THE STRUCTURES SHOW THIS DEFECT. IT IS POSSIBLE THAT CRACKS IN THE CHURCH COULD HAVE BEEN PREVENTED BY SUCH A PRECAUT

THE LOOM HOUSE WALLS (FIG. 11) ARE 12 INCHE. .ICK AND 9 FEET HIGH. NOTE CRACKS AT CORNERS PATCHED WITH CEMENT MORTAR AND CRACK OVER DOOR.

THIS STRUCTURE WHILE SMALL SHOWS THE LONG LIFE OF LIME STUCCO — NONE OF WHICH HAS FALLEN AWAY PROBABLY DUE TO PROMPTNESS IN MAKING REPAIRS. NOTE THE ABSENCE OF A HIGH FOUNDATION. THE RAIN FOR YEARS HAS SPLASHED RED MUD ON THE LIME STUCCOED EARTH WALLS WITHOUT APPARENT BAD EFFECT.

FIGURE 12 SHOWS A PORTION OF THE WALL WHERE THE LIME STUCCO HAS BEEN WORN OFF BY THE ELEMENTS. SOME OF THE OTHER BUILDINGS SHOW THIS SORT OF DETERIORATION, WHICH SHOULD NOT BE CONSIDERED A WEAKNESS SINCE IT HAS LASTED ABOUT 106 YEARS. A CLOSE EXAMINATION OF FIGURE 13 WILL SHOW THE WORK OF MUD DAUBERS ON THE TOOL HOUSE WALLS. A STRANGE FACT IS THAT THEIR ACTIVITY WAS STARTED ONLY 5 YEARS AGO ACCORDING TO MR. SAUNDERS. ANOTHER STRANGE FACT IS THAT WHERE THE LIME STUCCO IS INTACT THERE IS NO SIGN OF THEIR ACTIVITY BUT IN ONE INSTANCE THEY APPARENTLY HAVE BORED THROUGH A PORTLAND CEMENT PATCH 1/4 INCH THICK.

THE TOOL HOUSE, (FIG. 14) IS 13 FEET X 13 FEET, WALLS 18 INCHES THICK, 8 FEET HIGH, THE CORNER STONE OF WHICH IS MARKED 1821. THE HOUSE WAS EXPOSED TO THE WEATHER DUE TO A LEAKY ROOF FOR MANY YEARS AND WAS NOT WASHED DOWN. AT PRESENT THE EARTH IS IN PERFECT CONDITION THOUGH THE STUCCO HAS SUFFERED BADLY.

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Figure 15 shows the remains of a rammed earth wall. The foundations are still in place and the block of red earth on the left is all that remains of the wall. This piece of rammed earth has kept its form and today is hard and durable though it has stood for 50 years without any protection.

There are three other rammed earth buildings on the plantation – a well house (13' x 13', 12" walls, 7' high) in fair condition, a servants' quarters (16' x 32' walls 18" thick, 8' high), superimposed by a frame second story, in fair condition and Doctor Anderson's office (15' x 25', 18" walls, 11' high) with portico on front – in fair condition.

Two other structures of rammed earth were built on the plantation but stood unrepaired for so long a time that they were badly damaged and finally torn down.

<u>Weather Data:</u>

The average annual rainfall for the past 32 years in Stateburg Township is 45 inches, the smallest amount (2.22 inches) falling in November and the greatest (5.9 inches) in August. The average annual temperature is 64.5°, the average January temperature is 45.9° and average July temperature 79.2° , the lowest temperature observed in the past 32 years being 3° one February.

The average wind velocity for the past 20 years at Columbia (nearby) is 6 to 7 miles per hour and the maximum 42.63; although at Charleston on the other side an estimated wind of 105 miles is recorded. The average length of the growing season in this section is 242 days.

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CONCLUSIONS.

RAMMED EARTH IS A DURABLE BUILDING MATERIAL.

PROTECTION FROM WATER SHOULD BE PROVIDED.

REPAIRS SHOULD BE MADE PROMPTLY.

SOME FORM OF REINFORCEMENT IS APPARENTLY REQUIRED AT THE JUNCTION OF WALLS AND OVER OPENINGS TO PREVENT CRACKS.

RAMMED EARTH APPARENTLY DOES NOT SOFTEN BUT ABRADES. THE RESISTANCE OF UNPROTECTED EARTH WALLS TO EROSION IS SURPRISING.

LIME STUCCO HAS CONSIDERABLE MERIT AS THE STUCCO ON THESE BUILDINGS IS FREER OF CRACKS THAN MOST CONCRETE STUCCO; BESIDES IT POSSESSES A SOFT AND WARM APPEARANCE TO THE EYE. IT APPARENTLY WEARS THIN IN TIME.

NO EVIDENCE WAS VISIBLE THAT RATS ATTACK EARTH WALLS BUT MUD DAUBERS NEST FREELY ON EXPOSED EARTH WALLS.

THE DETERIORATION OF THE RAMMED EARTH BUILDINGS IS APPARENTLY DUE TO THE FACT THAT THE NATURE OF THE MATERIAL WAS NOT UNDERSTOOD BY THE OWNERS AND MAY BE ATTRIBUTED MORE TO NEGLECT OR DELAY IN REPAIRS THAN TO DEFECTIVE CONSTRUCTION.

THE INTERIORS OF HOUSES WITH EARTH WALLS ARE FREE FROM MOISTURE CONDENSATION.

THE LIBRARY, FIGURE 10, IS A VERY DESIRABLE TYPE OF ARCHITECTURE FOR THE PROTECTION OF EARTH WALLS.

NO OPPORTUNITY WAS AFFORDED TO INVESTIGATE THE COST OF BUILDING WALLS OF RAMMED EARTH NOR DO THE FEW EXAMPLES AT WASHINGTON AND SUMTER DEMONSTRATE THE CLIMATIC LIMITATIONS OF THIS MATERIAL. INFORMATION REGARDING THESE TWO PHASES OF RAMMED EARTH CONSTRUCTION CAN BE OBTAINED ONLY FROM PRACTICAL EXPERIMENTS. THE STRUCTURES DESCRIBED IN THIS REPORT RANK WITH MASONRY FOR DURABILITY AND INDICATE THAT THIS TYPE OF CONSTRUCTION HAS SUFFICIENT MERIT TO WARRANT SUCH EXPERIMENTS. CHC-001004

Appendix 3

The Church of the Holy Cross

<u>Chain of Title for the Church of the Holy Cross</u>

1770: First Church constructed near Glebe and Church lands on the land of Peter Mellette

Grantor: State of South Carolina General Assembly

Grantee: Episcopal Church of Claremont

Cost: $1,000.00

1788: Congregation sold the Glebe and Church lands and applied for a charter; under an Act of the Legislature the Episcopal Church of Claremont was officially incorporated.

Grantor: General Thomas Sumter

Grantee: Episcopal Church of Claremont

Cost: Donated by General Sumter

1819: When General Sumter donated the land in 1788, he did not make a proper deed to the acreage of the land. In 1819, he sold a piece of land to William M. Brooks that accidentally included the church and the graveyard.

Grantor: General Thomas Sumter

Grantee: William M. Brooks

1819: To solve the dilemma of accidentally selling the church to William M. Brooks, the property was sold back to General Sumter.

Grantor: William M. Brooks

Grantee: General Thomas Sumter

1819: General Thomas Sumter officially deeds the land to the Episcopal Church of Claremont.

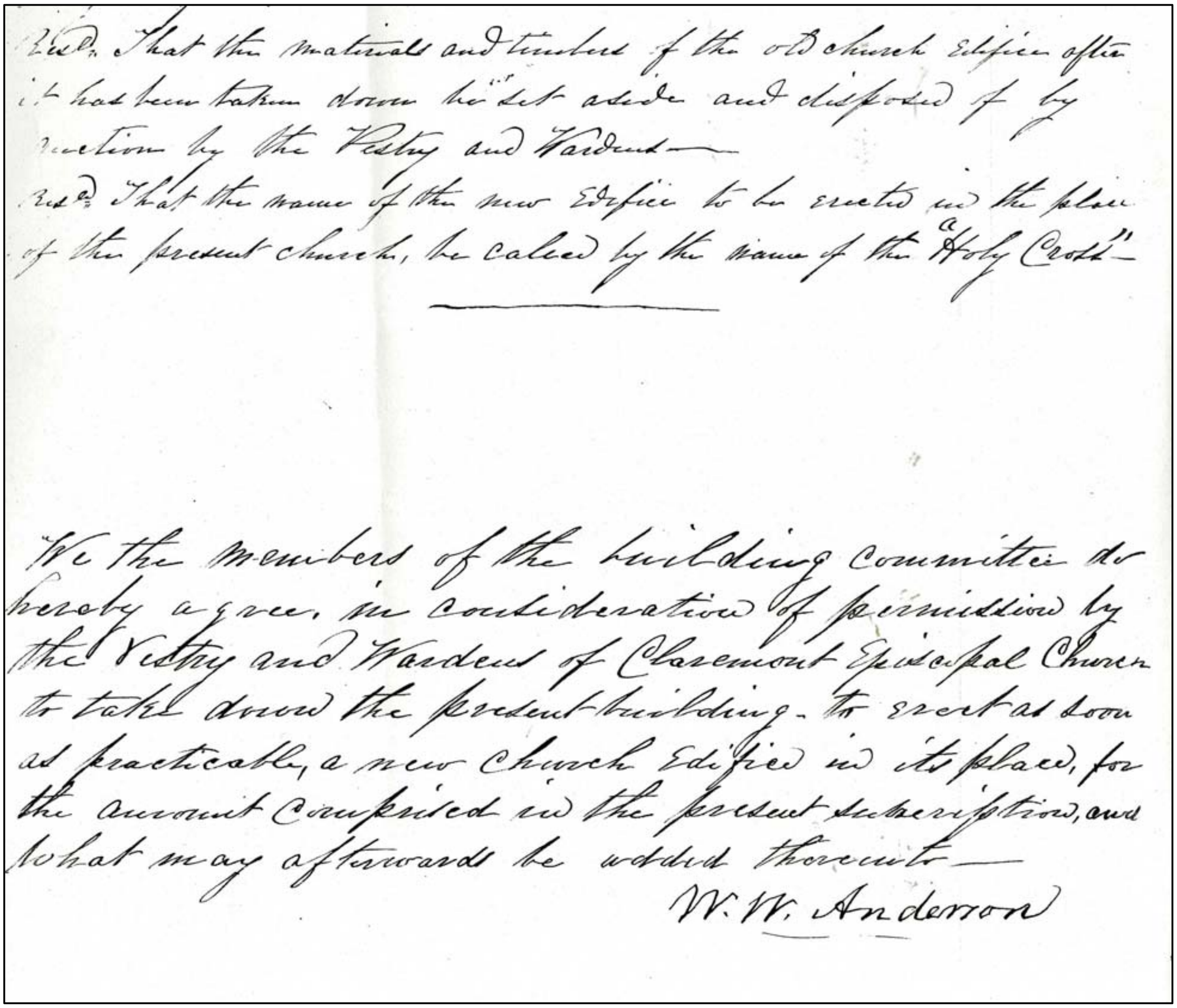
Grantor: General Thomas Sumter

Grantee: Episcopal Church of Claremont

In 1850 – 52, the Church of the Holy Cross was built on the same piece of land as the Episcopal Church of Claremont. The original wooden structure was removed and the current church was built and cost $11, 358.74.[223]

[223] Mrs. Richard Kerfoot Anderson. *Church of the Holy Cross Bicentennial Book*. 1988. (Sumter: The Church of the Holy Cross, 1988): pg 41.

Vestry Minutes


Resd. That the materials and timbers of the old church Edifice after it has been taken down be set aside and disposed of by auction by the Vestry and Wardens—

Resd. That the name of the new Edifice to be erected in the place of the present church, be called by the name of the "Holy Cross"—

We the members of the building committee do hereby agree, in consideration of permission by the Vestry and Wardens of Claremont Episcopal Church to take down the present building. to erect as soon as practicable, a new Church Edifice in its place, for the amount comprised in the present subscription, and what may afterwards be added thereunto—

W. W. Anderson

Figure A19. Vestry minutes from 1850 detailing the decision to erect a new church to be called the Church of the Holy Cross signed by building committee chairman, William Wallace Anderson. (Image: South Carolina Historical Society)

<u>William Wallace Childs Letter to the Editor</u>

4

must have stood there long before Columbus discovered America. All these buildings, still in an excellent state of preservation, are of pisé.

How the church came to be built of this material involves a characteristic bit of local history. Dr. Anderson was an enthusiast about pisé & everyone knew his predilection. As one of the large contributors to the building fund, & looked upon by most of the neighborhood as guide, philosopher & friend, it was to be expected that his wishes would receive due consideration without personal solicitation on his part, & he accordingly refrained from attending the vestry meeting where the momentous decision was to be made. The meeting proved to be unusually protracted. Conservatives in those days as in these were loth to lay the old aside for anything untried. It was not the cost of

Figure A20 – 22. Letter from William Wallace Childs, grandson of Dr. William Wallace Anderson, to the editor of the *Evening Star* in Washington, D.C. dated December 3, 1923. (Image: South Carolina Historical Society) brick or stone that gave them pause, but the difficulty + length of time required in those somewhat primitive times to find suitable material, + to transport it to a region then somewhat remote from ~~[illegible]~~ centres of industrial activity — and the people wanted their ~~so~~ beautiful new ~~place of worship~~ church. The plans had been drawn by a celebrated architect + they knew that it would be beautiful; + perhaps they were a little ashamed that a congregation embracing so many members of the historic families of Carolina should still worship in an old wooden building. The Doctor, sitting in his house on the hill, impatiently waited for the vestry to adjourn, when he knew that most of the members would come up to tell him the result, + to refresh themselves after their arduous labors before the long ride home. But at last patience ceased to seem a virtue + the Doctor reached for his hat.

"Now Doctor", said Mrs. Anderson, "don't you say anything about pisé."

"O, not a word, not a word", replied the Doctor, "I'll just step down there & see what's keeping them so long".

He found the vestry in the condition of a Congressional committee unable to function through a difference of opinion ~~between~~ ~~among the advocates of brick & stone~~. It was in fact a deadlock between the advocates of brick & stone. When the members had finally exhausted argument, & a long pause ensued, the Doctor forgetting all about his promise, rose to his feet & impetuously exclaimed: —

"Gentlemen, what do you say to pisé? What do you say to pisé?

And pisé it was.

Material map of the Church of the Holy Cross

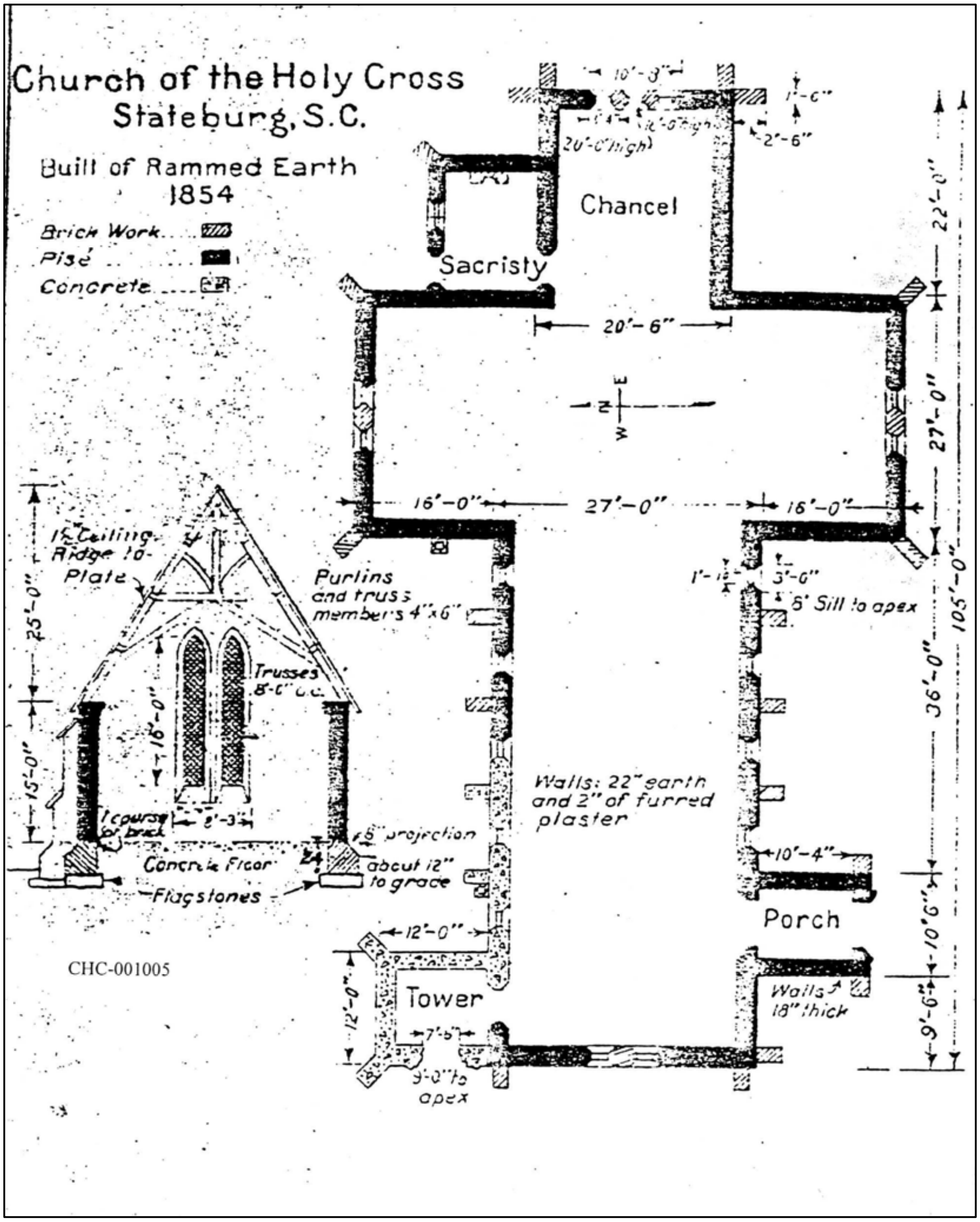


Figure A23. Map of the Church of the Holy Cross showing the different materials that make up its construction including the original pisé and brick buttresses as well as areas of brick and concrete repairs. (Image: Thomas A.H. Miller)

Historic American Building Survey Photographs of the Church of the Holy Cross

Plate A12. The interior of the Church of the Holy Cross showing the nave, transepts, and chancel. (Photo: Library of Congress)

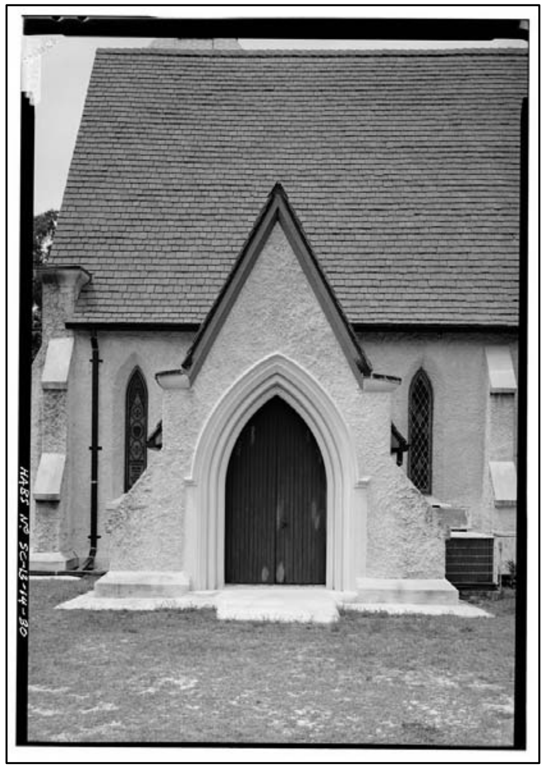


Plate A13. The side entrance on the south elevation of the Church of the Holy Cross. (Photo: Library of Congress)

Plate A14. Memorial plaques to members of the Anderson family: Dr. William Wallace Anderson and two of his sons, Edward McKenzie Anderson and Richard Heron Anderson. (Photo: Library of Congress)

Plate A15. Original pisé walls and brick buttress exposed during the 1974 restoration. (Photo: Library of Congress)

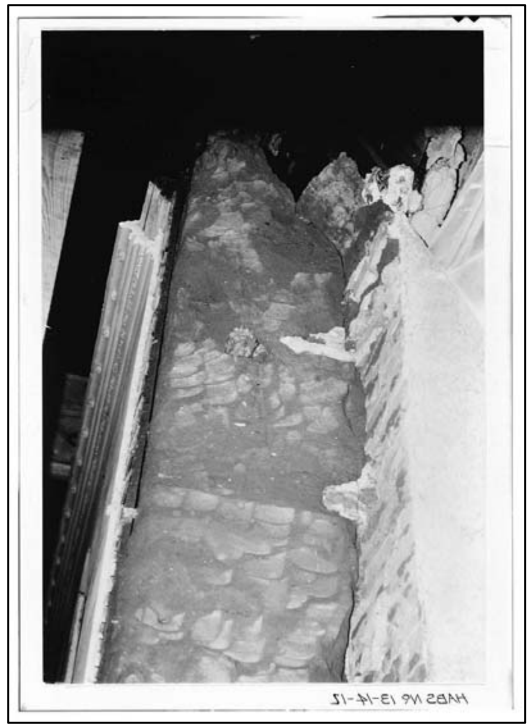


Plate A16. Original pisé walls and plaster cornice exposed during the 1974 restoration. (Photo: Library of Congress)

Plate A17. View looking east from the nave. (Photo: Library of Congress)

Plate A18. View of the Chancel and altar area. (Photo: Library of Congress)

Photographs of the Church of the Holy Cross from the 1990s and 2000s

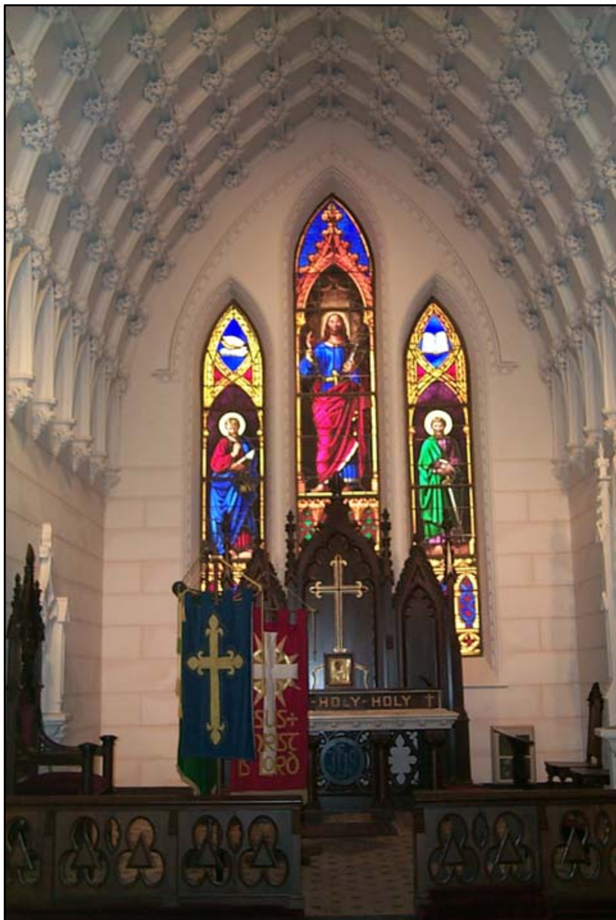


Plate A19. The interior of the nave before all of the furnishings and stained glass was removed in 2001 and 2002. (Photo: Cummings and McCrady Architects)

Plate A20. View looking east from the nave to the Chancel in 2008. (Photo: Author)

Plate A21. Brick repair made near the porch entrance on the south elevation. (Photo: Author)

Plate A22. Concrete block repair made after the collapse of a portion of the south wall in 1974. (Photo: Author)

Plate A23. View looking west from the Chancel to the nave and entrance of the church. (Photo: Author)

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