ANALYSIS AND RECONSTRUCTION OF
IMPERMANENT STRUCTURES OF THE 17TH AND 18TH CENTURIES

A Thesis

by

GLENN PAUL DARRINGTON

Submitted to the Office of Graduate Studies
Texas A&M University
in partial fulfillment of the requirements for the degree of
MASTER OF ARTS

May 1994

Major Subject: Anthropology
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ABSTRACT

Analysis and Reconstruction of Impermanent Structures of the 17th and 18th Centuries. (May 1994)

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Impermanent architecture was a major technology used to construct shelter in the Americas during the 17th and 18th centuries. Why these construction methods were employed instead of more permanent ones is a question historical archaeologists have been trying to answer since the 1970s. Because of their impermanent nature, only a small number of 17th and 18th century structures have survived, creating a gap in the archaeological record. This missing data must be replaced with other sources of information, such as carpentry handbooks of the period and historical accounts that describe the form and function of these dwellings.

The use of Computer Aided Design (CAD) technology, combined with a knowledge of impermanent building techniques assists in recording, manipulating, and displaying architectural data. This method has been used to reconstruct three historic buildings. Each of these
structures represents a stage in the settlement process which was used by early colonists to survive and succeed in the New World.

Earlier methods of recording site data have been compared with more modern methods possible with CAD technology. These new methods have shown that more information can be gathered, manipulated, and displayed than was previously possible. Computer Aided Design technology has opened new doors of opportunity for researchers who try and recreate the historic past.
ACKNOWLEDGEMENTS

The following thesis could not have been completed without the guidance, assistance, and encouragement of numerous individuals. Research guidance and constructive suggestions were provided by my thesis committee members, Dr. D.L. Hamilton, Richard Steffy, and James Earle. A special thanks to Dr. Hamilton for allowing me the access to his information on Port Royal and for his mentorship as my committee chairman. His encouragement lead me to pursue historical archaeology as a field of study. The data he gathered at Port Royal and his extensive technical background also proved to me how computers are changing the way archaeologist gather data.

In addition to thesis committee members, I would like to thank Dr. A.E. Rogge, Dr. Simon Bruder, and Melissa Keane of Dames & Moore for their support and comments concerning issues of archaeological methods and theories. Thanks also to Shirley Wille, a word processor at Dames & Moore, for proofing this thesis for grammatical errors. A special thanks also goes to Mark Groover for giving me permission to use materials published in his thesis.

I also would like to thank all the faculty, staff, and students of the Anthropology Department at Texas A&M University for their general support and assistance during my enrollment in the graduate program. Special thanks goes to Helen Dewolf and Wayne Smith for proofing the final draft for formatting errors.
Finally, I would like to thank my wife, Sandy, for her never ending patience and support.
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CHAPTER I

INTRODUCTION

Impermanent architecture can be broadly defined as any "earthfast" structure made predominantly of wood. Earthfast refers to the structural members either laying on the ground or in the ground. Examples of impermanent architecture can be seen in almost every area of colonial America. In contrast, brick and stone buildings would be examples of permanent architecture.

For the early European colonists, the New World opened up many opportunities and challenges. Their struggle for survival was very difficult and only after a period of years were they able to settle in and prosper. Shelter was a prime concern for these people and it was necessary for them to adapt Old World architecture to New World needs. In all areas, impermanent dwellings seemed to have been one of the predominant architectural traditions used in the Southern colonies throughout the 17th and 18th centuries (Carson 1981:136). Impermanent architecture is interesting because it is a method of construction that could be easily adapted to various frontier environments by utilizing local materials and simple tools. It also represents an economic strategy.

This thesis follows the style and format of Historical Archaeology.
used by first generation settlers which allowed them to plant crops before the winter season and to prosper without investing in more expensive types of construction. In some areas, impermanent structures were only used as the first step in settling, with permanent dwellings being used as the next.

Today, historical archaeologists try to reconstruct the past life-ways of the colonists and examine how they survived in and adapted to a foreign environment. This thesis discusses new methods for recording and analyzing impermanent architectural features to aid in reconstructing the historic past. The emphasis of this study is technical, but it is based on a theoretical model proposed by Deetz (1974) that relates social cultural complexity and the perceptibility of material culture. This theoretical framework is used to define settlement stages that can contribute significantly to our understanding of impermanent structures in the 17th and 18th centuries.

Impermanent dwellings are difficult to study because so few of the architectural features survive. Many times post holes are the only features remaining that indicate the presence of an impermanent structure. A method of enhancing this bare amount of information into a workable and useful data set is helpful. Computer aided design (CAD) is a rapidly expanding field utilized by
archaeologists to record and display site information graphically. With this new tool, it is possible to record the field data and then reconstruct the impermanent buildings in various ways making it easier to understand the nature of the structure.

Historical documentation aides in the reconstruction of impermanent dwellings which no longer exist, as well as understanding better those buildings which are still standing. For example, through the study of period carpentry handbooks, eye-witness accounts, and fire codes, archaeologists have access to data which can fill in the gaps of information missing from the archaeological record. Additionally, there are some surviving examples of 17th-century architecture from which architectural analogies can be drawn.

By combining archaeological and historical data, it is possible to graphically depict different scenarios. With the aid of CAD, it is possible to record and display these different reconstructions in a way that is helpful to historical archaeologists and assists them in arriving at the most reasonable possibilities.
CHAPTER II

IMPERMANENT ARCHITECTURE

Impermanent architectural techniques were not invented by the English colonists who travelled to the New World, but were techniques known throughout Europe and England for centuries. Antecedents of wood construction can be found as far back as the Neolithic Era (Kniffen and Glassie 1982:240). Impermanent dwellings found on Anglo-Saxon and medieval sites in England represent a sequence of building development which began with primitive, uncarpentered, earthfast structures, moved to ground-standing structures, and ended with prefabricated, fully framed buildings raised on stone pads or low foundation walls (Carson 1981:136). The first English settlers who landed at Jamestown in 1607 brought these building techniques to the New World. As these early settlers moved throughout the Chesapeake Bay area and settled on the James, York, Rappahannock, and Potomac rivers, they continued to utilize the same building techniques.

An element of impermanent architecture is that it allows the builder flexibility in choosing the length of time a dwelling might last. The builder may choose to construct a shelter to last only one year or several, as in the case of the Cedar Park House which is still standing after 250 years (Carson 1981:144, 155). This allowed colonists to adapt the construction of shelter to
the local environment and to allocate as much or as little of their resources as they saw fit, depending on their economic status.

**Building Types**

Impermanent building techniques fall into a continuum from primitive to complex. These techniques were used to build a wide range of structures including palisade walls, fences, chicken coops, root cellars, barns, and dwellings for servants and master alike. Seven basic structural types have been identified and there is a range of variation within each type. These include puncheon structures, hole set frame buildings, framed buildings on hole set blocks, crotchet buildings, raftered houses, turf-earth-and-log walled houses, and plank-framed houses (Carson 1981:153-155).

**Puncheon structures** were primitive buildings where vertical posts were driven into the ground and no real framing exists. After the driven posts were in place, the joining members were added. It is possible that an auger was employed to first make a pilot hole in the soil, making it easier to drive the timber. A large wooden mallet with a three foot long handle, called a commander, would be used to drive smaller wooden posts (Moxon 1702:125). This technique was widely used for the construction of palisade walls and fences, and would have been quickly done with only simple framing. This type of
structure required no special carpentry skill (Kelso 1979, 1984).

**Hole-set frame buildings** consisted of vertical framing timbers set into pre-dug holes. These structures could have had earth-laid interrupted sills, or were constructed with vertical studs which were set into shallow trenches. The stud-in-ground construction would indicate an earth floor, since there is no sill to which floor joists could be attached.

**Framed buildings on hole-set blocks** did not have any framing members in contact with the ground. The framed structure would rest on blocks of wood or stone which were set into holes. In the case of wood, only the blocks would be susceptible to decay and replaced as needed.

**Crotchet buildings** were basically a roof raised on forked poles which were set into the ground and a horizontal timber laid between them.

**Raftered houses** were made with an A-frame construction technique. Instead of having vertical walls, they slope towards the center line of the structure. Early raftered houses probably used crotchet construction. This type of house has also been referred to as a "roof hut."

**Turf-earth-log buildings** were one of the most common forms used by the early colonists because they were both simple and economical to build. The builder needed only
an axe and a shovel to construct this type of shelter. This technique followed the settlers as they moved West in the early and middle 1800s.

Plank-framed buildings consisted of vertical planks set into shallow trenches. Later, the vertical planking would be attached to a ground-laid sill.

Cary Carson (1981) has been primarily responsible for the initial research concerning impermanent buildings as an architectural type. The most substantial attempt to recreate a historical settlement based on archaeological excavations of impermanent wooden structures was done in the late 1970s by Ivor Noel Hume (1982) at Martin’s Hundred in James City County, Virginia. By combining the data from the excavated archaeological remains of the burned buildings with known architectural parallels of the same period, Hume was able to reconstruct the settlement of Wolstenholmtown, which included a palisade fort on the James River, a row of houses, storerooms, and a barn. William Kelso (1984) reconstructed several impermanent structures that were uncovered at the Kingsmill plantations located in Virginia. Examples of impermanent structures dating to the 17th and 18th centuries have been uncovered throughout colonial America. As settlers moved west they continued to build impermanent buildings and earthfast structures, and it is obvious the tradition still exists today.
CHAPTER III
MODELING SETTLEMENT

Shelter is one of the basic elements of survival utilized by all human population. It represents an investment of resources that depends on economic, technological, and environmental factors. Architecture falls within the technoeconomic subsystem of human behavior because it deals with the relationship between humans and their natural surroundings (Gibbon 1984:180). Deetz's (1974, 1977) cognitive historical model creates a framework for using architecture to explore human behavior and to examine a population's world views. An interesting aspect of this model is that the perceptibility of each of the material cultural assemblages (English, Anglo-American, or Georgian) is dependent upon the level of sociocultural complexity (Figure 1).

One problem with the Deetz model is its rigidity in defining the Georgian material culture. Potter (1992:121) states that Deetz's use of structuralism and binary opposition reduces analysis to either the presence or absence of Georgian traits in material culture. A more continuous model is needed to better represent the degrees to which variable manifestations of culture are reflected in the archaeological record.

Gibbon (1984:174) suggests that less complex sociocultural systems tend to be dominated by more urgent
Figure 1  Relationship Between Social Cultural Complexity and Perceptibility of Material Culture (after Deetz 1974: 21).
subsistence requirements. Subsistence, therefore, can overshadow the archaeological features that distinguish a cultural period. A model that examines how settlement and architecture relate can filter out some of the vagueness caused by subsistence overshadowing found in the archaeological record.

Settlement and complexity in the early American colonies represent three settlement stages: semi-isolated frontier environments, plantation-agricultural zones, and urban pre-industrial centers. These settlement stages also reflect the level of sociocultural complexity, interaction, and the amount of resources invested in shelter (Figure 2).

By examining structures from urban, plantation, and frontier environments, it is possible to compare and isolate those architectural features which are representative of each settlement stage. These architectural features also reflect the level of resources invested in building shelter, the level of interaction, and the level of sociocultural complexity (Figure 3).

This model focuses on recorded architectural features and ranks them by level of invested resources in shelter. Elements that rank high represent more complex social cultural systems. Elements that rank low represent simple social cultural systems. This system of ranking
Figure 2 Settlement Stages Reflecting Interaction, Invested Resources, and Sociocultural Complexity.
ARCHITECTURAL FEATURES

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<td>High to Professional Skilled Labor Required</td>
<td>Moderate to High Skilled Labor Required</td>
<td>Little to Moderate Skilled Labor Required</td>
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<td>Moderate Use of Preservation Methods</td>
<td>Little to No Use of Preservation Methods</td>
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<td>Prefabricated Elements</td>
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Figure 3 Architectural Features Representative of Different Settlement Stages.
architectural elements can define the settlement stage and make the material culture assemblage more perceptible, especially for less complex sociocultural systems which are clouded by dominant subsistence requirements.

The accurate recording of architectural features is critical, especially in the case of impermanent structures, because most of the archaeological information is destroyed during excavation. AutoCAD is one tool that helps to keep accurate provenience records and allows for quick manipulation of the important architectural features. The use of CAD technology aids in researching the architectural elements of a settlement model by recording complex spacial data in a way which is easy to access and manipulate. The data can also be exported and integrated with database management programs for further analytical examination. Because ranking features is a mathematical manipulation, the computer is a tool best suited for the task.
CHAPTER IV

CAD IN ARCHAEOLOGY

Computers have been used in archaeology for the last three decades to handle and manipulate large data sets. However, their utilization today is expanding to assist archaeologists in new ways. AutoCAD (ACAD) is one of many CAD (computer aided design) packages available for recording site information. It is a graphics package based on the AUTOLISP computer language first released by Autodesk in December of 1982. Since then there have been many subsequent releases, each improving the software’s capabilities. Release Version 10, which came out in 1988, was employed for the research presented in this thesis.

AutoCAD can be run on any basic computer system. A monitor with high resolution graphics is recommended; however, a monochrome monitor with a Hercules graphics card is sufficient to handle most drawing requirements. To utilize fully all of AutoCAD’s capabilities, an EGA (Enhanced Graphics Adapter) or a VGA (Visual Graphics Array) color monitor is needed. In addition to graphics capabilities, a math co-processor (8087, 80287, or 80387) is required for those computer systems which are based on the Intel 8086, 80286, or 80386 microprocessor family (AutoCAD Reference Manual 1988: 1). The latest 80486 DX microprocessor (not the 80486SX) has the math coprocessor built into the processing chip.
AutoCAD can be controlled through keyboard manipulation, but this is a slow and tedious way of drawing. With the use of a pointing device, either a mouse or digitizing tablet, AutoCAD is easier and faster to use for creating a drawing. A mouse is less expensive than a digitizing tablet, but more can be done with the tablet, such as copying maps and tracing profiles.

A drawing created on the computer screen in AutoCAD is limited in value unless a hard copy can be obtained. However, color photographs of the computer screen can be useful. AutoCAD drawings can be printed out on a dot matrix printer, a laser printer, or a plotter. Laser printers and plotters are much more expensive than regular dot matrix printers, but the resolution and quality are much better. Plotting out a drawing on a plotter or a postscript laser printer allows the user to set line width and color settings, and a much wider range of paper sizes is offered. With the development of color laser printers, AutoCAD drawings can now be given even greater detail.

AutoCAD is a very useful tool in archaeology because it allows the researcher to manipulate graphic information quickly and accurately. Drawings are not created any quicker by AutoCAD than by hand, but the computer editing process is a great time saver. One does not have to start from scratch if an error is made in a drawing. Portions of the AutoCAD drawing can be erased, moved, copied, and
scaled, to name just a few of the possible manipulations. The computer also offers the advantage of being extremely accurate. Each point can have a precision of up to 14 significant digits, although common field measurements do not need this level of significance (AutoCAD Reference Manual 1988:6). Lines are perfectly straight and all angles are accurate. The accurate recording of archaeological sites is important to insure and preserve the integrity of gathered information because data recovery usually leads to either partial or total destruction of a site.

The ability to control the size, scale, and units of measure in a drawing provides a greater amount of flexibility. Users can choose the parameters which best fit their specific needs (Table 1). Objects of any size can be drawn in AutoCAD, because the user sets the scale and chooses the units of measure, either decimal, metric, architectural, scientific, or engineering. AutoCAD also provides the user with perspective views of three-dimensional objects.

Attribute Definitions

AutoCAD's ability to store information is its prime advantage over conventionally drawn site maps. Through the application of attribute definitions, both numeric and character information can be stored in the drawing file.
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When an attribute is created, the user sets four parameters which control the input, type, and display of data. Attributes can be displayed in the drawing or made invisible. The attribute is then given a tag name and saved as a block entity. Every time the block is inserted the user is prompted to input the specified information. The prompt is in the form of a question defined by the user. Once the information is entered, the user can have the program verify the data by redisplaying it on the computer screen and asking if the input is correct. If incorrect information was entered, it can be corrected at this point. Any number of attributes can be saved together as a single block.

Attribute definition information can be exported from AutoCAD and imported into several database programs. The "ATTEXT" command will extract data from the drawing file and save the information in either a Comma Delimited Format (CDF), a Standard Delimited Format (SDF), or as a Drawing Interchange File (DXF). In addition to the attribute tag information which can be extracted, AutoCAD will also extract the block name, x-y-z coordinates, block nesting level, name of the layer in which the block was inserted, and the block's angle of rotation. An example of extracted attribute information is seen in Figure 4.
Figure 4: Example of Extracted Attribute Data.
View And Display Options

All site plan information can be put onto a single map. With the zoom option, users can focus on any part of a large drawing. The archaeologist can have a single drawing of an entire site, zoom in to any desired part of that site map, and look at finer details, such as features or artifacts (Figure 5). In architectural drawings, elements such as windows, locks, hinges, and trim can be defined separately within the overall site map. Moving around in a large drawing and focusing in on different parts may require switching between different views. Views, both plan and three dimensional, can be saved and recalled to reduce regeneration time.

With the introduction of Version 10, the user is given the option of splitting up the display screen into two or more view ports. By setting the screen to multiple viewports, the researcher can compare features side-by-side at the same time.

Three Dimensional Capabilities

AutoCAD has the capability to draw entities in three-dimensional space (Darrington 1988:12). With the release of Version 10 and later versions, it is now much easier to draw three-dimensional objects. AutoCAD allows users to define their own frames of reference through the application of the User Coordinate System (UCS). This
Figure 5: Example of Zoomed Features.
option allows the user to draw in an infinite number of planes.

AutoCAD Version 10 displays pull down menus which utilize graphic icons to help the user select various drawing elements. Under the "DRAW" menu is a selection for three dimensional entities which include spheres, triangles, cones, domes, and boxes (Figure 6). The BOX command allows users to create an entity by entering in 3 dimensions.

It is easier for the archaeologist to visualize information, especially architectural information, with three-dimensional drawings. Artifacts can be given a more complete provenience in three-dimensional space and their distributions can be examined more fully, as seen in the excavation and recording of the HMS Pandora (Good 1986). Three-dimensional representations are also helpful when publishing complex site information.

Three-dimensional drawings can be viewed from any angle. The "DVIEW" command allows users to view three-dimensional entities in perspective by using the "DISTANCE" sub-command. Through the use of clipping planes a user can also simulate a point of view from within the drawing looking outward.
Figure 6: Three-Dimensional Constructions.
Applications

AutoCAD has also been employed by Dr. D.L. Hamilton for his excavations at Port Royal, Jamaica. Port Royal is the site of a 17th century English port town destroyed by an earthquake in 1692. Most of the city fell into the sea and is today located under 2 to 30 feet of water. Even though this archaeological site is under water, the basic principles and techniques used for land archaeology apply. The application of AutoCAD to this site gives an excellent example of how it can help archaeologists, both on land and under the water.

Dr. Hamilton uses AutoCAD in the planning of excavations by allowing him to look at the site and determine where to excavate. Through the use of various inquiry commands, AutoCAD can give the precise position of where datum stakes must be placed. Excavation grids can be placed over the site and lot numbers assigned (Figure 7). This information is then recorded in the computer drawing. AutoCAD is also used to record architectural features and the provenience of triangulated artifacts from measurements taken by divers on the site. Also, with the help of a digitizing pad, historical maps of Port Royal have been recorded into the computer to help compile an accurate map of the town at different time periods. These maps can be used with the excavation maps to help illustrate the areas of the site where work has been
Figure 7: Archaeological Grid System.
conducted. Two or more maps can be put together, either in part or in their entirety, to help locate any anomalies. Inaccuracies in the excavation maps, as well as the historic maps, are easily deleted and corrected.

AutoCAD can be interfaced with other hardware to accurately map a site. Archaeologists uncovering a Roman bath at Isthmia used a laser theodolite connected to a computer with AutoCAD to record and illustrate the site information (CSA Newsletter 1990). The ability to identify each coordinate point with an attribute block description helped the surveyors to reduce error and minimize field note taking. Similarly, Sonic High Accuracy Recording and Positioning Systems (SHARPS) are being used to plot underwater archaeological features using ultra-sonic waves (Hamilton 1988a).

Archaeologists can also use AutoCAD to construct effective models to display their data in publications. Technical features ranging from ship hulls to artifacts can be created accurately and in detail with AutoCAD. Academic journals, such as The Journal of Nautical Archaeology, publish AutoCAD generated construction plans. AutoCAD comes with a large variety of font types which can be used to highlight reports as well.

Computers have become one of the most important and necessary tools for the archaeologist to manipulate large amounts of data. The use of computer graphics is
relatively new and there are some difficulties to overcome. However, the future holds many new and exciting innovations to help archaeologists record and disseminate information. Through the use of Geographic Information Systems (GIS) and Global Positioning Systems (GPS), archaeologists have new and better ways of precisely recording cultural resources, both historic and prehistoric, over an entire region. By using these data, it is possible to create models which will help predict site locations and determine the impacts modernization may have on both recorded and unrecorded archaeological sites. Remote sensing equipment is also improving the quality of recorded data. Virtual Reality is another field which may offer new ways of describing and displaying reconstructed buildings by allowing users to "walk" in a structure which may have existed 300 or 3,000 years ago. AutoCAD represents just the first step of how new technology can help record, analyze, and display archaeological information.
CHAPTER V

EVALUATING ARCHITECTURAL FEATURES OF THE ENGLISH COLONIAL SETTLEMENT PERIOD

English colonial settlement during the 17th and 18th centuries was a very dynamic process. The various New World environments required colonists to adapt in order to survive. Variability is a major factor when examining architecture and any reconstructive model must be flexible enough to account for the multitude of possible combinations of architectural features encountered in the archaeological record. Basing settlement on sociocultural complexity is one way of evaluating colonial architecture. The advantage of breaking down impermanent architecture into settlement stages is that each category is readily identifiable without being restrictive in its definition. Each definition can be confirmed by historical documentation or by comparison against the faunal and ceramic data assemblages when no historical documentation is available.

This model for examining settlement is most appropriate for smaller unknown sites. Usually an archaeologist will have foreknowledge concerning a structure from researching the historical documentation associated with the site. However, when an archaeological survey locates an unknown historical site with no historical references, architectural features can play a
major role in defining the settlement and determining its place in the regional history.

Survival and economic considerations seem to be the predominant factors which dictated the building of impermanent dwellings in the American colonies during the 17th and 18th centuries, and appears to follow a three-stage plan of settlement (Carson 1981:139). The first stage represents the frontier homestead settlement practice and consists of building a very crude, very temporary shelter to live in for one year, or for the first few years of settlement. From early descriptions it is possible to define four types of temporary shelters: dugouts, cabins, wigwams, and cottages (Morrison 1952:9). The second stage is the building of an impermanent, but much more substantial, house to live in until one's fortune was made from the planting of cash crops. This is most typical of plantation rural-agricultural impermanent dwellings which are found on many of these types of sites. The final stage is the building of a "fare house" which was considered to be made out of brick or stone.

Characteristics of Frontier Architecture

Frontier architecture represents the first stage in the survival strategy of the colonists who came over to the New World to plant crops. These primary structures were small, simple, crude, and able to be raised quickly.
Frontier architecture represents the most generic form of Euro-American vernacular architecture.

The colonial settlers brought tools and had an abundant supply of building materials, but they lacked time. If one were to eat during the winter, land had to be cleared and planted with food crops. This did not leave any time to build a proper house, so a quickly erected shelter had to suffice. A description by Cornelius Van Tienhoven gives a good example of the timing involved with moving to the New World:

Boors and others who are obliged to work at first in Colonies ought to sail from this country in the fore or latter part of winter in order to arrive with God's help in New Netherlands early in the Spring in March, or at latest in April, so as to be able to plant, during that summer, garden vegetables, maize, and beans, and moreover employ the whole summer in clearing land and building cottage. All then who arrive in New Netherland must immediately set about preparing the soil, so as to be able, if possible to plant some winter grain, and to precede the next winter to cut and clear the timber...including such trees as are suitable for building, for palisades, posts and rails, which must be prepared during the winter, so as to be set up in the spring on the new made land which is intended to be sown, in order that the cattle may not in any wise injure the crops.... The farmer can get all sorts of cattle in the course of the second summer, when he will have more leisure to cut, and bring home hay, also to build houses and barns for men and cattle. The wealthy and the principal men in New England, in the beginning of the Colonies, commenced their first dwelling-houses in this fashion for two reasons: first, in order not to waste time building and not to want food the next season; secondly, in order not to discourage poorer laboring people whom they
brought over in numbers from Fatherland. In the course of three or four years, when the country became adapted to agriculture, they built themselves handsome houses, spending on them several thousands…. (Van Tienhoven 1874).

He goes on to describe a turf-earth-log structure used by the first settlers:

Those in New Netherland and especially in New England who have no means to build farmhouses at first according to their wishes, dig a square pit in the ground, cellar fashion, six or seven feet deep, as long and as broad as they think proper; case the earth all round the wall with timber, which they line with the bark of trees or something else to prevent the caving-in of the earth; floor this cellar with plank, and wainscot it overhead for a ceiling; raise a roof of spars clear up, and cover the spars with bark or green sods so that they can live dry and warm in these houses with their entire families for two, three, or four years, it being understood that partitions are run through these cellars, which are adapted to the size of the family… (Van Tienhoven 1874).

Figure 8 is a schematic drawing of this type of structure. It would have involved the digging of a "cellar" and the felling of between 12 and 15 trees with a length of 12 feet and diameter of 1 foot. The earth removed from the cellar would later be used to cover the log roofing. This type of shelter would require little or no carpentry skill and could be built entirely of local materials. Later as settlers moved out of the coastal regions and into the frontier, they took with them this same strategy to survive in the wilderness.
Figure 8: First Settlement Stage Structure.
Frontier homesteads were built simply as shelter from the elements. Living comfortably inside them was probably not a major concern as they were crude, uncomfortable, and not very big. Most homestead structures were single room, single story, with no elaborate carpentry. The homesteader was also the builder and could only build with the tools and skills he had brought with him. Out in the wilderness there was no source of professional skilled laborers.

Frontier settlements were extremely isolated. Self-sufficiency was the rule. Settlers cared less about how a dwelling looked than its ability to protect them from the elements and the wilderness. Frontier settlements could only be built with local, roughhewn, raw materials. Crude mud bricks and nails were available only in limited quantities. Mortise and tenon joints were irregular and uneven, as were the spacing of members. The structure might even be dangerous to live in, but better than nothing at all. This reflects the quickness in which these buildings were made.

Decorative elements would be extremely rare on a frontier homestead because they would be both unnecessary and unaffordable. Metal hardware such as doorknobs, locks, and hinges would also be less common. The
historian Lewis Gray (1933: 441) states,

The one-room cabin, possibly with a loft, was the pioneer's home. Windows were mere openings guarded by wooden shutters. Frequently there was no floor, or merely a rough puncheon floor. The fireplace was built of sticks, moss, and clay. Rude furniture, homemade by the use of axes, adze, and auger, consisted mainly of a table constructed of a roughhewn slab with legs driven into auger holes, a few rude stools, and beds. The cabin was lighted at night by a pine knot. A tin cup and an iron fork were luxuries, and iron pot a treasured possession. One or two hunting knives and a gourd completed the list of culinary utensils.

Characteristics of Plantation Architecture

Plantation architecture of the English colonial settlement period represents a middle range between urban architecture and frontier architecture. Small towns and villages fall within this range of settlement architecture because of the simpler level of social complexity and interaction which they represent. Small towns and villages are more agrarian based and less industrialized than urban areas.

Plantation buildings were usually built in a manner which is both quick and cheap and they reflect the second stage of colonial settlement. The reason for this is that there was no time to construct an elaborate dwelling when fields had to be cleared, plowed, and planted, and beginning planters had very little capital to spend on the construction of an expensive house. Out in the country
the availability of usable land to build on was not as restricted as it was in a city. Buildings could be larger and built out instead of up.

Another element of plantation architecture is the degree of variation between buildings located in the same area. Buildings recorded on plantation sites show significant differences between the main house, the outbuilding for the overseer, slave quarters, storehouses, and barns. Building codes and fire laws in cities create a higher degree of structural conformity which is not found between buildings located on plantations which have no codes to restrict them. One example of this is the methods of chimney construction between the different plantation buildings. The main house might have had a well-crafted brick masonry fireplace, while the slaves quarters would only have had a catstack made of sticks and clay.

Although the plantation owner did not have to abide by any kind of imposed building code, it is evident that they did take care in the construction of their second stage living quarters by practicing sound carpentry methods. This is reflected archaeologically by square cut, evenly spaced post holes, charred timbers for preservation, finished mortise and tenon joints, and the utilization of brick and stone elements when available.
Since plantations had to be connected to the trade routes in order to sell their produce, imported building materials would be available but in smaller quantities than would be found in an urban area. This is a function of both access and economic factors. Access to imported materials would have been restricted to when a small plantation owner could leave the plantation and travel to a town. Also, fewer resources could be spent on decorative non-essentials when planting, and maintenance of the plantation was the prime concern, especially for beginning planters.

Social status would not be as important out in the country as it was in the city, since interaction with one’s neighbor was reduced. As the level of social interaction decreased in plantation settlements, the demand for self-sufficiency increased. During times of difficult weather or warfare, the plantation would have to supply itself with raw materials and labor. This element of self-sufficiency is reflected archaeologically by a higher concentration of locally procured materials than would be seen at urban sites.

Littletown Tenement, one of the Kingsmill Plantations, is an excellent example of first and second stage settlement practices (Kelso 1984:59-65). The first stage dwelling represents a structure built with driven posts having an irregular plan. The second stage dwelling
was also impermanent, but reflects a higher degree of invested resources as seen in the large post holes and evenly spaced post molds.

**Characteristics of Urban Architecture**

Urban architecture represents the most complex level of sociocultural interaction and settlement. In the English colonial period, urban architecture was substantially governed by the problems of restricted sites and the regulations necessary for neighborly design (Brunskill 1987: 164). Building in an urban area required a high degree of interaction with neighbors, local government, and skilled laborers.

Urban design reflected an emphasis on maximizing space utilization. City land is more costly because supply is limited. The size of plots in a city were restricted and confined, thus requiring a structure to be built up instead of out. The need for stairs would break up the space into smaller rooms. Roofing structures were more complex to fully utilize the half-story of space available at the top of a structure with dormers and special rafter joints being more common.

Because urban areas were focal points for trade and commerce a wide range of resources and raw materials were available for the construction of shelters. Such materials as brick, window glass, imported lumber, and
metal ornamentation were all easier to obtain in an urban area than in isolated frontier environments. Status also becomes more important in areas of higher population density, and can be expressed through architecture. This increases the demand for architectural elements which have a decorative function as well as a structural one.

Urban areas were characterized as having a higher technological level. Pre-processed materials, a skilled labor force, specialized tools, and a wider range of raw materials were easier to obtain in towns and cities than in rural areas. For example, nails were more common in urban buildings of the colonial period because they were more readily available to the urban builder and because nails were less costly to use, when they were readily available, than labor intensive mortise-and-tenon joints. Urban populations also had easier access to local processing centers, such as sawmills and carpentry shops, than did rural areas.

City architecture reflects the interaction between the builder and the local government. The use of building codes is a mandatory element in city dwellings. As colonial towns grew into cities, fire laws and building codes became necessary to protect people and property. One example of how such laws and codes influenced construction is seen in the London codes for the 17th
And be it further enacted, that the said houses of the first and least sort of buildings fronting by streets or lanes, as aforesaid, shall be of two stories high, besides cellars and garrats; That the cellars thereof 6 foot and an half, if the springs of water hinder not; and the first story of 9 foot high from the floor to the seeling; and the second story 9 foot high from the floor to the seeling; that all walls in front and reer as high as the first story, be of the full thickness of the length of two bricks, and thence upwards to the garrats of the thickness of one brick and a half; and that the thickness of the garrat walls on the back part, be left to the discretion of the builder, so that same be not less than the length of one brick; and also that the thickness of the party walls between these houses of the first and lesser sort of building, be one brick and 1/2 as high as the said garrats, and that the thickness of the party wall in the garrat, be of the thickness of the length of one brick at the least.

And be further Enacted, that the houses of the second sort of building fronting streets and lanes of note, and the river of Thames, shall consist of three stories high, besides cellars and garrats as aforesaid; that the cellars thereof be 6 foot and 1/2 high, (if the springs hinder not) that the first story contain full 10 foot in height from the floor to the seeling: The second full 10 foot, the third 9 foot; that all the said walls in front and reer, as high as the first story, be two bricks and 1/2 thick, and from thence upwards to the garrat floor, of one brick and 1/2 thick; and the thickness of the garrat walls on the back part be left to the discretion of the builder, so that the same be not less than one brick thick: And also that the thickness of the party-walls between every house of this second, and larger sort of building, be two bricks thick as high as the first story and thence upwards to the garrats, of the thickness of one brick and 1/2.

Also, that the houses of the third sort of buildings, fronting the high and principle streets shall consist of four stories high,
besides cellars and barrats as aforesaid: That the first story contain full 10 foot in height from the floor to the seeling; the second 10 foot and 1/2; the third 9 foot; the fourth 8 foot and 1/2: That all the said walls in front and rear, as high as the first story, be of two bricks and 1/2 in thickness, and from thence upwards to the garrat floor, of the thickness of one brick 1/2: That the thickness of the garrat walls on the back part be left to the discretion of the builder, so as the same be not less than one brick: And also that the party walls between every house, be two bricks thick as high as the first floor, and thence upwards to garrat floor, the I 1/2 brick in thickness.

And, be it further enacted, that all houses of the fourth sort of building, being mansion houses and the greatest bigness, not fronting upon any of the streets or lanes as aforesaid; the number of stories, and the height thereof, shall be left to the discretion of the builder, so as he exceeds not four stories... (Moxon 1702:262-264).

These codes also reflect the multi-story component of urban architecture.

Of the many different examples of impermanent architecture available, three will be selected for reconstruction. The first is an 18th-century frontier homestead from the South Carolina low country. The second will be a building from Middle Plantation, Maryland, which dates from the 17th and 18th centuries. The last example will be a 17th-century building from the sunken city of Port Royal, Jamaica. Each of the three examples of impermanent buildings share a similar cultural affiliation, but represent different settlement stages. The historical and geographical background of each example
will be examined along with the archaeological data and proposed reconstructions. In addition, the steps involved in a computer reconstruction for each structure will be outlined, followed by a comparison of results.
CHAPTER VI
HOWELL HOMESTEAD

Introduction

There are only a few examples of impermanent dwellings in South Carolina that have been excavated, even though the technique was probably used extensively early in the area’s history (Stan South, personal communication 1992). One example is the Howell Homestead which was constructed at an 18th-century plantation located in the South Carolina backcountry. The Howell building is a smaller, simpler structure representative of a secluded frontier homestead.

Settlers of the South Carolina frontier did not have the extra time or resources needed for upgrading their dwellings as more integrated locations could. The architecture of the South Carolina backcountry reflects the self sufficiency of the frontier homesteader.

The Howell dwelling was excavated in 1990 by Mark Groover to study cultural continuity and change in the South Carolina frontier during the 18th century (Groover 1992). All information concerning this site and its history was derived from Groover’s research.

Site Location

The Howell Plantation was part of the Congaree Settlement which began in 1718 with the construction of
Old Fort Congaree located at the confluence of the Broad and Saluda rivers (Groover 1992:33)(Figure 9). A composite land plat map created by Robert Meriwether in 1940 was compared to current topographic maps to determine the exact location of the Howell Plantation. The site was located about 10 miles southeast of Columbia, near Mill/Raiford's Creek, approximately 400 feet southwest of Bluff Road (Groover 1992:84).

**Historical Background**

The deerskin trade and rice production were primary factors in the settlement of the South Carolina backcountry in the early 18th century (Groover 1992:33). These two incentives, along with a land grant of 50 acres, attracted colonists to move from as close as Charleston or as far away as Europe.

William Howell arrived from Maryland with his two brothers, Thomas and Arthur, in the early 1740s. He first registered his land grant of 400 acres in 1742 (South Carolina Department of Archives and History 1742:60). It was Thomas Howell's 200-acre plat which designated the original homestead as a "plantation."

Thomas Howell seems to have been more than just a planter. His activities included overseeing the construction of a road, the operation of a ferry, and the manufacturing of various household items. He died in 1760.
Figure 9: Site Location of Howell Homestead.
and the land passed on to his son William who then passed it on to his wife Lucy in 1784. It is uncertain what happened to the plantation after 1784 because there is no reference to it in any of the subsequent wills. Groover does not identify the present owner of the land, but he does mention that the site was surveyed after recent plowing, suggesting that it is still used for agriculture.

**Archaeological Research**

Groover (1993:81) states that the archaeological excavation conducted at the Howell plantation was aimed at "achieving three primary goals: locating the plantation, obtaining architectural data, and recovering artifacts for exploring foodways, cultural interaction, and the general lifeways of the plantation residents." After the site was located on topographic maps, the site was surveyed in 1990 and assigned the Smithsonian number 38RD397. A scatter of historical artifacts measuring 100 by 200 feet was recorded and collected.

Limited testing indicated two areas which possessed a high potential for subsurface features and steel probe testing was conducted. One large feature, Feature 1, was encountered and further extensive testing was done. Feature 1 was later determined to be a building and was designated as Structure 1.
Extensive excavation was conducted later that year exposing 343 square feet, recording 26 features, and recovering 1,399 identifiable historic artifacts (Groover 1992:91) The size and building techniques of Structure 1 were defined and recorded.

Elements of the Howell Homestead

Groover thoroughly evaluates the archaeological information and reconstructs the Thomas Howell homestead. The house itself was a one-room frame earthfast house, measuring 16 by 17 feet. It contained a cellar and a crude wattle and daub chimney (Figure 10).

The Thomas Howell homestead represents a very basic building which was probably the first structure built on the plantation. Groover believes that the occupation of this site lasted only about 35 years before it was abandoned. It is possible that Thomas Howell moved to another location and allowed one of his slave families to live in the dwelling until it was finally abandoned.

Posts

The corner posts were set into roughly rectangular holes measuring between 2 and 2.5 feet and excavated to a depth of 2.5 feet. The hewn posts were rather large, being between 1.5 and 2 feet square. They were spaced at irregular intervals and were probably set into the holes
Figure 10: Howell Homestead Site Plan (Groover 1992:94).
before being joined together with tie-beams. Two smaller posts located on the south wall indicate the location of the doorway. The presence of previously set posts indicates that these members were replaced frequently (Groover 1992:93)

sill

Because there was no indication of earthfast studs, the building probably contained an interrupted sill (Groover 1992:92). Because of the irregular spacing and size of the corner posts each of the sills would have been made-to-fit after the posts were in place so that they could be properly sized.

Door

An entrance was located on the south wall and measured three feet wide. The construction of the door is unknown but was probably made of vertical battens.

Windows

Flat glass was recovered at the site and its distribution suggests that a window was located near the northeastern corner of the north wall (Groover 1992:99). However, the sample was small, comprised of only eight pieces of glass.
siding and Roofing

Groover (1992:98) states that clapboard siding and wooden roof shingles are indicated from an analysis of nails recovered from the site. Usually, early weatherboarding is pegged to the timbers; however, there are examples of it being attached with nails (Morrison 1952:31). Roof shingles were commonly made from white pine, oak, chestnut, or cedar (Morrison 1952:32).

Chimney

The wattle and daub chimney, located on the west wall, measured eight feet wide and was constructed with a wooden crib composed of logs averaging three inches in diameter (Groover 1992:97). Fingerprint impressions left in the daub indicate it was applied by hand and the clay was extracted from the excavation of the cellar (Groover 1992:98). No brick or mortar was found.

Cellar

The cellar measured 8 by 12 feet and had a depth of 2.5 feet. The shallow depth of the cellar would indicate that it was used only for the storage of vegetables and other bulk foods. Wood recovered from the bottom of the cellar indicates that it had a plank floor (Groover 1992:92).
Summary of Howell Homestead

The Howell Homestead is representative of typical first stage settlement homes with elements which are rough and irregular. Its shape, uneven spacing, and size suggest that it was constructed quickly using only the most basic of carpentry practices.

Groover's accurate reconstruction shows a single room frontier house (Figure 11). Groover uses extensive historical documentation to prove that Structure 1 was a domestic residence which was later used as a kitchen. His discussion did not focus on the architectural elements themselves, but on how the size of the structure related to the inventories of the Howell family and the family size. This use of historical documentation strongly supports the three-stage theory of settlement proposed earlier and can be used to define other non-architectural elements which represent a shift from the first stage of frontier settlement to the second of plantation settlement. Groover (1992:118) states that "Historical sources outline a sequence of development for frontier residence in which a temporary domestic structure was initially constructed and then a larger and more substantial residence was built later." He goes on to state that the original domestic structure was reused as a "dependency, often functioning as a detached kitchen" (Groover 1992:118). If his theory is correct, then an
Figure 11: Reconstruction of Howell Homestead (Groover 1992:96).
increase in the amount of kitchen and utility wares combined with a decrease in personal items over time will indicate a shift from a frontier settlement structure to a plantation settlement structure. Even though the building is the same, its cultural utilization and complexity have changed.

Computer Reconstruction of Howell Homestead

The process of reconstructing impermanent structures with a computer is similar to building them in real life. The first step in creating a three-dimensional reconstruction is to set up a drawing file with set parameters which are used as a template for subsequent drawings. This template contains all the layers, drawing units, blocks, hatch patterns, views, user coordinate systems files, and line-types which are needed for all the reconstructions. AutoCAD offers a wide range of drawing parameters to choose from. Decimal English units of measure were used since this matched the form in which the archaeological data were collected. Doing this in the beginning saves time by not having to redo the parameters over again for each new drawing file. By saving the template under a new filename the master file remains unchanged.

When constructing a three-dimensional drawing it is important to create a baseline elevation from which to
work and use as a guide. It is easier to use the coordinates 0,0,0 as your origin to avoid confusion later when determining the lengths, widths, and heights of the different members of the building. AutoCAD gives the user the option of altering the origin coordinates and the elevation.

The task of drawing in three dimensions is made easier with the use of the User Coordinate System (UCS). AutoCAD lets the user define not only the viewing perspective, but also the drawing perspective. It would be very difficult to draw a diagonal three-dimensional line if it could only be seen from a plan view. The UCS allows a user to view the drawing from the "side" and define that orientation as the drawing plane. This was helpful when drawing brace framing and rafters.

The next step involved entering the known data. The Howell Homestead was by far the easiest of the examples to reconstruct, because it was a single room structure with few complex architectural elements. Almost the entire building was constructed with three-dimensional boxes and faces (Figure 12).

The ground elevation was set at 2.5 feet and the length of the corner posts was 12.5 feet. This was to give a room height of 10 feet. The overall plan was standardized and squared off. The framing members were individually constructed boxes, while the chimney was made
Figure 12: AutoCAD Reconstruction of Howell Homestead.
of three-dimensional faces joined together. One of the edit commands, "STRETCH", was used to change the shape of the chimney because it was found to be too short after the rafters were added. This made it easy to change the entity without having to erase it and start over again.

One of the main characteristics which sets the Howell Home off from the other examples is the presence of a large cellar. When viewed in three dimensions it becomes apparent that this is a dominant feature of the Howell Homestead.

Groover's reconstruction is accurate for a dwelling built with post-in-hole construction, and his interpretation seems very probable. However, a CAD drawing of the same information serves as a better diagnostic tool than does the artist's rendition. One aspect which Groover does not discuss is the possibility of two possible construction phases being represented in the archaeological record. Looking at the three-dimensional model and the dominating size of the cellar indicates that the cellar might have served as a dugout dwelling before the post-in-hole dwelling. Groover's site plan shows two extensions from the cellar. The northern extension's size is typical of an entrance for a dugout structure (Figure 13). Groover does not explain these features or the out-of-place post holes located next to the cellar walls. The historical accounts of frontier
Figure 13: Modified Howell Homestead Site Plan (Groover 1992:94).
settlement support the idea that a dugout structure would come first.

Easily retrievable measurement information aids in the spatial analysis of a structure as well. By using AutoCAD's "INQUIRY" function the volumes of the structure and the cellar can be quickly calculated and compared (Table 2). The distance between any two points, as well as angle measurements, can be determined from any view quickly. Gathering this same type of information with a ruler, from either an artist's reconstruction or a set of plan and profile drawings done by hand, is tedious and more time consuming.

By combining an understanding of CAD technology, settlement stages, and impermanent architectural types, information which would be missed or difficult to see is brought to the surface. The AutoCAD reconstruction revealed the dominating size of the cellar when it was viewed in three dimensions and AutoCAD's information function supplied data on its relative volume. Historical accounts indicate that dugout dwellings were initial settlement structures. An understanding of impermanent architectural types shows that dugouts require a lower expenditure of resources than a full post-in-hole dwelling. All of these elements suggest the possibility of a previously built dugout structure, and that the
TABLE 2: Measurement Information From AutoCAD Drawing

Cellar Dimensions

Command: dist
First point:  Second point:
Distance = 12.0000,  Angle in X-Y Plane = 270,  Angle from X-Y Plane = 0
Delta X = 0.0000,  Delta Y = -12.0000,  Delta Z = 0.0000

Command:
DIST First point:  Second point:
Distance = 8.0000,  Angle in X-Y Plane = 0,  Angle from X-Y Plane = 0
Delta X = 8.0000,  Delta Y = 0.0000,  Delta Z = 0.0000

Command:
DIST First point:  Second point:
Distance = 2.5000,  Angle in X-Y Plane = 270,  Angle from X-Y Plane = 0
Delta X = 0.0000,  Delta Y = -2.5000,  Delta Z = 0.0000

Cellar Volume = 240 square feet

Structure Dimensions

Command: dist
First point:  Second point:
Distance = 10.0000,  Angle in X-Y Plane = 270,  Angle from X-Y Plane = 0
Delta X = 0.0000,  Delta Y = -10.0000,  Delta Z = 0.0000

Command:
DIST First point:  Second point:
Distance = 17.0000,  Angle in X-Y Plane = 270,  Angle from X-Y Plane = 0
Delta X = 0.0000,  Delta Y = -17.0000,  Delta Z = 0.0000

Command:
DIST First point:  Second point:
Distance = 16.0000,  Angle in X-Y Plane = 0,  Angle from X-Y Plane = 0
Delta X = 16.0000,  Delta Y = 0.0000,  Delta Z = 0.0000

Structure Volume= 2720 square feet
Total Volume= 2960 square feet
Cellar = 8.1% of Total Volume
sequence of how the Howell plantation started should be re-evaluated.
CHAPTER VII
MIDDLE PLANTATION

Introduction
Middle Plantation (18AN46) is located about nine miles west of Annapolis, Maryland, and was founded by a French Huguenot in 1664. For the past 300 years, the land of Middle Plantation has been used for tobacco farming. William P. Doepkins, a tobacco farmer and amateur archaeologist, excavated at the site for 10 years, uncovering historic trash dating to the 17th and 18th centuries. All information concerning the excavation and analysis of the site is contained in a report published by Mr. Doepkins in 1991. The following sections are a summary of that report. Because Mr. Doepkins did not wish to have any graphic elements from his work reproduced, only site descriptions are presented.

Site Location
Site 18AN46 is located on the west side of the Chesapeake Bay, between the South and the Patuxent rivers, in Anne Arundel County, Maryland (Figure 14). It sits on a ridge of low hills with an average elevation of approximately 170 to 180 feet. The local soil conditions are well suited for agriculture and the area is spotted with woodlands and meadows.
Figure 14: Site Location of Middle Plantation.
Historical Background

Mareen Duvall was a French Huguenot who founded Middle Plantation in 1664. Mareen Duvall came to Maryland from France as an indentured servant in 1650. After 9 years of service he was made a free man and given 50 acres of land.

Over the next 35 years, he became a wealthy tobacco planter and merchant growing tobacco. In 1664 Mareen Duvall, then a carpenter, received his second land grant called Middle Plantation. It is here he settled, built his home, and raised his family. At the time of his death in 1694, he had accumulated nearly 3,000 acres of land and his estate was valued at 1400 pounds.

After his death, Middle Plantation passed on to Mareen Duvall’s daughter, Mary, married to Reverend Henry Hall. The land was passed to their son, Henry Hall, and on to his son, Henry Hall, Jr. The Hall family sold the property, which contained the Duvall dwelling, to Mr. Thomas Davidson in 1839. At the time of the 1968 excavation, the land was owned by Richard Dove who leased his land to sharecroppers.

Archaeological Research

William P. Doepkins is a farmer and outdoorsman whose curiosity encouraged him to seek out the past. While walking the fields of Maryland, Mr. Doepkins searched for
fragments of past human activity such as pipe stems, flints, and ceramic sherds. He joined the Anne Arundel Archaeological Society and learned more about the history and prehistory of Maryland. In the spring of 1968, a tobacco sharecropper on the Richard Dove plantation uncovered some ash and brick while plowing the field. Mr. Doepkins collected some artifacts from the surface of the area, but did not excavate until later that summer.

Over the next year, Mr. Doepkins conducted limited excavations with the advice of a professional archaeologist. In 1970, a meeting was set up with historical archaeologist Ivor Noel Hume to examine the artifacts recovered from the site and to make an evaluation as to their context. Hume acknowledged that they belonged to a late 17th or early 18th century plantation of considerable wealth. He encouraged Doepkins to continue with his excavations.

Harvesting and planting interrupted the excavation work, which consisted of exposing small areas showing signs of subsurface deposits. Later, a tractor was used to scrap away larger areas of overburden, but no detailed records of the excavation units were kept. Features were mapped by measuring from two known points, usually from the corner of buildings. As the site area expanded and became more complex, a base line was measured between two
features and was used to map all features found subsequently.

In 1969 the state archaeologist for Maryland visited the site and further emphasized the need for careful recording. The site was assigned Smithsonian Number 18AN46. Data recovery was concluded by the end of 1977 and the excavation report was published in 1991.

Site Description

Middle Plantation covers a large area of approximately 2.67 acres. It consists of two temporal elements, the 17th-century occupation by Mareen Duvall, and the 18th-century occupation when the plantation became a tenement (Carson 1981:183). The 17th-century component, according to Mareen Duvall's probate inventory of 1694, includes a main dwelling structure, kitchen, milk house, tobacco houses, quarters, and old and new storehouses (Doepkins 1991:23-31).

The predominant features of the site were the main dwelling which measured 40 feet by 20 feet, and the kitchen which measured 16 feet by 30 feet (Doepkins 1991:102). The outbuildings were spread around the main buildings with two large tobacco houses to the northwest and trash pits to the south.

A small graveyard was also uncovered 72 feet west of the main buildings; however, only scattered traces of
human remains were found. The graves were rectangular in shape. Bricks found at the bottom of at least three of the graves indicate that the coffins were propped up.

**Elements of the Mareen Duvall House**

The Mareen Duvall House at Middle Plantation is typical of the many impermanent buildings found in Maryland and Virginia. It was of post-in-hole construction with an interrupted sill measuring 40 by 20 feet. The post holes and the post molds are the only surviving remnants of the house. Many of the architectural elements were lost because of plowing disturbances.

**Posts**

The post holes were rectangular in shape and ranged in size from 20 by 30 inches to 30 by 36 inches, and had a depth of 34 inches. The post size ranged between 8 by 8 inches, 7 by 9 inches, 8 by 10 inches, and 10 by 11 inches. Each post was spaced at 10-foot intervals and the rows were 20 feet apart. The earthfast ends of the posts were charred to help preserve the wood.

**Room Layout**

Since there was little more than the location of the post holes left of Mareen Duvall's dwelling, historical
information played an important role in defining the remainder of the building. The best record of Mareen Duvall's dwelling is derived from an inventory done in 1694 of his property. The inventory lists his belongings by location, mentioning a hall chamber, south chamber, and middle room (Doepkens 1991:22). Rooms above the hall chamber and south chamber are also mentioned, indicating that the structure was 1-1/2 stories. The kitchen and other outbuildings were also inventoried.

Storage Pits

The archaeological evidence uncovered extensive use of subsurface storage pits. One rectangularly shaped pit was uncovered in the middle of the south chamber. It measured 5 feet by 6 feet with an original depth of about 24 inches. This pit may have been associated with the double-backed hearth.

Chimney

The hearth feature proposed by Doepkens is probably correct based on his hypothesized floor plan, although no evidence of one was found in the dwelling structure. Brick rubble representing the base of the chimney was found in the kitchen structure. Any bricks which belonged to the superstructure of the chimney seem to have been removed by plowing. Chimneys found throughout the
southern American colonies are typically placed at the ends of the building. In the New England colonies however, the chimney structure was placed within the center of the building. Given the geographic location of Middle plantation it is probable that either type of chimney could have been used.

Wall Construction

Brace-framed construction is typically associated with this type of structure and is seen in most impermanent buildings. Infill could have consisted of either wattle and daub, or brick nogging, but it is hard to say which. Because no evidence of brick rubble being scattered across the site is mentioned by Doepkens it is more likely that wattle and daub was probably used. The infill would have been covered with clapboards to protect it from the elements.

Windows

The archaeological evidence indicates that lead casement windows were used. Several pieces of lead contained marks and dates, including one with 1667. One maker's mark indicates a possible tie to site 18ST23 at St. Mary's City, Maryland. The lead fragments recovered are described by Doepkens as "triangular" but these
probably represent diamond-shaped panes instead of triangular ones.

Doepkens' reconstruction shows dormer windows on the second story (Doepkens 1991:103). These would have been added after Mareen Duvall's death, as most of the dormer windows that appear today on New England Colonial houses are almost certainly additions made in the 18th or 19th century (Morrison 1952:38). Dormers form a complex joint with the roof and represent a higher level of invested resources and a more sophisticated carpentry skill. If a dormer is constructed incorrectly, the roof structure will be severely weakened and will leak. It seems unlikely that a struggling plantation owner would expend the resources required to build a dormer or take the risk.

Roofing

Wooden shingles were the most likely roofing material used, as there is no evidence of tile or slate. Shingles were hand riven with a froe and irregular in shape. Boards with many defects that could not be used for flooring were used as "roofers" (Morrison 1952:36).

Stairs

Two staircases are shown in the inventory floor plan. There is no archaeological evidence to show the number of stairways used in the house, or their type. It seems
unlikely that two staircases would have been employed because of the significant loss of living space caused by adding another staircase when one would be sufficient.

Doors

The exterior door was likely a vertical batten door. The interior doors would be similar except of much lighter construction. This is based on the assumption that exterior doors serve as protection and insulation from the outside environment while interior doors are used primarily for privacy. The heating of outer rooms is also facilitated by lighter construction given a central fireplace. "H", "T", and strip hinges were recovered from the site.

Summary of the Mareen Duvall House

The Mareen Duvall house represents a typical 17th-century plantation house common throughout Virginia and Maryland (Carson 1981; Kelso 1984, 1990; Morrison 1952). It was a 1-1/2 story impermanent building using post-in-hole construction with an interrupted sill. The brace framing and infill was probably covered with clapboards and it had a wooden shingle roof. Lead casement windows were present in all sides of the house and there might have been more than one doorway. Mareen Duvall’s own inventories indicate that the first floor was broken into
three rooms with living space above them. No evidence of a brick chimney was uncovered in the main house but the kitchen structure contained brick rubble as well as a brick-lined storage pit.

The Mareen Duvall dwelling typifies the second stage settlement structure commonly found on plantations. Spacing between structural members is even and uniform. Post holes are square and have the same depth. Skill was used in piecing together the interrupted sill and matching up mortise and tenon joints. The dwelling covers a large area but is only 1-1/2 stories. The site plan clearly shows multiple structures with a wide range of variability among them. Evidence of trade was found in the form of window lead with maker’s marks, but most building materials were procured locally.

**CAD Reconstruction of Middletown Plantation**

Since the archaeological evidence of the Mareen Duvall dwelling consisted of a simple plan of post holes, the southwest corner post was used as a starting point and all other features were measured from there. The bottom of the post holes were set at 0 elevation, and ground level was set at an elevation of 2.9 feet.

The reconstruction of the Duvall dwelling was made using three-dimensional boxes to represent building members instead of using ruled surfaces. The "RULESURF"
command creates a polygon mesh between two curves (polylines) and joins them into a single entity. The polygon mesh is defined by presetting surface tabulations. Even though a ruled surface is selected as a single entity, it behaves as many single lines when regenerating or hiding a drawing. As a drawing becomes more complex, the time required to regenerate or hide lines accumulates and severely impedes the drawing process. Three dimensional objects, which can be boxes, spheres, domes, cones, pyramids, or wedges, use up less memory and are easier to hide and regenerate than ruled surfaces.

The "COPY" command was used to save time. Similar building timbers, such as posts, sills, and rafters, were drawn once and then copied as many times as was needed.

The post holes were constructed with three-dimensional boxes as were the posts themselves. The vertical posts measured 12.9 feet, giving an overall room height of 10 feet which is a customary height (Carson 1981:144). Next, the sills were placed at ground level and were constructed as three-dimensional boxes as well (Figure 15).

Since the roof plates required a bottom groove, they could not be drawn with a simple box. Three-dimensional faces were constructed for each side of the timber. AutoCAD creates these faces by connecting three or four points. For complex figures, which are made up of more
Figure 15: AutoCAD Drawing Showing Basic Framing.
than four points, it is possible to hide the fourth edge by making it invisible. This is done by entering an "i" before selecting the fourth point. Different three-dimensional faces were joined by using the Object Snap function (OSNAP) to select common endpoints (Figure 16).

The bottom section of the chimney feature was constructed entirely of three-dimensional faces. The bottom plan was drawn and copied to its full height. Each face of the hearth was then drawn by connecting the top and bottom plans with three-dimensional faces. The top of the chimney was created using boxes of varying sizes created at different elevations (Figure 17).

Many different layers were used in the Middle Plantation house drawing. It was found that printing time was reduced when there was more control over the different elements of the building. Only the features which needed to be seen were left on before printing and hiding lines. Two layers were created for each major building element so that entities which fell "behind" the view could be turned off. This decreased the time needed for printing by about one-half because the computer had to calculate for less entities when rendering a drawing. The versatility of an AutoCAD drawing is exemplified by printing the finished reconstruction from different views (Figure 18).

The outbuildings associated with the Mareen Duvall house were drawn schematically to show a general
Figure 16: AutoCAD Drawing Showing Rafters Only.
Figure 17: AutoCAD Drawing of Chimney Structure.
Figure 18: Three AutoCAD Views of Duvall's House.
reconstruction of the area around the house (Figure 19). Each building was drawn using three-dimensional boxes.
Figure 19: Schematic Three-Dimensional View of Duvall's House with Outbuildings.
CHAPTER VIII
PORT ROYAL

Introduction

In 1688, John Taylor described in his travel journal the city of Port Royal, Jamaica as a "formidable" English city, which was "well built, strongly fortified, and Populated by a Valiant Inhabitants" (Taylor 1688:251). At that time, Port Royal was one of the busiest ports in the New World. It covered approximately 51 acres and had an estimated population of 6,500 (Hamilton 1984:12). Unfortunately the city was doomed when it was hit by an earthquake in 1692, and two-thirds of the city fell into Kingston harbor. This cataclysm marked the decline of Port Royal as a major trade center in the West Indies. As its population steadily decreased over the years, so did its economic importance to England. Today, Port Royal is a small fishing village which supports a local population of about 1,800 people (Hamilton 1984:12).

Recent archaeological research concerned with unraveling Port Royal's past has yielded significant information about this lost English port town. One of the aims of this research is to determine how historical accounts compare to the archaeological record (Hamilton 1992:39).

From 1981-1990, underwater excavations were conducted under the auspices of Texas A&M University and the
Jamaican National Heritage Trust by Dr. D.L. Hamilton, a professor with the Nautical Archaeology Program at Texas A&M University and a researcher for the Institute of Nautical Archaeology. After 10 consecutive summers of excavation, all or part of 8 different buildings were uncovered and recorded by underwater archaeologists. Four of these buildings were constructed with brick and two were constructed of wood (Buildings 2 and 3). One of the wooden structures, Building 3, represents a variation on the framed building on hole-set blocks. Instead of full wooden blocks, the vertical framing members were set on thinner wooden plates and the interrupted sills were pressed into the soft mortar of raised foundation walls before hardening. This type of architecture reflects the high water table that was present at the time of Port Royal’s existence. Even today the water table is extremely high, ranging from 2 to 3 feet below the present ground surface.

Dr. Hamilton (1984:12) states that the city of Port Royal is one of the most important 17th century British archaeological sites in the world. The archaeological remains found at Port Royal represent what Hamilton refers to as a "catastrophic site", or a city which has been "frozen" in time. Because of the sudden and drastic nature of the disaster which befell the city, almost all of the archaeological materials found are in their primary
context. This creates a "snapshot" effect when examining the archaeological record. This snapshot represents a picture of the city taken during 1692. Only at other catastrophic sites such as Pompeii and Herculaneum is this type of archaeology possible.

The study of Port Royal's architecture is of particular importance because it offers historical archaeologists the opportunity to study an array of brick structures. The architecture found in Port Royal sets it apart from other English colonies of the same period in that there is an unusually large number of brick buildings present in contrast to most New World English colonial sites of the same period. At no other archaeological site in the New World is there a higher density of brick structures dating to the 17th century.

Site Location

Port Royal is located on the southern coast of the island of Jamaica, on the lip of a long sand spit separating Kingston Harbor from the Caribbean Sea. Across the harbor from Port Royal is the present capital of Jamaica, Kingston. Of the original 51 acres of the 1692 townsite, 38 acres are on land and 13 are underwater (Mayes 1972:3) (Figure 20). However, most of the 17th century remains of Port Royal on land are as much as 8
Figure 20: Port Royal Site Plan (Hamilton 1984).
feet below the present ground surface, well below the
water table (Mayes 1972:3).

**Historical Background**

The overall history of Port Royal's founding and rise
to glory has been well documented (Hamilton 1984, 1992;
Mayes 1972; Pawson & Buisserent 1975). The island of
Jamaica was captured by the English in 1655 and quickly
grew. Mayes (1972:6) estimated that Port Royal's
population in 1688 to be at least 8,000; however, Hamilton
(1984:12) suggests a lower estimate of 6,500. Port Royal
became very wealthy and was a major trade center for the
West Indies, trading in tobacco, slaves, sugar, and pirate
plunder. However, after the earthquake of 1692, the city
began a slow decline as it was plagued by hurricanes and
eARTHQuakes. Today, Port Royal is a simple fishing
village.

**History of Archaeological Research**

The history of the archaeological excavations at Port
Royal goes as far back as 1859, but it wasn't until the
Port Royal Project was started in 1969 that controlled
excavations were carried out. Edwin Link's work with the
National Geographic Society produced a useful map of the
city, but his excavations at the King's Warehouse and Fort
James were not conducted in a systematic order (Hamilton
1984:15). Hamilton goes on to state that "little of the field work done at Port Royal has been conducted by professional archaeologists with the control and documentation demanded by modern archaeology" (Hamilton 1984:15).

From 1981 to 1990, the Institute for Nautical Archaeology, Texas A&M University, and the Jamaican National Heritage Trust all worked together to conduct a field excavation, headed by Dr. Hamilton. For 10 years the Port Royal Project carried out archaeological excavations on the submerged sections of Port Royal. Archaeological features were mapped and photographed. Measurements were done in units of feet instead of metric units because English units of measure correspond to the historic land plats and maps, a common procedure for excavations on English historical sites (Hume 1982; Kelso 1984). No formal field school was held during the summer of 1988, but a research team went to Port Royal to analyze previously excavated artifacts and historical documents at the archives located in Spanish Town, Jamaica. During this summer, a trench being dug by the city of Port Royal through a soccer field uncovered the remains of several 17th-century brick buildings. Dr. Hamilton organized a recovery effort to record the archaeological information before it was lost (Hamilton 1988b). The regular field school was held the following two summers. The 1981 to
1990 Texas A&M University excavations are the most thorough and well documented to date at Port Royal.

**Site Description**

At least eight different buildings comprise the main archaeological features uncovered by the Port Royal Project. These eight buildings are associated into three groups. Buildings 1, 2, and 3 are all aligned on Lime street and comprise the first group. Buildings 4, 5, and 8 are located at the meeting point of Lime and Queen streets, while buildings 6 and 7 back up against Buildings 4 and 5 and face onto Fisherman's Row (Figure 21). Excavation units located on the other side of Lime Street from Group I failed to uncover any distinctive architectural features, but it is believed that the remains of a building are located in the area. Buildings 1, 4, 5, and 8 were brick structures, while Building 2 and 3, as noted earlier, were built of wood. Building 3 had an interrupted sill, with the wall sills elevated on a mortar foundation, while Building 2 had a brick foundation on which a wooden structure was built. Only the backyard area of Buildings 6 and 7 were excavated so nothing is known of their construction. Buildings 1 and 5 are the best preserved.
Figure 21: Port Royal Project Excavations (Hamilton 1989).
Associated with Buildings 4, 5, and 7 are brick yards and 4 hearths. These features are located behind the buildings. A brick cistern was discovered between Building 5 and Buildings 6 and 7.

**Characteristics of Port Royal Architecture**

John Taylor wrote "in this Town are now at least 600 well built brick houses, and as many more built of Timber..." (Taylor 1688:252). For most of the New World colonies, wood was the primary building material. Brick was usually reserved for public buildings or for wealthy individuals. For the early colonists in North America, construction of living quarters had to be done quickly. It would take a year just to make and cure the bricks needed to build a house. Wood construction offered the early colonists quickly built cheap houses which they could live in for a number of years while getting established and making a profit by planting crops. Brick was much more sturdy but far less practical for the early colonists.

Port Royal's creation was unique in that a very high percentage of its early structures were of brick. The reasons for this high percentage include: a steady trade line with London, a large supply of skilled workers, the influence of defensive architecture on the city, and the
wealth of the merchants and craftsmen who built up the town.

Defensive structures requiring brick seem to predominate the early construction of Port Royal. When the English captured Jamaica from the Spanish, the captors built numerous fortifications around the town for protection. These fortifications needed to be of brick in order to support the large number of cannons surrounding the settlement. From the beginning, there was always a steady supply of brick coming from England to build these fortifications, until local production of bricks became established.

Where other colonies were almost completely cut off from the mother country and had to survive on their own, Port Royal had a substantial trade line with London, for it was a major source of Spanish gold, silver, sugar, and spice for England. Port Royal was also the hub of the West Indies slave and mercantile trade. There was an extensive trade network with a constant traffic of merchant ships coming and going. This offered a vast supply of skilled laborers who helped to build the city, and access to enough material to get a wide variety of jobs done. When other colonies in North America were founded they would have only the basic necessities to settle and survive since space aboard their transport vessels was limited. This restricted their access to many
processed materials, such as glass, brick, and metal. The colonists themselves consisted mostly of merchants and non-skilled craftsmen, who had to either learn to build and work or suffer the consequences. Port Royal was never limited as other North American colonies were because of the large labor force it offered.

Elements of Building 3

Although Building 3 was severely damaged by the earthquake of 1692, enough architectural information remains to reconstruct what it possibly looked like three hundred years ago (Figure 22). Building 3 is interesting because it is one of the few surviving examples of the timber structures mentioned by Taylor in 1688. It also represents the third stage of colonial settlement in which an impermanent building was utilized as a "fare house" (Carson 1981:140). In Building 3, the builder made a choice to invest fewer resources in shelter by using wood than did his neighbors in the same urban area who built with brick.

Foundation

Foundations are designed to protect walls from being undercut by erosion and decomposition by raising them above the underlying soil. Most historical documentation states that a foundation must be made of brick or stone so
Figure 22: Building Feature Drawing (Hamilton 1985).
that it will be strong and lasting. The archaeological evidence suggests that this was not a hard and fast rule and that shortcuts were taken to save time and cut building costs.

The foundation of Building 3 is composed of a poured mortar footing measuring one foot wide. The dimensions are estimated at 38 feet long by 27.2 feet wide. On the top side of the footing is a 6-inch trough for holding half rounded and squared sills. This trough appears to have been made by pressing the sill into the mortar while it was still soft. The foundation is interrupted by vertical upright timbers at the corners and major junctures of the building. Each timber sits on three-inch thick wooden plates which were placed at ground level. These wooden plates are a variation of the hole-set blocks used to support the corner posts and other vertical framing members. Wooden plates were probably used instead of hole-set blocks because of the sandy nature of the soil where plates would be more effective.

Moxon states that wood can be laid on brick foundations but that the mortar "eats and corrodes the Timber" (Moxon 1702: 264). His solution is to "lay them in Loam, which is a great preserver of Timber," or to use pitch (Moxon 1702:265).
Framing

The only timber-based wall construction used in England during the 16th, 17th, and 18th centuries was the braced frame type (Brunskill 1987:52). These braced frame structures probably came out of the Anglo-Saxon tradition in which wood was the only building material used. It wasn’t until William the Conqueror came over from France in 1066 that stone and brick were used to build castles and other fortifications in England. Braced frame construction was used to build churches, houses, and barns.

All major structural members were joined by mortise and tenon joints. Nails served no structural function but were used to attach elements to the framing, such as clapboards. According to Moxon (1702:85) a mortise should be one-fourth as wide as the width of the member (Moxon 1702:85).

No framing timbers were recovered from Building 3 but there is a historical deed detailing the construction of a house by a Robert Snead, an architect of Port Royal in 1684 (Pawson and Buisseret 1975:88). In the deed, the following dimensions are given for framing:

and that the gerders of the first floor shall be twelve inches and thirteen, and the joists shall be six inches and three and framed at fifteen inches distance, and that the principal rafters shall be no less than nine inches and six at the bottom and six inches square at the top. The purloines to be six
and eight inches, wall-plates the same, and that the beams of the upper floor shall be ten and nine, the joists four and three inches at fourteen inches distance. (Pawson and Buisseret 1975:88).

It would be erroneous to assume that these measurements were consistently used by all carpenters for building different houses. Moxon gives slightly different measurements for framing proportions.

Walls

No sections of wall, other than a single fragment of wall sill, were found in place. Any wall fall appears to have been displaced, probably by tidal action in the harbor. The size of the wall sill, as indicated by the width of the sill impression in the poured mortar foundation, suggests that Building 3 was a single story structure, with a half story in the roof area. Moxon states that the corner posts, or "principal" posts, should be of one piece and should be "so long as to reach up to the beam of the roof, or Raising plate," and that this member should measure "8 inches broad; and 6 inches thick" (Moxon 1702:133).

Brick nogging, or wattle and daub infill, may have been used because of the abundant supply of bricks available and brick nogging was commonly used as wall fill in England since medieval times. One timber-framed house
in Lutterworth had the date 1695 scratched into one of the infill bricks (Brunskill 1987:70). However, in the area of Building 3, it is probable that no infill was used because the Caribbean climate does not require wall insulation as do cooler climates. Exposed half-timber buildings with infill walls are present in England but for the New World it was common to protect such walls with an exterior covering of clapboards (Morrison 1952:30).

It is not known at this time if Port Royal had its own fire laws. It would seem that in a town with such a high density of buildings there would be at least some type of fire regulations dictating wall thickness. It is probable that if Port Royal did have some type of fire code it would be similar to those used in London at the same time. As seen in the site map (see Figure 21), the Port Royal buildings that have been uncovered are close together, wasting no space.

**Cellars**

Throughout the literature are various references to cellars being present in Port Royal (Pawson and Buisseret 1975; Taylor 1688). Historical inventories clearly show that the areas under stair wells were called cellars. Given the composition of the sandy soil and the high water table present at Port Royal, it is impossible for true cellars to have been constructed.
Chimneys and Cookrooms

John Taylor wrote in his travel log that "here they need not feare paieing hearth mony, for they build noe chimneys, but only in their cookrooms, which stand at some distance from their houses" (Taylor 1688:252). There are many examples in the literature which corroborate John Taylor's statement. On one house plot called "Corker's house," there is mention of an oven erected in the northeast corner of the land plot, measuring five square feet (Pawson and Buisseret 1975:87). This oven is mentioned in several other transactions concerning the property and was probably of some commercial significance.

In 1682, a plot belonging to John Mann, the Surveyor-General, contained a shop "whereof containeth 25 feet in length and 19 feet in breadth, together with the dinning-room and other rooms over the same, being of the like dimensions, and the storehouse thereto adjoining containing 19 feet square and also a kitchen" (Pawson and Buisseret 1975:87). This passage might indicate that there was a distinction between the cook room, where a fireplace was located, and the kitchen, where meals were prepared after being cooked.

Buildings 4, 5, and 6 contained hearth features in the yard areas behind the main house structures. In the case of Building 5, the hearth was originally placed behind the building, then connected to the main building
in a subsequent building phase with an intervening wall. The area behind Buildings 1 and 2 was not excavated so there is no information on the presence or absence of hearth features being associated with them. Brick rubble associated with Building 3 may represent the remains of a hearth feature.

The buildings in Port Royal had no need of a chimney, for heating was totally unnecessary in the warm tropical climate. The problem was eliminating heat from the buildings, therefore the hearths were commonly placed outside and behind them. Both the historical and archaeological evidence indicates that in most cases cooking was done outside in a separate building. It is almost a certainty that the buildings of Port Royal had no internal fireplaces. None, to date, have been found archaeologically, either on land or under water.

Cisterns

Pawson and Buisseret state that when references are made to "well" in historical documentation, what is really being referred to is cisterns (Pawson and Buisseret 1975:94). One cistern was uncovered behind Building 5. None were discovered near Building 3, but again, no excavations were conducted behind the structure because of extreme slumping and depth of overburden.
Yards

The excavations at Port Royal have uncovered large yard areas behind Buildings 4, 5, 6, and 7. These yards were usually paved with bricks in a straight common bond brick pattern or in an irregular pattern. The exception is one-half of Yard 5 which is skewed 45 degrees making a triangular configuration. The brick pattern was elaborate with a single line of bricks going from one corner of the yard diagonally to the opposite end. Bricks were then laid perpendicular to the north wall of the yard. On the bottom half of the diagonal the bricks were laid perpendicular to the diagonal line of bricks.

Moxon states that "Holland" sized bricks are used for paving and that a herring bone brick pattern looks good (Moxon 1702:240). Yard 4A contained "Dutch" brick. It is speculative whether the back area of Building 3 represents a small enclosed yard with a hearth.

Windows

Taylor's travel log refers to the sash windows of Port Royal (Taylor 1688:252). However the term "sash" may refer to another type of window which used lead instead of wood. Archaeologically only lead casement windows have been found (Plate 1). The form of these lead casement windows appears to have been both the diamond shaped and square pained glass frames. Some glass has been found in
Plate 1: Window Recovered From Port Royal.
association with the lead casements, but it was of such a poor quality that 300 years of being submerged in saltwater left it in a very fragile condition. No stamped dates were found on any of the lead fragments.

Doors and Doorways

Several door sills and door jams has been uncovered at Port Royal. Doors probably consisted of the vertical batten form. Door sills measured about four feet wide and were joined to the door jams by mortise and tenon joints (Plate 2). Pawson and Buisseret (1975:88) quote Snead’s description of a door with a width measurement of five feet; however, of 10 intact door sills recovered at Port Royal none were more than 3.5 feet wide. A door recovered from Building 1 was constructed from Jamaican boxwood and the door frames were made of oak.

Stairs

Buildings 1 and 5 contain the remains of stairwells. The brick patterning is different and pieces of wood define the area. Since historical documentation indicates that many of the buildings of Port Royal were multi-story, and since land space was at a premium, it is not surprising that we should find a stair feature in at least two of the buildings. Building 3 contained no real evidence of a stairwell; however, access to the
Plate 2: Door Sill Recovered From Port Royal.
upper story may have been gained through the use of a ladder and not a staircase.

**Woods Used in Construction**

In the description of work to be done for Robert Snead, we are given a list of the various woods used in Port Royal to build houses (Pawson and Buisseret 1975:89). Mahogany, cedar, bullett tree, yellow saunder, blackhearted fiddle wood, base terre, lignum vitae, fustick, and logwood are some of the woods mentioned. The excavations at Port Royal have uncovered lignum vitae, oak, pine, cedar, mahogany, and Jamaican boxwood. Snead's description goes on to state that more than just one type of wood may be used throughout the construction of a building.

**Roofing**

Roofing materials found at Port Royal include red ceramic roof tiles, wooden roof shingles, and slate shingles. It is probable that the slate shingles came from the Old Naval Hospital located near the site. Only wooden shingles were recovered from Building 3, except at the back where a few square clay tiles were found.
Building 3 Summary

Building 3 was a five room, 1-1/2 story, braced frame house. It had an interrupted sill pressed into a poured mortar footing, a wooden shingle roof, clapboard siding, lead casement windows, and no chimney. Corner posts were placed on wooden plates, not blocks, set at ground level. The excavations conducted at Port Royal offer an excellent data set to reconstruct a building destroyed by an earthquake and submerged for three hundred years.

Building 3 also represents a third-stage settlement structure which used impermanent building techniques. This structure stands out because it is located in an area of more substantially permanent brick buildings.

CAD Reconstruction of Building 3

Building 3 at Port Royal was recorded in plan view and it is from this two-dimensional drawing that a three-dimensional drawing was created. The initial strategy was to digitize the plan drawing which would show the basic outline of Building 3 (Figure 23). Digitizing creates a sketch line which is composed of many small lines each representing a single separate entity. This tends to consume a great deal of memory. Instead, the digitized lines should be drawn with polylines. This is achieved by typing the SETVAR command, entering SKPOLY and typing "1" to activate the function. This will draw the image with
Figure 23: Digitized Drawing of Building 3 Foundation.
polylines instead of sketched lines. If sketched lines have already been drawn, they can be converted to polylines by using the PEDIT command. The digitized sketch lines can be joined and converted into a polyline that is a single entity. Polylines are easier to manipulate and require less memory. The entire digitized outline is placed in the layer "PLAN."

The digitized outline of Building 3 was placed at 0 elevation with all other drawn entities having a positive Z value. For other drawings with significant subsurface features, the 0 elevation may be set with the historic ground surface if it is known. All subsurface features would then have a negative Z value and all surface features would have a positive Z value. This is helpful when selecting between surface and subsurface entities.

The two-dimensional plan of Building 3 was then converted into a three-dimensional entity by use of the "COPY" and "RULESURF" commands. The plan represents the bottom of the poured foundation. The top of the foundation is created by making a copy of the original plan six inches directly above itself. As mentioned earlier, the "RULESURF" command creates a polygon mesh between the two curves (the polylines) and joins them into a single entity. The polygon mesh is defined by presetting surface tabulations. This allows the user to
control the amount of definition which each entity requires (Figure 24).

At this point it became evident that the initial strategy for reconstructing Building 3 was inefficient. The complexity of the drawing was making it too time consuming to regenerate and hide lines effectively. The problem was due to the numerous entities which were created by ruled surfaces. In order to simplify the drawing and reduce regeneration time the ruled surfaces were replaced with three-dimensional boxes (Figure 25). This decision replaced the definition of a digitized image with the easy use of a three-dimensional entity. If a drawing requires a high degree of accuracy, digitizing is still the most effective method; however, if the accuracy will not be significantly reduced, three-dimensional entities are more efficient to use.

The poured mortar footing of Building 3 probably experienced shifting and breakage causing it to appear uneven. It is assumed that the builders of the time tried to keep framing timbers as square as possible and that the foundation would also be square. This was another reason for replacing the digitized plan with a squared off and standardized footing.

Once the foundation was completed, the wooden corner plates were created. Their position was to be measured from the original drawing. Since these were relatively
Figure 24: Foundation Created With Ruled Surface.
Figure 25: Foundation Created With Three-Dimensional Boxes.
basic elements it was easier to draw them from the map instead of digitizing. The corner plates were placed in a separate layer "WPLATES."

The framing was also given its own layers so that it could be turned on and off when needed. The length of the corner posts was set at 11 feet so as to give a room height of around 10 feet based on the historical documentation (Carson 1981; Moxon 1702). The roof structure was based on Robert Snead's description since no roofing timbers were recovered (Pawson and Buisseret 1975:89). Each member was drawn once, copied, and then placed in its proper orientation (Figure 26).

The roofing of Building 3 was drawn using a hatch pattern. AutoCAD has many different preprogrammed patterns available, but users can also define their own if necessary. Care must be taken when employing hatch patterns because they can utilize large amounts of memory. To use a hatch pattern the area to be hatched is defined by drawing a three-dimensional plane. The selected pattern is then drawn over the plane at the appropriate scale.

The clapboard siding was created by drawing three-dimensional faces which were placed over the framing. Only two had to be drawn, one for the length and one for the width, and these were copied and placed in position.
Figure 26: AutoCAD Drawing of Framing and Roofing.
The windows and doors of Building 3 are based on examples recovered from Port Royal (see Plates 1 and 2). Since they were positioned over the clapboards they would cover the lines of the three-dimensional faces. If it was later discovered that sash windows were used, it would easy to change them and replot the drawing without having to start over.

Uniform entities which are constantly being repeated (such as bricks, nails, etc.) can be saved as a block which may be accessed again and again, from drawing to drawing. This was used for the brick flooring in the middle back room of Building 3 (Figure 27). When inserting blocks, AutoCAD automatically asks if you want to rotate the block for a different orientation. This is the main advantage of inserting blocks instead of using the copy command. Blocks may also contain hidden attributes which help define what they are. Type, date, and maker could all be attributes defined for a brick entity which was saved as a block.

Dimensions are also given their own layer so they may be turned off when not desired. Everything drawn in AutoCAD can be measured, from the largest summer beam, down to the smallest finishing nail (Figure 28). Because of this control, drawings are always to the proper scale and proportion.
Figure 27: Brick Flooring of Building 3.
Figure 28: Drawing of Building 3 with Dimensions Layer Turned On.
The reconstruction of Building 3 was by far the most complex because it was larger and involved more sophisticated carpentry methods. However, it is an excellent example of how an AutoCAD drawing can combine complex architectural information and display it in a variety of ways, both quickly and easily (Figures 29-31).
Figure 29; View 1 of Building 3.
Figure 30: View 2 of Building 3.
Figure 31: Window and Door Features of Building 3.
CHAPTER IX

EVALUATION OF COMPUTER RECONSTRUCTIONS

The process of reconstructing the three buildings was similar to building them. Each one had to be built from the ground up. Before the roof could be put on the walls had to go up. Before the walls could go up, the footings had to be done. The location of doorways and windows were determined by the placement of structural members. The computer allows a researcher to construct a 17th century dwelling without having to physically build it.

The process of building scale models is common in house and ship reconstructions but it is a time consuming and costly practice. The computer saves time because no actual building is required. The computer can also save money because it can do multiple reconstructions without the purchase of any additional material. Errors in building scale models cost time and materials, but errors in a computer reconstruction only cost time and additional paper. An advantage of building scale models over CAD models, suggested by Richard Steffy, is that they provide tension and application information that can not be duplicated on a computer except with only very expensive custom-designed mainframe programs.

Each of the examples required about 20 to 30 hours of computer time. The reconstruction of Building 3 required the most time because it was the most complex structure
and it was the first attempted. Many mistakes were made and as the work progressed, shortcuts and easier ways of manipulating the data were found. The replacement of ruled surfaces with three-dimensional boxes and faces is one example of a timesaving measure that was found through the process of trial and error.

Problems that arose were mainly due to the type of computer AutoCAD was run on. The 8086 microprocessor and the 640K of RAM was not adequate to handle each of the drawings as they became more complex. The time required to print each drawing became longer and longer as the computer had to calculate for more and more entities. The final plot of Building 3 took three and a half hours. The amount of detail that could go into each drawing was not included because of these considerations. However, with an upgraded system, all of these problems can be overcome.

AutoCAD does have difficulty drawing and editing complex curved lines. CAD is much more effective with straight linear features. Editing curved lines is not impossible, but an experienced draftsman can hand draw complex curves easier.

Data that can be easily extracted and manipulated is the greatest advantage of a CAD drawing. Provenience, artifact type, material type, specimen number, and date are a few examples of the data attributes that can be assigned to a drawn entity. This information can be
extracted and imported into a database program for manipulation. Figure 32 demonstrates how data attributes that were incorporated into the CAD drawing of the Mareen Duvall dwelling are extracted and analyzed by a database program. The database file (see Figure 4) was opened into Excel 4.0, a spreadsheet program and charts were created without having to enter the raw data by hand more than once. In terms of invested resources and social cultural complexity, a future application of this method is to assign price values to each element of a structure, extract those values, and determine the overall cost of construction. The use of a computer makes such tasks much more feasible.

The advantages of CAD drawings over conventional hand-drafted ones is quite obvious. As Table 3 demonstrates, a CAD drawing offers a wide range of functions which hand drafted drawing do not have. As the availability of more sophisticated computer systems and software increases, CAD drawings will become the standard for recording, manipulating, and displaying graphic information.
Figure 32: Manipulated Data Extracted From AutoCAD Drawing of Mareen Duvall's House.
TABLE 3: CAD Versus Hand-drafted Drawings

<table>
<thead>
<tr>
<th>AutoCAD</th>
<th>Hand-drafting</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Fast and easy to edit</td>
<td>Slow and difficult to edit</td>
</tr>
<tr>
<td>✓ Stores attribute data</td>
<td>Does not store attribute data</td>
</tr>
<tr>
<td>✓ Multiple Views</td>
<td>Single View</td>
</tr>
<tr>
<td>✓ High start-up costs of equipment</td>
<td>✓ Low start-up costs of equipment</td>
</tr>
<tr>
<td>✓ Multiple scales possible</td>
<td>Single scale possible</td>
</tr>
<tr>
<td>✓ True three-dimensional drawings possible</td>
<td>Only isometric views possible</td>
</tr>
<tr>
<td>✓ Interfaces with high-accuracy recording equipment</td>
<td>Can not interface with high-accuracy recording equipment</td>
</tr>
<tr>
<td>✓ Easy to reproduce large scale maps</td>
<td>Difficult to reproduce large scale maps</td>
</tr>
<tr>
<td>✓ Requires computer-drafting skills</td>
<td>✓ Requires hand-drafting skills</td>
</tr>
<tr>
<td>✓ Large scale drawings can contain minute details</td>
<td>Large scale drawings only contain major details</td>
</tr>
<tr>
<td>✓ Multiple drawing layers</td>
<td>Single drawing layer</td>
</tr>
<tr>
<td>✓ Quickly copies identical entities</td>
<td>Each identical entity drawn individually</td>
</tr>
<tr>
<td></td>
<td>✓ Easier to draw complex curves</td>
</tr>
<tr>
<td>✓ Difficult to draw complex curves</td>
<td>False perspective views</td>
</tr>
<tr>
<td>✓ True perspective views</td>
<td></td>
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</table>
CHAPTER X
CONCLUSIONS

In closing, the gap between manipulation of raw archaeological data and the sometimes subjective interpretation of that data can be bridged much easier as technology improves the tools that archaeologists use to record, manipulate, and display information. The methods and techniques discussed here are an attempt to improve the way archaeologists gather and display their data.

As more historical archaeological sites are recorded and excavated, the need to reconstruct impermanent buildings becomes greater. Impermanent building techniques are one of the predominant forms of architecture utilized by colonists in the 17th and 18th centuries. Because of its very nature of impermanence, a significant section of the historical archaeological record is hidden. Carson estimates that there are only six surviving examples of 17th-century buildings still standing in the area that was the Chesapeake colonies, one of the more populated areas at that time (Carson 1981:135). A basic knowledge of its forms and functions is necessary to properly interpret many historical sites.

Models that help to recreate impermanent dwellings are an essential part in understanding the past lifeways of European colonists who settled the New World. However, archaeologists must also look into why a structure was
built and what factors determined its form. It has been shown through historical documentation and through the buildings themselves that settlement and the building of shelter in the American colonies were based on an economic strategy as well as an aesthetic one.

It has also been shown that architecture is related to a stage of settlement which reflects a continuum of social cultural complexity. A building's form is too complex to be placed into a definite category, and instead must be graded. Rarely does a form fit perfectly into a frontier, plantation, or urban settlement stage, but many times it will fit in between the stages. Littletown Tenement is an example of a frontier-plantation transitional form (Kelso 1984:59-65).

AutoCAD is a valuable tool which can record and display complex archaeological data. Because it can be used to reconstruct impermanent historical structures, new insights can be gained from the archaeological record. Previous reconstructions have always been adequate, but this new technology enables researchers to construct models which are more accurate, more realistic, and contain real data that can be extracted and manipulated.

The Howell Homestead computer drawing highlighted the cellar as a major architectural feature which had been lost in the plan drawing and the traditional artist's reconstruction. The data recorded at Middle Plantation
could have been manipulated much further if it had been recorded with a CAD system. The Port Royal Project has shown how AutoCAD can be used to its fullest and is an integral part of any data recovery project. These three examples show that by combining a knowledge of impermanent building techniques, historical documentation, archaeological data, and a computer aided design package, the past can be analyzed more thoroughly.

Methods of reconstructing impermanent dwellings are not limited to applications of 17th- and 18th-century English architecture, but to any type of impermanent structure or device. Prehistoric sites, shipwrecks, and historic machinery are all areas where computer recording and reconstruction are applicable.

The frontier of computer technology is quickly expanding as new hardware and software become available. Virtual reality, artificial intelligence, and computer animation represents the next generation of diagnostic tools which archaeologists will use to help discover the buried past.
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