EXPLORING THE UTILITY OF BIM IN BUILDINGS ARCHAEOLOGY: A CASE STUDY AT THE HISTORIC BRIGGS HOUSE, SPRINGFIELD, OREGON

by

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TERMINAL PROJECT ABSTRACT

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Title: Exploring the Utility Of BIM in Buildings Archaeology: A Case Study at the Historic Briggs House, Springfield, Oregon

The objective of this project was to investigate the utility of Buildings Information Modeling (BIM) in a Buildings Archaeology approach to the study of the box-constructed first build (c. 1872) and stud-wall framed second build (c. 1892) of the Briggs House in Springfield, Oregon. The use of BIM software *ArchiCAD* was tested as an aid to the exploration and recordation of structural elements discovered through direct study of the house. The software was found to be highly useful in the coordination and consolidation of building information as it is collected from the field, and for the digital extrapolation from this collected information in the creation of a completed model. The product of this work is a concise, complete, and accurate digital model which may be used for the subsequent production of 2D, 3D, and 4D interpretive materials.

ACKNOWLEDGEMENTS

This Terminal Project is the culmination of innumerable hours spent in research and discovery, modeling and production, and discussion and review with peers, colleagues, and advisors over the past year, and the conclusion of six academic quarters of study in the Historic Preservation Program at the University of Oregon. There are a great many who have helped me in ways large and small over the course of this program, and to them I owe a debt of gratitude.

First and foremost I extend my sincerest thanks to my patient and encouraging project committee. My chair, Dr. Rick Minor, helpfully endured the discomfort of field work with camera and suggestions at the ready, and artfully edited my topical meanderings from the project as it evolved. Liz Carter's familiarity with the subject property was enormously helpful in clarifying the direction my questions should take, and in offering guiding riposte to my earliest answers. Their interest in and dedication to this undertaking has been of immeasurable service to the success of the project. I thank them both for their guidance in creating a project far stronger than that I could have crafted alone.

Further deserving of my gratitude are my teachers and peers in the Historic Preservation Program at the University of Oregon. Dr. Kingston Heath, Director, has been continually and thoughtfully supportive and encouraging of my various projects undertaken

during my tenure with the program. Further, I have benefitted greatly through exposure to the unguarded optimism and contagious enthusiasm of my colleagues, and owe an extra measure of thanks to Lauren Rieke and John Hill for their time spent in and under the Briggs House, working under suboptimal thermal conditions, helping me greatly with the direct data collection portion of this study.

Further thanks are due Damon Crume and Willamalane Park and Recreation District for kindly allowing my repeated access to the Briggs House for this study. Without this permission and trust, this project would not have been possible.

This project was supported in part by a grant from Heritage Research Associates, for which I am enormously grateful. The laptop computer used extensively in the production of the model and this paper was purchased in part with funds from this grant. Further, as this project builds directly on a previous study, my thanks extend further to its financial supporters. Partial funding for the study of the Briggs House in 2010 was provided by a small grant from Willamalane and a similar grant from Heritage Research Associates. The bulk of the work effort was performed by unfunded volunteers from the Historic Preservation Program at the University of Oregon led by Liz Carter, to whom I am indeed grateful.

Finally, a special thanks is due my wife Emily for her immense patience and enduring support; of those who worked with me on this project, it was only she who has the dubious distinction of working directly with me on my next project.

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CHAPTER I

INTRODUCTION

Historic Preservationists today work in an era of rapid technological change. Many tools and techniques that are now available to aid in the research and recordation of buildings were not in existence when Historic Preservation first emerged as a formal discipline. This study explores the utility of an evolving technological tool and a borrowed methodology in asking the question: how can 3D digital emulation be useful in a Buildings Archaeology approach to the study of historic buildings? This question itself is comprised of perhaps unfamiliar concepts. First of all, what is meant by *3D digital emulation*? Second, what is meant by *Buildings Archaeology*? These questions are addressed below and are explored in greater detail throughout the course of this study through the investigation of a case study, the historic Briggs House in Springfield, Oregon.

3D Digital Emulation

Not long ago the only way to build a model of a building was to use actual materials such as cardboard and basswood and glue, a time-consuming, expensive, and challenging process, and therefore not one undertaken lightly. However, today it is possible to construct a 3D digital emulation of a building relatively quickly, cheaply, and easily. A multiplicity of specialized computer graphics packages are commercially available, designed variously for the specific use of the entertainment industry, medicine,

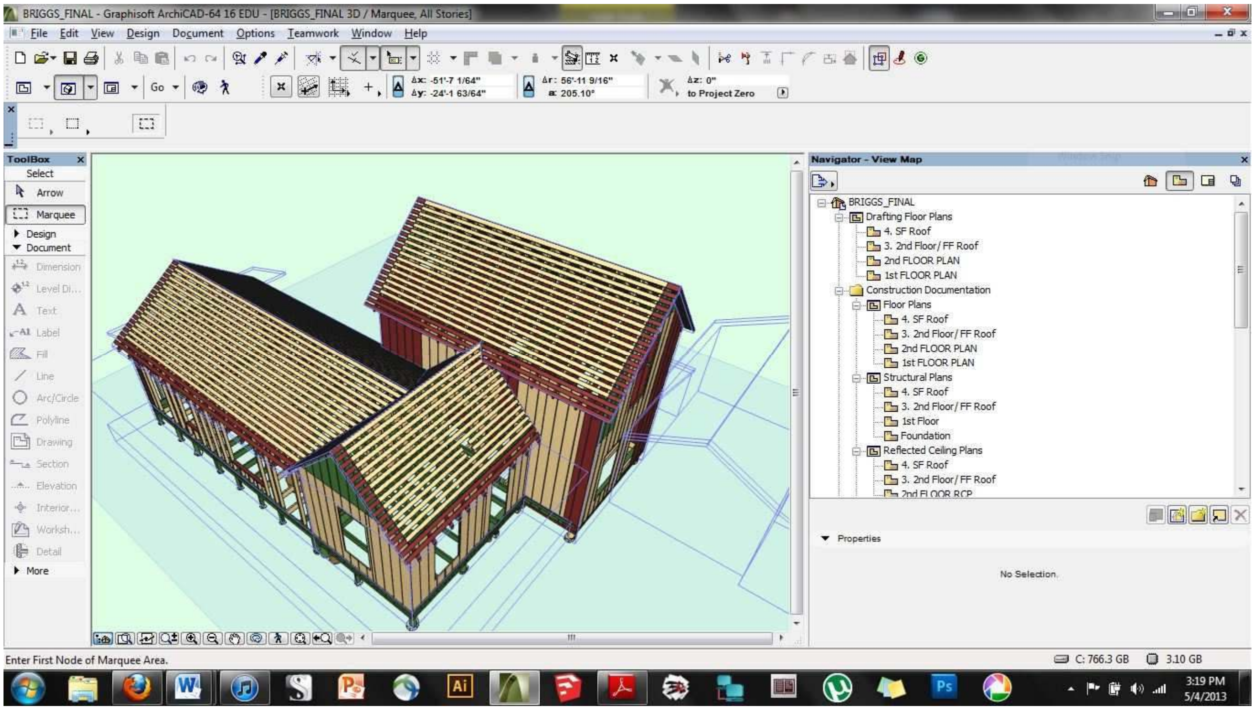

Figure 1.1. BIM interface.

engineering, and architecture, among others. In this case study, the class of software used in building design known as Building Information Modeling (BIM) software is explored for its use in the detailed investigation and documentation of historic buildings.

BIM[1] was first developed in the 1980s as a design tool for use by the Architecture, Engineering, and Construction (AEC) industries.[2] In some respects, BIM is similar to the now-familiar 2D Computer-Aided Design (CAD) software packages that have been in common usage for the past three decades in the AEC industries.[3] The user interface (keyboard, monitor, and mouse), hierarchical organization of visual information (into

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[1] Note that in common usage the acronym “BIM” is used for both the process of “Building Information *Modeling*” and the “Building Information *Model*” itself, as well as shorthand for “BIM software.”

[2] Erika Epstein, *Implementing Successful Building Information Modeling* (Boston: Artech House, 2012), 11.

[3] Blane E. Cliver et al., “"HABS/HAER at the Millennium: Advancing Architectural and Engineering Documentation," *APT Bulletin.* 29, no. 4:33.

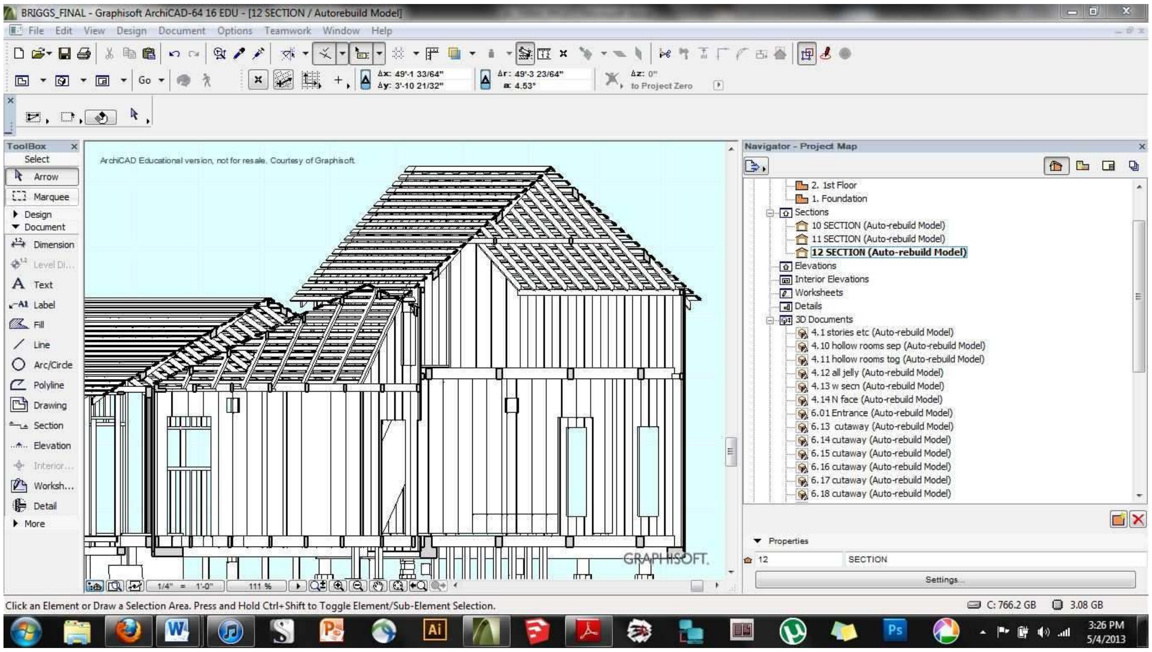

Figure 1.2. 2D cutaway projection created directly from BIM model.

nested layers, groups, and combinations thereof), and graphical software conventions (such as drop-down menus, scroll bars, and tool buttons) are all familiar concepts to even the casual user of CAD, and are functionally similar in BIM.

However, unlike 2D CAD, in which a user describes a real-world three-dimensional object with multiple 2D drawings, with BIM the user directly constructs a 3D digital model, and from this model produces 2D projections by way of description.[4] In addition, BIM is unlike other 3D modeling software with which individuals working in AEC may be familiar (such as *SketchUp*) in that virtual "objects" modeled with BIM are parametrically defined.[5] That is, they are described by and retain information about themselves, such as their geometry, their spatial relationships to other objects, and other attributes such as assigned

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[4] Epstein, *Implementing Successful Building Information Modeling*, 16.

[5] Charles M. Eastman, *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors* (Hoboken, NJ: Wiley, 2011), 19.

physical properties or descriptive information.[6] BIM is used "to create a single virtual model of the geometry of a building that is a visual representation of an intrinsic database containing information about construction materials and assemblies, as well as spaces and areas within the building."[7] Given its content-rich nature, this virtual model is used is often used by multiple professions over the course of the project life-cycle, facilitating not only design, as does traditional CAD, but also construction management and even building operation.[8] However, as recently as 2011 it was written, "…BIM is still a novel technology and…now is an appropriate time to investigate BIM and its applicability to heritage documentation. Despite a trend to adopt BIM for the design and life-cycle management of new buildings, very little research has been undertaken to explore the value of BIM in the documentation and management of heritage buildings and cultural landscapes."[9]

Further, "BIM is not just a technology change, but a process change."[10] Accordingly, the goal of this study is not to simply demonstrate the capacity of BIM to create familiar output. Rather, it is to test the use of building emulation as a field instrument for the focused investigation and documentation of historic buildings. This use of BIM as a process tool will be considered in three primary modes.

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[6] Eastman , *BIM Handbook* ,VII.

[7] D.M. Foxe, "Building Information Modeling Constructing the Past and Future," *APT Bulletin* 41, no. 4 (2010): 40.

[8] Epstein, *Implementing Successful Building Information Modeling,* 16.

[9] Stephen Fai et al., "Building Information Modeling and Heritage Documentation," in *Proceedings of the XXIIIrd International CIPA Symposium,* ed. Karel Pavelka (Prague: Czech Technical University in Prague, 2011), 2.

[10] Eastman , *BIM Handbook* , VII.

Figure 1.3. BIM rendering of the Briggs House.

First, due to the object-based information storage, BIM has the capacity to readily consolidate information about the building being studied (in contrast to the multiple 2D sketches required to adequately describe 3D forms). Second, through the use of an evolving "sketch model," BIM allows the user to monitor the completeness of data collection during a field investigation in real-time, rather than relying on the serial translation of field notes into 2D drafts to detect omissions. As D.M. Foxe points out, "it is a logical extension of our technologies to use them to encapsulate and unify an ever-widening scope of partial representations.[11] Third, BIM offers the user the opportunity for rapid comparison of the model to the resource from multiple viewpoints, rather than working with single, unlinked,

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[11] Foxe, 39.

2D projections.[12] As Autodesk summarizes, "a parametric building model combines a design model (geometry and data) with a behavioral model (change management). The entire building model and complete set of design documents is in an integrated database, where everything is parametric and everything is interconnected."[13] The result of this process is a concise, complete, and accurate model.

To summarize, while 3D digital emulation using BIM does have the capability of producing familiar and traditional 2D output, more importantly it offers the user a strong system for organizing data collection from the resource itself, which enhances both user understanding and thoroughness of documentation. This present study demonstrates the utility of BIM through a Buildings Archaeology approach to the investigation of an historic building, the Briggs House in Springfield, Oregon.

Buildings Archaeology

Buildings Archaeology is the application of an archaeological approach to the study of standing structures. According to Richard K. Morriss, Buildings Archaeology is both a *science*, in that it demands objective observation and accurate recordation of artifacts, as well as a *social science*, in that its subject matter—buildings—are a product of people and their environment.[14] Buildings Archaeology requires rigor in direct observation and recordation of the physical remains of structures, and demands high standards for analysis and interpretation of these artifacts.

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[12] Eastman, *BIM Handbook* , 21.

[13] Autodesk, Inc. "Parametric Building Modeling: BIM's Foundation." *Revit Building Information Modeling.* Internet. Available at http://www.consortech.com/bim2/documents/bim_parametric_building_modeling_EN.pdf (accessed 1 February, 2013), 4.

[14] Richard K. Morris, *The Archaeology of Buildings* (Stroud, Gloucs: Tempus, 2000), preface.

Although they do not use the term themselves, Gabrielle Lanier and Bernard Herman effectively define "Buildings Archaeology" when they wrote that in using an archaeological approach, "buildings are viewed, not just as examples of a particular style or time period, but as above-ground archaeological sites, each building expressing its own sequence of historical changes."[15] Lanier and Herman add that "evaluating a building archaeologically involves 'excavating' the structure as if it were an archaeological site: peeling back its layers of occupation and use, assembling the traces of change into some sort of logical sequence, and interpreting or 'reading' the evidence."[16] Simply stated, the objective of Buildings Archaeology is "to understand the way buildings were built, and how they subsequently have changed."[17]

One of the first archaeologists to explore and develop methods for an archaeological analysis and interpretation of extant historic buildings was Peter Coutts. Writing in *World Archaeology* in 1977, he disparagingly described the methods of recordation employed by historians as "basic," including, at best, "undisciplined photography" and "sketchy architectural drawings." Coutts further noted that the methods used by historians "still concentrate on the aesthetic and stylistic aspects to the exclusion of others."[18]

However, there are excellent examples of architectural studies of historical buildings by historians. The seminal work by Henry Glassie, *Folk Housing in Middle Virginia*, Abbott Lowell Cummings' *The Framed Houses of Massachusetts Bay* (1979), Lanier and

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[15] Gabrielle M. Lanier and Bernard L. Herman, *Everyday Architecture of the Mid-Atlantic: Looking at Buildings and Landscapes* (Baltimore: Johns Hopkins University Press, 1997), 2.

[16] Lanier and Herman, *Everyday Architecture of the Mid-Atlantic*, 2.

[17] Morris, *The Archaeology of Buildings*, preface.

[18] Peter Coutts, "Old Buildings Tell Tales," *World Archaeology* 9, no. 2 (1977):198.

Figure 1.4. Investigating layers at the Briggs House.

Herman's *Everyday Architecture of the Mid-Atlantic* (1997), and *A Building History of Northern New England* (2001) by James Garvin are four stellar examples of works that investigate, at multiple levels, how buildings were built and have changed over time. Garvin speaks directly to the importance of deeply understanding buildings and how they have changed over time: "it is impossible to date a building, to evaluate its significance in relationship to other structures…without understanding its mute but eloquent language."[19]

Most archaeologists consider the study of historic buildings outside their area of expertise. Dan Hicks and Audrey Horning write in *The Cambridge Companion to Historical*

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[19] James L. Garvin, *A Building History Northern New England* (Hanover: University Press New England, 2001), vii.

Archaeology that “for many [historical archaeologists] studying the historical built environment is the field of architectural and art historians, historical geographers or local historians,” and for that reason “the study of buildings is virtually invisible in some overviews of historical archaeology.”[20] Hicks and Horning proceed to argue that “built structures represent a highly significant part of the material remains of the past five hundred years, the study of which deserves to be integrated with the analysis of sites, artefacts, and landscapes.”[21]

To again quote from Lanier and Herman, “while traditional historic research utilizes [documentation], an archaeological approach…begins with the building itself as the primary research source.”[22] In 2009, the journal *World Archaeology* devoted an entire issue to the archaeology of buildings. In the introduction to this issue, Andrew Reynolds noted that there is today a “remarkably pervasive” distinction made between the remains of the past that are above and below ground.[23] In an effort to address this distinction, Reynolds concluded that “the intention of [this issue is] to foster cross-fertilization, especially in view of the divergent traditions that exist in ‘world archaeology’ with regards to modes of recording and interpretation of structural remains.”[24]

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[20] Dan Hicks and Audrey Horning, “Historical Archaeology and Buildings,” in *The Cambridge Companion to Historical Archaeology*, eds. Dan Hicks and Mary Carolyn Beaudry (Cambridge, UK: Cambridge University Press, 2006):273.

[21] Hicks and Horning, 273.

[22] Lanier and Herman, *Everyday Architecture of the Mid-Atlantic*, 2.

[23] Andrew Reynolds, "The Archaeology of Buildings: Introduction," *World Archaeology.* 41, no. 3 (2009): 345.

[24] Reynolds, 347.

Figure 1.5. Brick chimney foundation built up on base of boulders.

Martin Davies, in an article published in the *Australian Journal of Historical Archaeology,* emphasizes the central importance of determining a structure's evolutionary sequence. Davies further suggests that this undertaking is directly comparable to the task of identifying the stratigraphic sequence in an archaeological excavation. The analogy is drawn still tighter as Davies moves on to describe the development of a system of building recordation, and to demonstrate the modification and application of an analytical tool used in traditional (below-ground) archaeology known as a Harris Matrix to the analysis of standing structures.[25]

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[25] Martin Davies, "The Archaeology of Standing Structures," *Australian Journal Historical Archaeology* 5 (1987):54.

An excellent example of the Buildings Archaeology approach was carried out at the historic Robinson House on the Manassas National Battlefield in Virginia. Led by Kenneth Sandri of the Williamsport Preservation Training Center (now the Historic Preservation Training Center), this project was undertaken to collect information about the physical history of the Robinson House, and "correlate it with documentation and historical information previously gathered" and to "determine (its) physical history and construction chronology."[26] The house, damaged by fire, was deemed unsafe. It was decided that the building should be removed, and the investigation took the opportunity to document the entire building, stick by stick, as it was disassembled. While this study was termed an "architectural fabric investigation," the approach is very much one of Buildings Archaeology.

Selection of Case Study

The historic building chosen for exploration in this study was the Reynold and Eva Briggs House in Springfield, Oregon. A key feature of this building that led to its selection is that some structural elements are exposed, visible in areas of the structure beyond the crawlspace and attic, which allowed for discrete components to be observed at multiple locations throughout the house. Structural components are visible in historic buildings to varying degrees. When structural components are visible, opportunities are available to test the use of digital modeling in a non-destructive investigation.

Work undertaken during this study builds directly on a previous report on the

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[26] Kenneth Sandri, *Architectural Fabric Investigation and Documentation of the Robinson House* (Williamsport Preservation Training Center, Williamsport, Maryland, 1994), 1.

Figure 1.6. Direct entry of data at the Southwest face of the Briggs House.

Briggs House by Liz Carter.[27] Carried out in 2010, this project employed a traditional (non-digital) investigative approach. Minimally invasive subsurface explorations of the underlying building fabric were undertaken at several locations in the house. The overall form of the house presents opportunities to explore structural adjacencies, as it was constructed in multiple phases over many years, involving different construction types. These several phases of construction present multiple intersections which lend themselves well to an exploration of digital modeling and analysis. Overall, the previous study of the Briggs House makes for an excellent baseline against which to compare new information collected with the help of BIM.

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[27] Liz Carter, ed., "Briggs House: Final Project Report and Condition Assessment" (Report, Willamalane Park and Recreation District, 2010).

CHAPTER II

VERTICAL PLANK AND BOX CONSTRUCTION

The Briggs House is an example of box construction, a kind of vertical plank construction, an early type of domestic construction that was recently the subject of a thesis by Shannon Bell.[28] Vertical plank construction is a surprisingly common structural system that was in use beginning in the late 17th-century, and continued regionally as late as the early 20th-century.[29] A variety of names has been historically applied to this construction type, and even today it is variously referred to as consisting of "plank," "plank frame," "vertical plank," "box," "box frame," "box-type," "box and strip," and "single-wall" construction.[30]

However, vertical plank construction is not readily apparent from the exterior of a finished building, as it is usually covered with finish siding on the exterior, and therefore may be commonly overlooked in the surficial assessment of an historic building. Due to this lack of visibility, descriptions of this construction type are underrepresented in the architectural literature, especially considering its importance to early settlement and its prevalence across the American landscape.[31] Indeed, as Walter Nelson poignantly writes, "considering their

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[28] Shannon Bell, "The Preservation of Vertical Plank and Box Constructed Buildings in the Pacific Northwest," Master of Science thesis, University of Oregon, 2006.

[29] Bell, 3.

[30] This Old House Discussions. *"box" type construction?* Internet. Available from https://advice.thisoldhouse.com/showthread.php?t=118988 (accessed 14 February, 2013).

[31] Bell, 2.

age-dimmed origin and proven service to mankind, it is indeed ironic that plank-walled houses have been given such a minor place in architectural literature."[32]

Vertical Plank Construction

Two primary classes of vertical plank buildings are found in the Pacific Northwest: "plank-on-frame" construction and "box construction."[33] Plank-on-frame construction appears to be a more immediate derivative of traditional timber framing technology, as it employs a heavy wood frame assembled with joinery, and is erected as bents. This building type has been found to incorporate the vertical planking in its structural frame to varying degrees.[34] Like the balloon frame or platform frame, vertical plank construction employs relatively small, lightweight, sawn structural elements which are secured to one another with nails (in contrast to heavy timber construction, in which large, heavy, hewn components are held together through complex joinery). In contrast, the box construction building type is more similar in some respects to the familiar wood light frame structural systems commonly used today. Unlike modern framing techniques, in which equally-spaced studs are affixed axially to top and bottom plates to construct a cavity wall, the vertical planks in box construction are affixed laterally to a "cap" and a sill. This solid assembly comprises the entirety of the bearing wall system, and transfers roof and floor loads directly to the foundation.[35] The remainder of this section focuses on the box construction type of vertical plank building, as that system best describes the construction of the Briggs House.

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[32] Walter R. Nelson, "Some Examples of Plank House Construction and Their Origin," *Pioneer America* 1, no. 2 (1969):18.

[33] Bell, 16.

[34] Bell, 17.

[35] Bell, 9.

Box Construction

The vast forests of the Pacific Northwest provided the raw material used by early settlers in the production of sawn lumber, produced by the small scale water-powered mills that by the 1850s had proliferated throughout the region.[36] Such locally milled lumber was used in box construction for nearly all of the smaller structural elements of houses, including the roof rafters, the floor and ceiling joists, and the planks themselves, in addition to their cap.[37] The sills, upon which the floor joists rest and to which the vertical plank walls are affixed, are usually hand-hewn timbers harvested and shaped near the construction site.[38] Other components used in the assembly of the box construction house such as paint, window glass, and nails could be purchased in the small quantities needed from nearby towns or cities.

Bell describes a generalized construction sequence as follows. The only heavy components of the box construction were the sills, felled and hewn on site. These rectangular-section timbers (by definition, no less than 5 inches in their smallest dimensions)[39] were laid horizontally, supported at their ends by low (less than 12 inches high) "rock, brick, or stump round foundation piers."[40] After the sill timbers were all in place, each corner received two vertical boards, nailed to one another and to the sill perimeter. The boards formed a rigid "L-shape" in cross section. The four corners, once erected and secured, received a cap (to support the roof) at the top, and on occasion a ledger

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[36] Thomas R. Cox, *Mills and Markets; A History of the Pacific Coast Lumber Industry to 1900* (Seattle: University of Washington Press, 1974):55-56.

[37] Bell, 10.

[38] Bell, 10.

[39] Bell, 13.

[40] Bell, 13.

(to support a second floor) at an intermediate height. These horizontal members were secured to the inside face of the corner boards with nails. Once this frame was in place, additional boards were nailed in place to the sill and cap, completing the exterior walls of the house. Simple openings for doors and windows were cut directly from the completed walls, and rafters, skip sheathing, and shingle roofing installed contemporaneously with weatherboard siding.[41]

The above construction sequence is understood to serve solely as a general "order of operations" for an idealized box construction, and Bell notes that there are multiple variations on this assembly. Two specific areas of constructional variation found in Pacific Northwest box construction are worth considering in greater detail: the connection of the vertical boards to the sill, and the connection of the vertical boards to one another.[42]

As described by Bell, the box construction board-to-sill connection is found in three configurations. The simplest connection consists of directly face nailing the vertical boards to the sill. A slightly more complicated but stronger connection is created with the addition of a face-nailed ledger board below the vertical boards. The last type of connection described is still more complex, but is considered to be the most efficient and strongest of the three, wherein the sill timber itself is rabbeted along its length to accept the vertical boards, and the nailing serves primarily to secure the boards laterally to the sill. [43] The second mode of affixing planks to the sill in conjunction with a small ledger is the technique employed at the Briggs House.

There are only two known variations for the connection of boards to one another. The

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[41] Bell, 19-21.

[42] Bell, 22.

[43] Bell, 22.

more common variation is simply the absence of any direct connection between adjacent boards. Less frequently found, and only in those instances of plank houses constructed with very thick boards (termed “planks” by common convention, if 2 inches or more in thickness), is the presence of a ½-inch-thick spline inserted into ¾-inch deep dado cuts running the length of the edge of the planks. It is postulated that the presence of these splines increases the rigidity of the plank wall even as it is being erected, and may have allowed for the gable end walls to be constructed as an advancing array of planks and splines, moving from one corner to the next, rather than corner board constructions being put into place first.[44] Either way, there is no evidence of splines or dado cuts between adjacent vertical boards at the Briggs House.

Bell notes that “other variations of box construction include the thickness of the planks, the size and shape of the ledgers, caps, and floor joists, and the number of layers of planks used in the walls.”[45] Bell concludes that “vertical plank and box-constructed buildings come with many structural details that are unique to a particular structure,” and that “ultimately, these buildings must be analyzed on an individual basis, paying careful attention to how elements are attached to the basic structural pieces.”[46] In summary, each box construction house is different and deserving of careful and attentive independent study. The Briggs House, beneath its veneer of modern and inexpensive applied structural siding, is an opportunity worthy of close exploration.

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[44] Bell, 24.

[45] Bell, 24.

[46] Bell, 34-35.

CHAPTER III

THE BRIGGS HOUSE

Dorris Ranch Historic District in Springfield, Oregon, is a National Register-listed property (1988) determined to be of statewide significance under Criterion A for its association with George A. Dorris, who in 1892 purchased the land and within a decade planted one of the first filbert orchards on the West Coast.[47] According to the National Register nomination, the 109 nominated acres include "eight specialized orchard sections, the original service road network, the diversion dam channel, ranch house, freezer house, and two barns."[48] In spite of its relevant location and history, the Briggs House, was "not included in the district boundaries because it was under private ownership at the time of nomination."[49] A 2009 evaluation of the Briggs House found it lacking in both significance and historical integrity, two prerequisites for nomination to the National Register.[50] However, a Revised Request for Determination of Eligibility Form included as an appendix to the 2010 report on investigations at the Briggs House makes a strong case for its inclusion as a contributing feature to the listed Dorris Ranch Historic District.

The above serves as a reminder of the value of revisiting previous projects with an

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[47] Mary Horvat and Robert Melnick, National Register of Historic Places, Dorris Ranch, Springfield, Lane, Oregon, National Register # 88000724.

[48] Horvat and Melnick.

[49] Carter, 1.

[50] Carter, 2 citing Pat French (Willamalane) to Ian Johnson (Oregon SHPO), "Documentation and Level of Effect regarding the Briggs House" (letter dated July 7, 2009).

eye toward a continuing refinement of understanding. Duncan James wrote, "over the last 50 years or so…the foundations have been laid…in the study of vernacular architecture. However, there is undoubtedly a vast amount still to be done…[in] revisiting some buildings—recorded in the past but only to a limited level of detail—with a view to gleaning further data to increase the depth and quality of the information gathered."[51] There are certainly differing levels of detail that can be extracted from any given resource, and that can be undertaken as iterations of investigation over time. In the example above, the 2009 evaluation was insufficient to detect the historical importance of the Briggs House, while the 2010 report explored more deeply and determined that the Briggs House is, in fact, of an example of an early construction type in the Pacific Northwest.

Figure 3.1. View to Southwest at the Briggs House.

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[51] Duncan James, "On the Need to Acknowledge the Parochial Nature of Timber Framing: Some Thoughts on the Unrealised Potential in the Detailed Recording of Vernacular Buildings," *Vernacular Architecture.* 42 (2011):11.

Origin, Process, and Findings

The oldest house at Dorris Ranch is the Briggs House, built sometime between 1872 and 1874 by George Thurston of Springfield. The house was sold in 1892 to George A. Dorris along with the ranch that now bears his name. The house was inhabited by George and Lulu Dorris for a time, and later served as the residence of Reynold and Eva Briggs. Reynold worked as the operations manager for the filbert orchards owned by George, and later his nephew Ray Dorris, for more than 40 years. The Briggs family received the Briggs House as a gift from Ben and Kay Dorris in 1973. In 2000, the house and its five surrounding acres were transferred to the Willamalane Park and Recreation District of Springfield, Oregon.[52]

In 2010, heritage consultants Liz Carter and Kathryn Toepel learned of plans by Willamalane to use the Briggs House as a practice burn by the Springfield Fire Department. They approached Willamalane with the proposal that a detailed study be undertaken before it was burned down. For the detailed study, the participants were granted full access to the property and permission to selectively remove existing finish materials to investigate the underlying fabric. With the removal of the 1970s additions of T1-11 structural sheathing outside and the decorative wallboard inside, it was apparent that the original structure of the earliest build of the house actually possessed remarkable historical integrity. Furthermore, at this time it was discovered that this wing of the house was of box construction, surviving examples of which are becoming increasingly rare in the Willamette Valley.[53] This discovery immeasurably enhanced the significance of the Briggs House.[54]

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[52] Carter, 1.

[53] Carter, 1.

[54] Carter, 2.

Phases of Construction

The Briggs House was built in several stages over time. The land was purchased by George Thurston and his sister Elizabeth Blandon Stowell in 1870. Based on the record of ownership and physical attributes of the house itself the first build was probably constructed "shortly before or just after George Thurston's marriage to Marietta" in 1872, and was used by the Thurstons until c. 1880.[55] It is this earliest component of the house that is box constructed.[56]

This oldest section of the house was described as a vernacular Gothic-influenced upright-and-wing of ± 866 square feet.[57] In terms of construction, this house falls well within the norms of box construction described by Bell.[58] The substructure consists of hand-hewn sills supported by log and "partially-hewn" posts, themselves bearing on stone piers.[59] The floor structure consists of joists bearing directly on the sills. The exterior walls are constructed of circular-sawn boards oriented vertically, attached to the sill and a top cap. The roof is composed of rafters bearing on the walls and top caps. The fenestration pattern is noted as being "regular, typical of farmhouses of this type."[60]

The first addition to the house is thought to have been made at around the time of the purchase of the property by George A. Dorris in 1892, and consists of a simple, single-story rectangular extension to the south of the one-story wing of the original build. The

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[55] Carter, 4.

[56] Carter, 6.

[57] **C**arter, 6.

[58] Bell 19-22.

[59] Carter, 24.

[60] Carter, 6.

construction of this “living/dining room & kitchen,” which added ± 609 square feet, differs significantly from the box construction of the earlier portion of the house. The sills are described as sawn lumber supported by various hewn and sawn posts bearing on stone piers, supporting sawn floor joists. The walls are described as “full-dimension, rough-sawn 2”x 4” stud walls.”[61]

Several later additions, which include a 1920s-era attached garage on the north face, later shed-roofed additions to the south and west facades (and to the north face of the garage), and the replacement of the north- and east-facing wraparound porch,[62] contribute to the massing that is observable today. There was evidence of multiple alterations to the original window and door openings: the north elevation was at one time the front elevation, and featured an off-center entrance door and a two-story front porch at the upright portion, while the wing had a “secondary” entrance, also on the north elevation. These openings, as well as several window openings on the west facade, were at some point in time boarded up and obscured with later surface treatments or structural additions, and revealed only with the removal of these finish materials.[63]

Tables 1.1 and 1.2 are tabulated consolidations of the structural information found in both the text and figures of the 2010 Briggs House report which serves as a baseline for the continued work in the current study. The report additionally includes samples of field notes and scaled plan drawings with locations of current and sealed doors and windows.

The 2010 report on the Briggs House concluded with a series of recommended next steps which vary depending on decisions made regarding the fate of the house (specifically,

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[61] Carter, 7, 24.

[62] Carter, 36.

[63] Carter, 7.

rehabilitation, relocation, or deconstruction) by the owner, Willamalane Park and Recreation District. For each of these three possible futures outlined for the house, however, the first suggestion was "to complete detailed documentation and condition analysis work begun by students in 2010."[64] This study strives to contribute to the completion of detailed documentation of the Briggs House with a rigorous recording of the structure and discussion of the data recovered using BIM modeling.

Table 1.1. Summary of first build structural information.

FIRST BUILD	
Foundation Structure	
Posts	8"-11" log or partially-hewn posts Median posts each joist
Piers	Stone
Sills	7"-9"x 8" hand-hewn sills
Floor Joists	2"x 8" floor joists @ 24" o.c., no notching
Wall Structure	
Sill ledger	1"x4" alignment ledger
Wall planks	Roughsawn 1"x 9"-11" wide
Top Cap	2" x 4" top cap
Roof Structure	
Ties	1"x 4" rafter ties span 89" attic width
Rafters	2"x 4" rafters @ 24" o.c., 12:12 pitch
Skip sheathing	1"x 4" skip sheathing
Additional Information	
Door and window locations sawn into place by hand after the box constructed	
Staircase and adjacent (East) wall modified when the 1890s addition was built	

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[64] Carter, 39.

Table 1.2. Summary of second build structural information.

SECOND BUILD	
Foundation Structure	
Posts	4”x 5”-6” hewn and sawn posts
Piers	Stone
Sills	4”x 6” sawn sills three sides No sill north side
Floor Joists	2”x 8” floor joists @ 24” o.c.
Wall Structure	
Studs	2”x4” rough-sawn studs Face-nailed flat to original wing
Top plate	2”x 4” top plates

CHAPTER IV

BIM METHODOLOGY

Two decades ago, a study conducted by Edward Johnson employed much less sophisticated software (though advanced for its day) to study defects and decay in existing structures. He stated that “physically remote defects, although interrelated, often cannot be observed simultaneously due to the opacity of floors, walls, ceilings, and other building components. Moreover, it is very difficult to depict these relationships graphically using photography or conventional two-dimensional drawings.”[65] Johnson concluded that “there is a serious need for a viable method of depicting remote but interrelated defects in historic buildings.”[66] His study imported existing 2D CAD files into a rudimentary 3D CAD program and inspected, in the model, previously hidden adjacencies for shared defects. Johnson determined that “ the 3-D computer model developed from 2-D recordation drawings … constitutes a viable approach to analyzing and interpreting complex relationships among remote but interrelated defects in historic buildings.”[67] The approach suggested twenty years ago by Johnson can now be implemented by means of the more advanced software and modeling available today.

Traditionally, the documentation of historic structures proceeds in a fairly direct

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[65] Edward A. Johnson, "Condition Assessment Using Computer Models," *APT Bulletin*, 26, no. 1 (1994):47.

[66] Johnson, 47.

[67] Johnson, 51.

fashion from the field collection of data to the drafting of measured drawings. Although it is best practice to produce the preliminary drawings in the field, to ensure their accuracy and completeness by checking them against the actual resource, this is not always possible. In any case, the production of the preliminary, or draft, drawings from field notes allows the opportunity to check consistency and accuracy within the draft set, usually undertaken in concert with the design of the page layouts for the final set of measured drawings. In this study, an additional step is introduced into the sequence, that of *digital emulation*. This step assumes the role of checking the field notes for consistency and completeness, and, if undertaken in the field, assessing their accuracy by comparison against the original resource itself.

Although BIM software was first introduced commercially more than two decades ago, there are only a handful of competitors on the market today. Autodesk Revit, Bentley Microstation, and Graphisoft ArchiCAD are currently the three most popular software packages available. While Revit is the most recognizable name of these three, it was ArchiCAD that initiated the BIM revolution in 1987.

ArchiCAD is now in its 16th full release, and is the BIM software selected to be used in this project, primarily for the reason that the author has the most familiarity with this product, but additionally because Graphisoft offers a fully-functional student version as a free download, with a renewable 1-year license for qualified (student) users. A simplified explanation of the architecture of an ArchiCAD file follows.

Model components in ArchiCAD are located spatially in the digital model, and are further classified by their assignment to one of several user-defined categories within each of several software-dependent sorting sets. The most relevant sorting-sets for this case study are *story*, *layer* and *material*. *Stories* in ArchiCAD are simply horizontal "slices" (with an assigned height) of space within the model, much as stories of a building are in the real world. *Layers* are used to group any user-selected collection of model components, across any number of stories, into a single assemblage for modeling convenience and the intended purpose of the model. *Materials* in ArchiCAD describe a suite of associated graphic attributes assigned to a model component, the most apparent of which is its surface color. The custom ArchiCAD template file created for this project was assigned a reduced set of layers, stories, and materials to simplify the process of allocating categories to modeled elements during the construction of the model. Figure 4.1 graphically illustrates the spatial organization of *stories*, the component-type organization of *layers,* and the distinct colors of *materials* in a hypothetical situation.

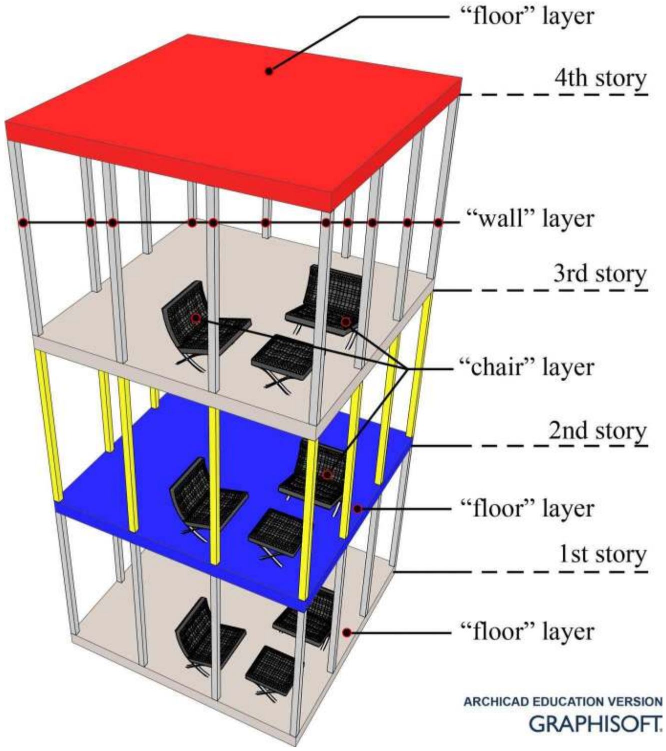

Figure 4.1. *Stories*, *layers*, and *materials* differentiated.

Three *stories* were created for use in the template, numbered simply 1, 2, and 3. These stories were established for ease of modeling, and do not necessarily correlate to the height of the actual building. Six *layers* were employed in the template: SEO, Massing, Floor, Foundation, Wall, and Roof (Figure 4.2). Two *materials* were used in the initial construction of the model: "Jelly" and "Accurate." Unlike the previous two parameters, the assignment of a material to an object serves not as a modeling convenience, but is instead an attribute that describes the nature of the object being modeled (Figure 4.3).

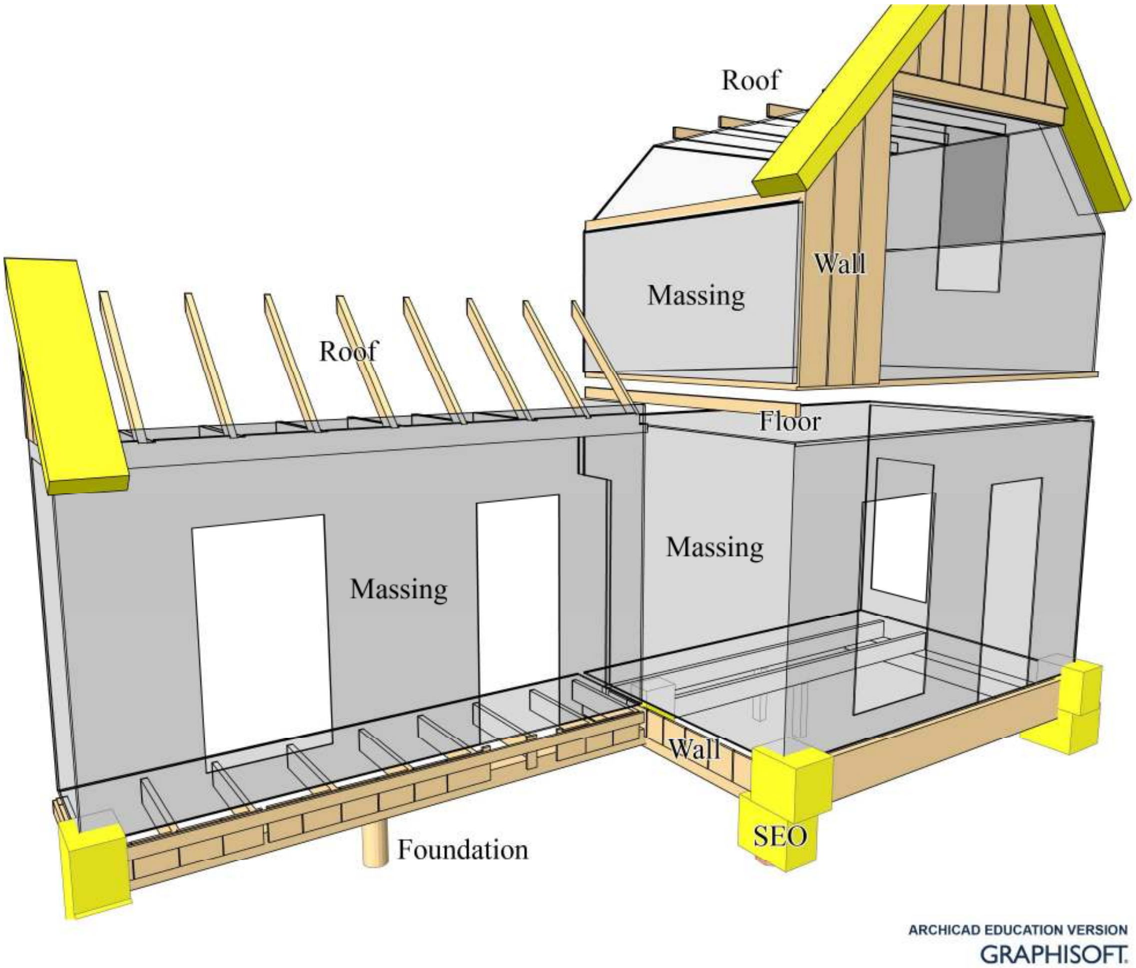

Figure 4.2. *Layers* in the Briggs House ArchiCAD model.

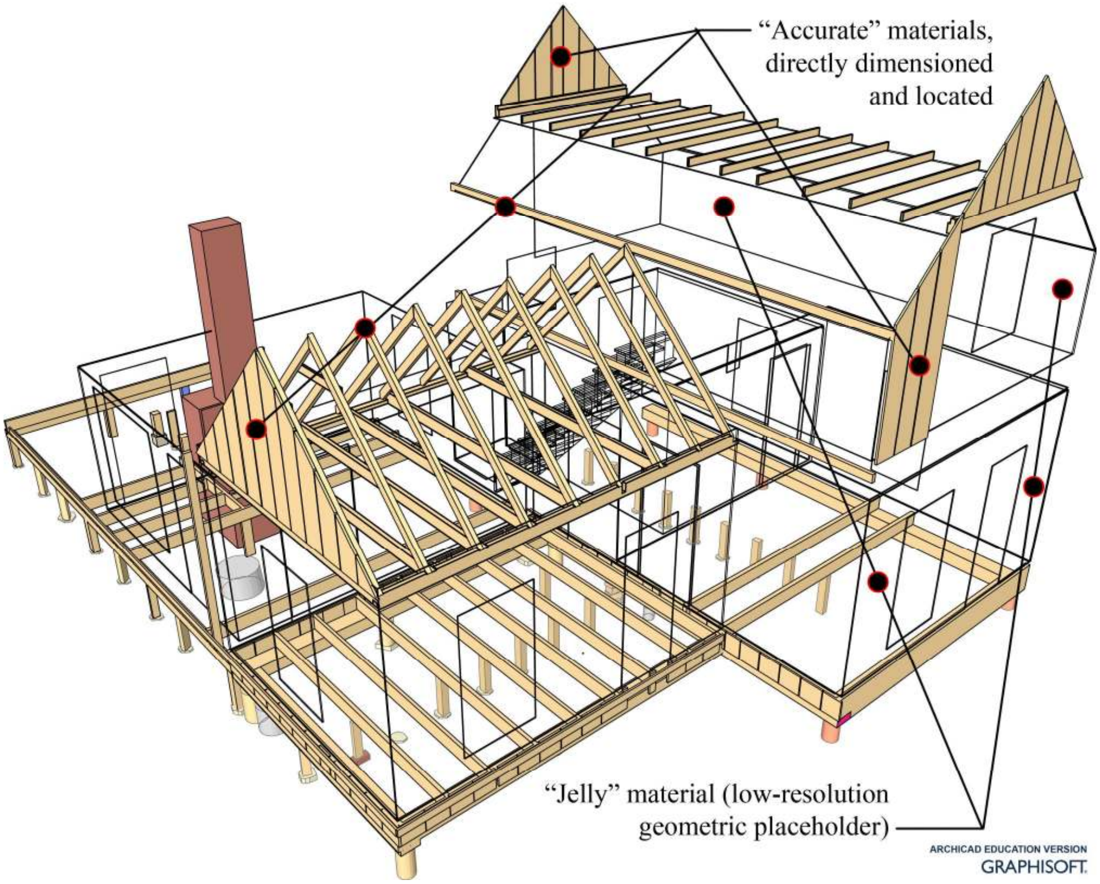

Figure 4.3. *Materials* used in the initial model.

The designed field protocol established as a first step that the overall massing of the building was to be modeled using the "Jelly" material, which would represent accurately but imprecisely the volume of the building, excluding the roof forms. The material itself was designed as a nearly-transparent solid, which served as a low-resolution geometric placeholder into which subsequent high-resolution components could be placed. The "Accurate" material was designed to be visible as a solid color, and was assigned only to elements that were fully measured and located.

Two additional materials, "Interpolated/Extrapolated" and "Probable," were also created at the outset of the project, but these were not assigned to any objects until the final stages of the construction of the model. While the initial methodology of this project called for the direct-entry of values and information into the live building model on-site, later site visits employed a reduced use of field-entry, as discussed below.

CHAPTER V

FIELD INVESTIGATIONS

Field investigations at the Briggs House were undertaken by the project lead, assisted by a crew of three to five assistants, over five field sessions, to record the information used in the construction of the digital model. Altogether, the field sessions totaled 73 human-hours. Constructing the model required an additional 57 hours of studio time.

Field Session 1

The intention of the first visit was to complete a walking survey of the house and immediate surroundings, assess the scope of project, construct a massing model of the house, and test the feasibility of the direct-entry of data into the software in the field concurrent with data collection.

The construction of the massing model as a simple vertical extrusion of the measured footprint of the building was not difficult. A measured outline of the overall building footprint was obtained through simple hand measuring of the perimeter at the exterior of the house and quickly translated into a digital massing model in ArchiCAD. However, as work began in the crawlspace, several limitations of real-time building modeling soon became apparent. Direct data entry into the laptop was very slow in the dark and cold conditions of the crawlspace, and errors requiring later correction were frequent.

Figure 5.1. Direct data entry in the crawlspace of the Briggs House.

The project lead and the laptop moved to the porch above while the team of helpers remained in the crawlspace. Data entry now became rapid, but two new and related challenges arose. First, communication was difficult. Second, any new elements discovered by the crew were difficult to model accurately based on a verbal description alone. Accurate direct modeling required the project lead to climb back into the crawlspace to assess the novel elements directly, and then return to the workspace above to model them in the computer. This procedure effectively idled the measuring team and was tedious and inefficient for the project lead. Accordingly, hand-sketching in a notebook was employed in situations where measurements could not be efficiently entered into the computer and transfer from the notebook to the computer occurred later in the day.

Figure 5.2. Teamwork in the crawlspace of the Briggs House.

Two new challenges arose, and temporary solutions devised. First, the software presented no acceptable means to digitally record “marginal” notes in the 3D representation of the model, so text was entered directly into a single 2D view of the model. Second, a distinction needed to be made between fully recorded (all dimensions taken) and partially-recorded modeled elements. Coloring the unknown ends of modeled elements in bright pink was developed as a visual reminder (Figure 5.3).

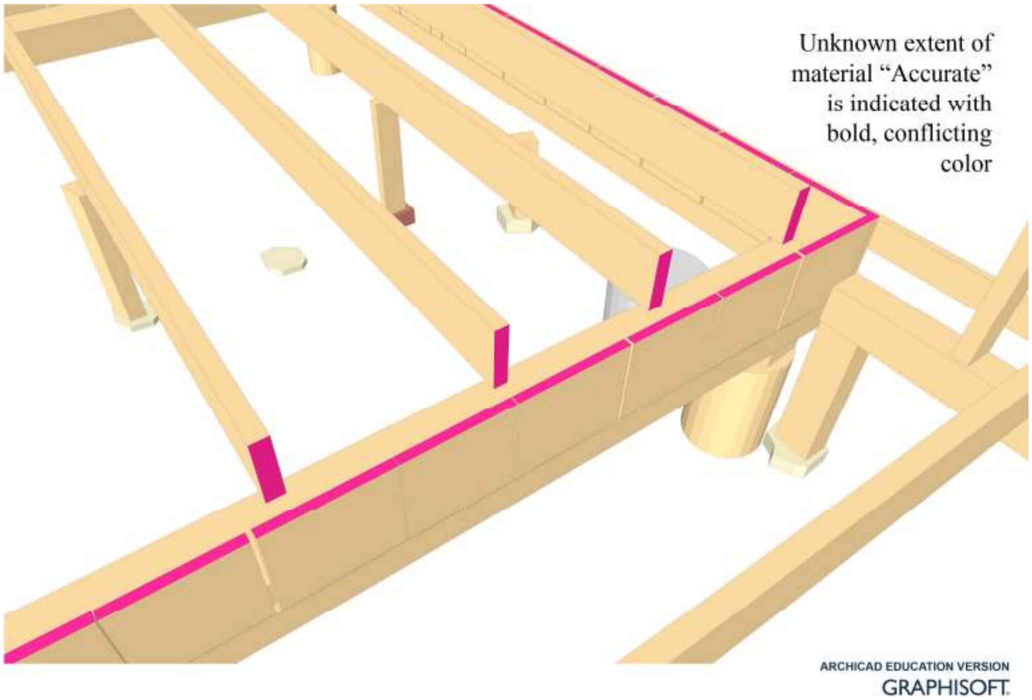
Unknown extent of material "Accurate" is indicated with bold, conflicting color

Figure 5.3 Graphically indicating the extent of known material.

Field Session 2

This field session began with a review of work completed and a virtual walk-through of the digital model. All notes were recorded manually in sketchbook format. The team worked collectively to gather data on the substructure of the house. During this session, the project lead translated this data into the BIM model while the crew worked independently to record interior dimensions on the rooms. The model was then reviewed by the entire crew and used as a tool to detect omissions and identify unknown areas and intersections in the building. Later, in the studio, individual "Jelly" rooms were constructed according to the recorded dimensions, with the locations of doors and windows included (Figure 5.4). These rooms were then manipulated with respect to one another through the alignment of interior doorways between adjacent rooms to develop an overall 3D layout of each floor (Figure 5.5).

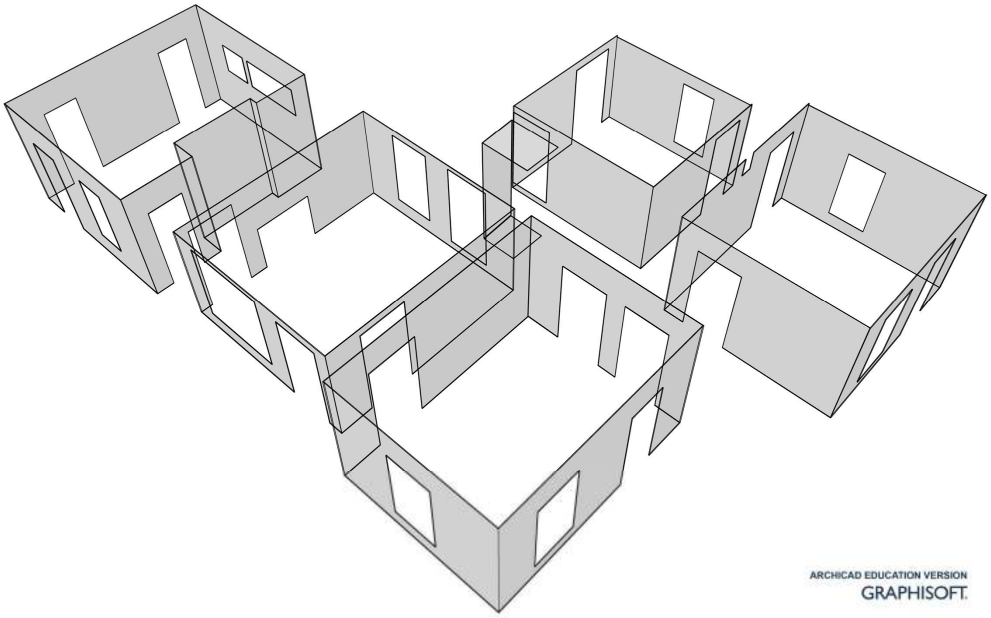

Figure 5.4. Interior walls recorded separately.

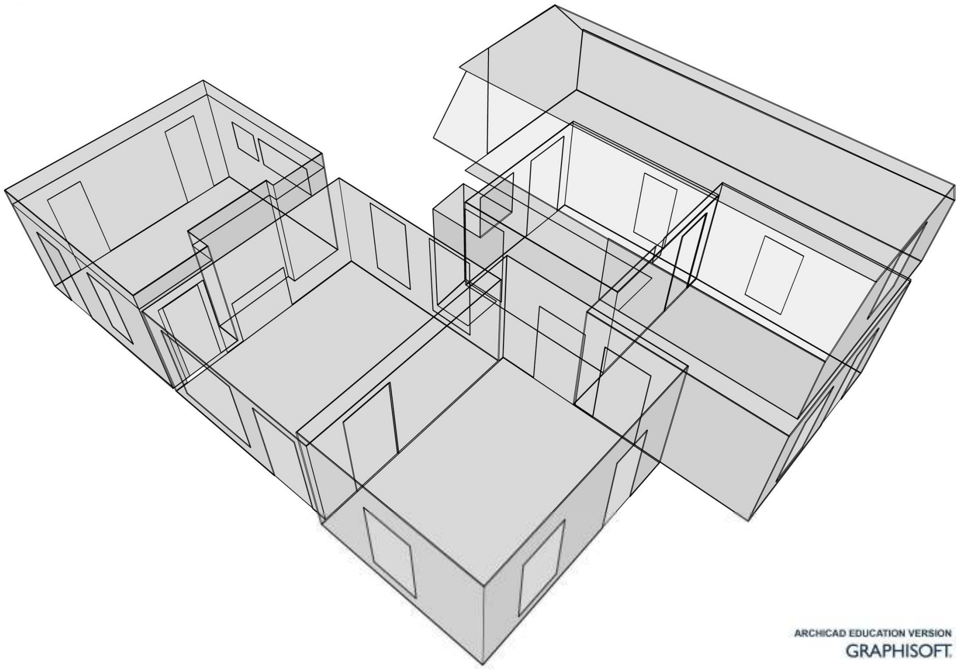

Figure 5.5. Interior walls aligned.

These assemblies were then moved to position within the originally modeled massing, and checked for fit (Figure 5.6). Measurements taken outside the building were compared to measurements taken inside the building to check for accuracy and to determine wall thicknesses (Figure 5.7).

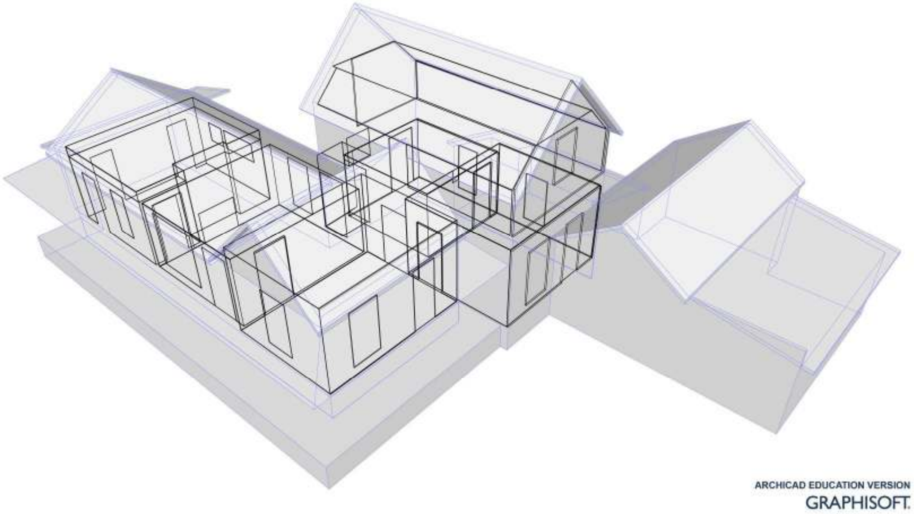

Figure 5.6. Interior walls aligned and located in massing.

Figure 5.7. Section view of interior walls and massing alignment.

Field Session 3

This session began with a tour of the digital model, with special attention to areas of unknown or confusing parts of the Briggs House revealed through the virtual construction of the model. All notes were taken directly into the field sketchbook. It was confirmed at this time that several areas of the crawlspace were inaccessible, and in other areas only a sample of member dimensions and spacing could be recorded. These limitations were noted and taken into account later when completing the model.

Figure 5.8. Locating and dimensioning framing of the First Build Wing attic.

Field Session 4

The work during previous field sessions was organized according to simple lists of unknowns, grouped by area of the house that needed to be addressed (e.g., crawlspace, attic). For this field trip, the list was supplemented with printed drawings produced from ArchiCAD, annotated with questions printed directly on the plans adjacent to the specific location they referenced. Missing information was sketched directly on to the printed drawings in the appropriate locations.

Field Session 5

A final field session was undertaken as a "punch list" opportunity to pick up any remaining details and measurements. This session also served to allow the team to confirm and cross-check dimensions that were recorded earlier. Outstanding questions were noted for future work.

Completion of Model

The final phase in the development of the model involved the addition of extrapolated and inferred constructional elements. As much of the building fabric could be seen, measured, and touched directly from several discontinuous locations (such as from within the attic and beneath the house), adjacent areas could often be confidently modeled as extensions or replications of the known component, using the material "Interpolated/Extrapolated," which had been assigned a different color so that this aspect of the model could be readily differentiated.

However, there were also large swaths of the building fabric that were simply unknowable, either because they are obscured by the more recent addition of surface materials, or because they are physically inaccessible, as is the case in several areas beneath the house. For these areas, information gleaned from other, similar areas of the structure was applied in the construction of a virtual suggestion of the unknown elements, using the material "Probable," and assigned its own readily discernible color (Figure 5.9).

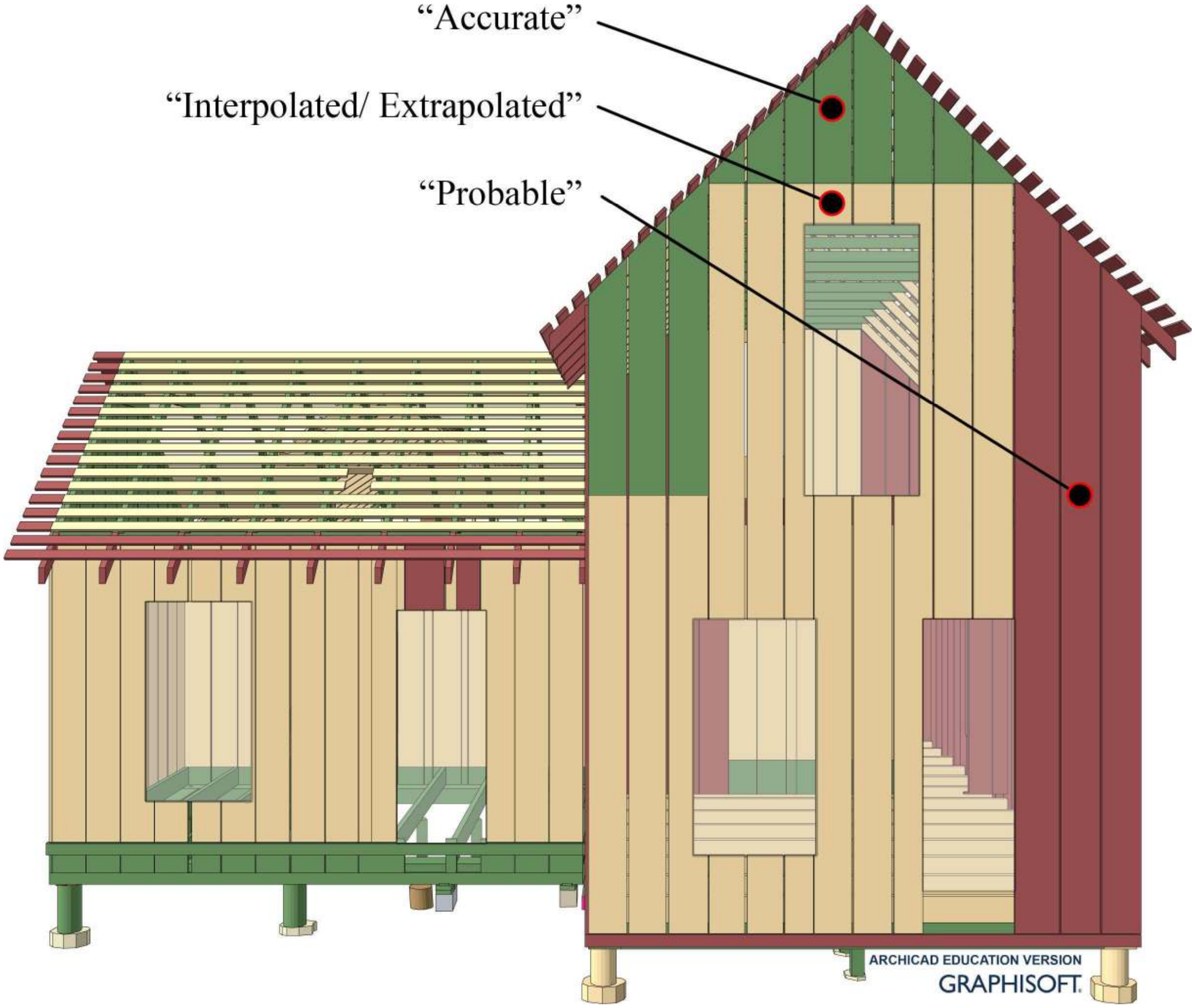

Figure 5.9. Three *materials* used in the final model.

CHAPTER VI

THE FABRIC OF THE BRIGGS HOUSE

The objective of this case study was to assess the utility of BIM for Buildings Archaeology through an inquiry into the historical building fabric of a specific building, the Briggs House in Springfield, Oregon. The information collected during field investigations at the Briggs House is presented here in detail, accompanied by graphics produced with ArchiCAD BIM software. A limited number of *layers* were used to organize the building components during the construction of the model, as outlined in Table 6.1. These layer designations are used in this study as an organizing scheme for the itemized descriptions of the elements of the Briggs House, as found in the following four sections.

Table 6.1. Layers used in the completed digital model.

LAYER COMBINATION	LAYERS
FIRST BUILD UPRIGHT (Table 6.2)	Foundation Structure
	Wall Structure
	Stairs, Interior Walls, and Upper Floor
	Roof Structure
FIRST BUILD WING (Table 6.3)	Foundation Structure
	Wall Structure
	Roof Structure
SECOND BUILD (Table 6.4)	Foundation Structure
	Wall Structure
	Roof Structure
LATER BUILDS (Table 6.5)	Massing Only

The earliest phases of construction of the Briggs House can be constructionally understood as three conjoined boxes: the upright and the wing, both of box construction, and the second build of stud frame construction. Short narrative summaries of these three overall constructions as well as descriptions of the nature of the window and door openings and interior walls, are presented below. The upright and wing are thought to have been built at the same time (i.e., over the course of one building season), but the upright was constructed before the wing within that one season.[68]

First Build

The First Build of the Briggs House (Figure 6.1 and Figure 6.6) is comprised of the original Gothic-influenced box constructed upright and wing, built by George Thurston between 1872 and 1874. The upright is a four-sided box. Bearing on posts and piers, the substructure is comprised of two hewn sill logs oriented north-south and two, shorter, hewn sill logs perpendicular to these, connected at their intersections with half-lap joinery and trunnels (confirmed where accessible). Floor joists span the short dimension. No squash blocks or blocking were found anywhere in the substructure. Vertical planks bear on ledgers affixed to the sills, and are additionally connected to the sills directly. No pegs or splines between adjacent planks were found. The planks of the gable ends (north and south facades) continue to the plane of the roof. The planks of the long sides (east and west facades) are connected at the top to a top plate. Partway up the long sides an intermediate ledger, attached to the planks, serves to support the notched joists of the second floor. The rafters are notched (with a birdsmouth cut) to bear on the top plates. Ceiling joists are face nailed to the rafters. Skip sheathing connects the rafters and supports the roofing. The

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[68] Carter, 6.

wing is a three-sided box. While very similar in construction to the upright, the substructure consists of only three total hewn sill logs: two oriented east-west, each connected by a half-lap onto the eastern sill of the upright, and connected at their eastern ends to the shorter north-south sill, again with half-lap joinery. Trunnels were located for only two of these connections. Floor joists span the short dimension. No squash blocks or blocking were found anywhere in the substructure. Again, vertical planks bear on ledgers on the three sides of this box, the planks of the gable end rise to the roof plane, and the planks of the long sides (north and south walls) connect to top plates. A relative dearth of fully exposed vertical planks in the wing prevented a search for pegs or splines between adjacent planks. The rafters are notched (with a birdsmouth cut) to bear on the top plates. The ceiling joists are also notched to bear on the top plates. Skip sheathing connects the rafters and supports the roofing.

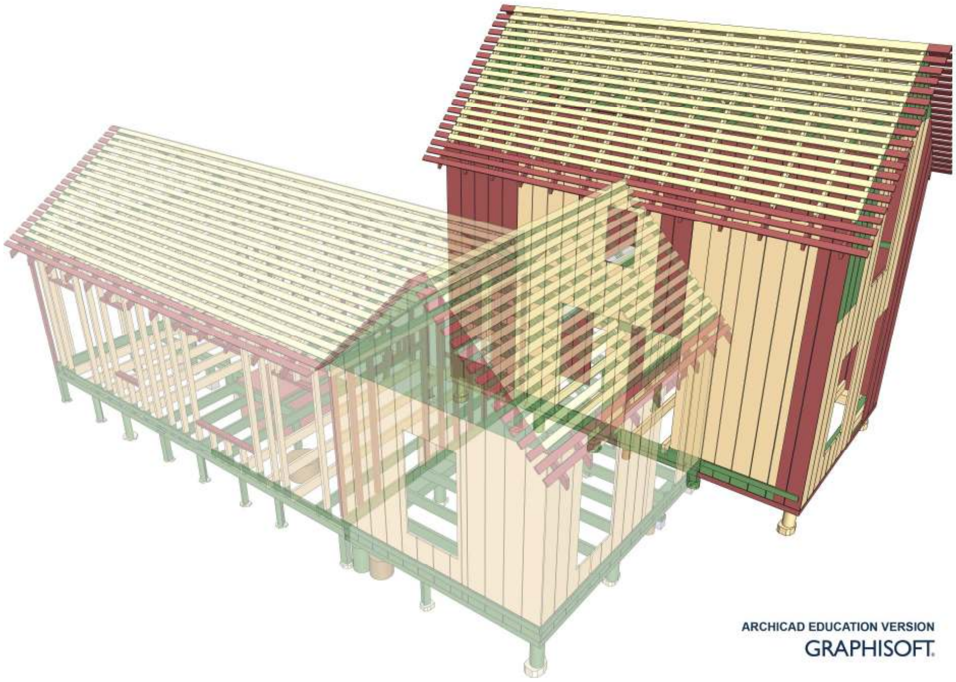

Figure 6.1. First Build Upright.

Table 6.2. Components of the First Build Upright.

FIRST BUILD UPRIGHT (Figure 6.1)	
Foundation Structure (Figure 6.2)	
Posts	(4) beneath each N-S sill, ± equally spaced (1) split log beneath each joist @ midpoint
Piers	stone
Sills	(2) N-S hewn logs, ±10" x ± 8" high (2) E-W hewn logs, ±10" x ± 8" high E-W sills over N-S sills w/half-lap joinery Pegged with single treenail at corners
Floor Joists	Roughsawn 2 ½" x 8" @ ± 24" o.c. Simple bearing on sills No blocking or rim joists
Wall Structure (Figure 6.3)	
Sill ledger	Roughsawn 1" x 3 ¾"
Wall planks	Roughsawn 1" thick x 9 ½" – 12" wide No pegging or splines
Old deck ledger	Roughsawn 1" x 4"
Top Cap	Roughsawn 2" wide x 4" high
Interior Walls and Upper Floor (Figure 6.4)	
Single ply walls	Roughsawn 1" thick x 9 ½" – 12" wide
Double ply wall (@ head of stair)	Roughsawn 1" thick x 9 ½" – 12" wide
Upper floor joists	Roughsawn 2" x 8" @ ± 24" o.c.
Roof Structure (Figure 6.5)	
Ties	Roughsawn 1" x 4", one per rafter pair Facenailed to rafter pair
Rafters	Roughsawn 2" x 4" @ ± 24" o.c. No bird blocking
Skip sheathing	Roughsawn 1" x ± 3" @ ± 5" o.c.

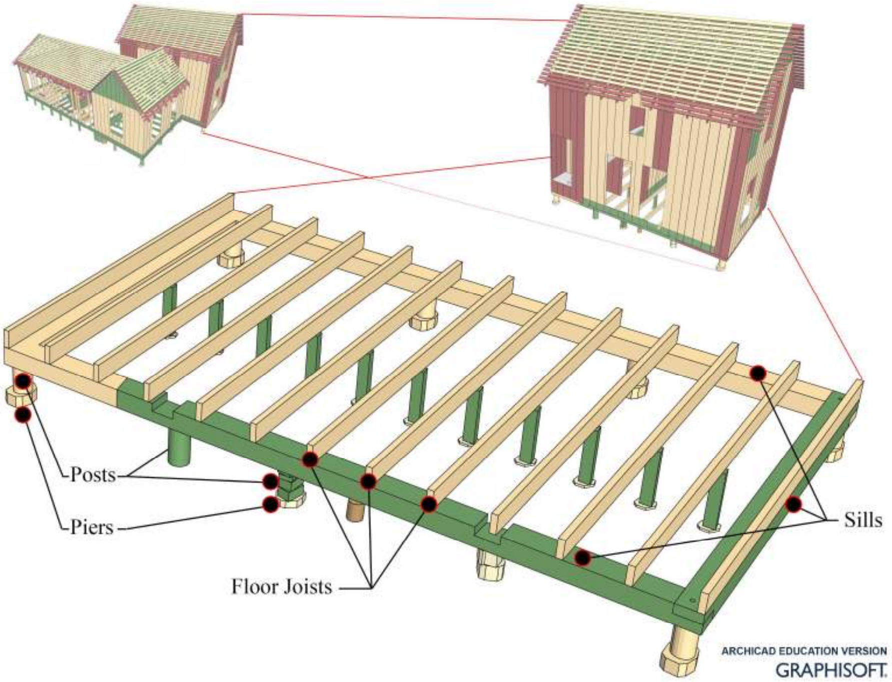

Figure 6.2. First Build Upright foundation structure.

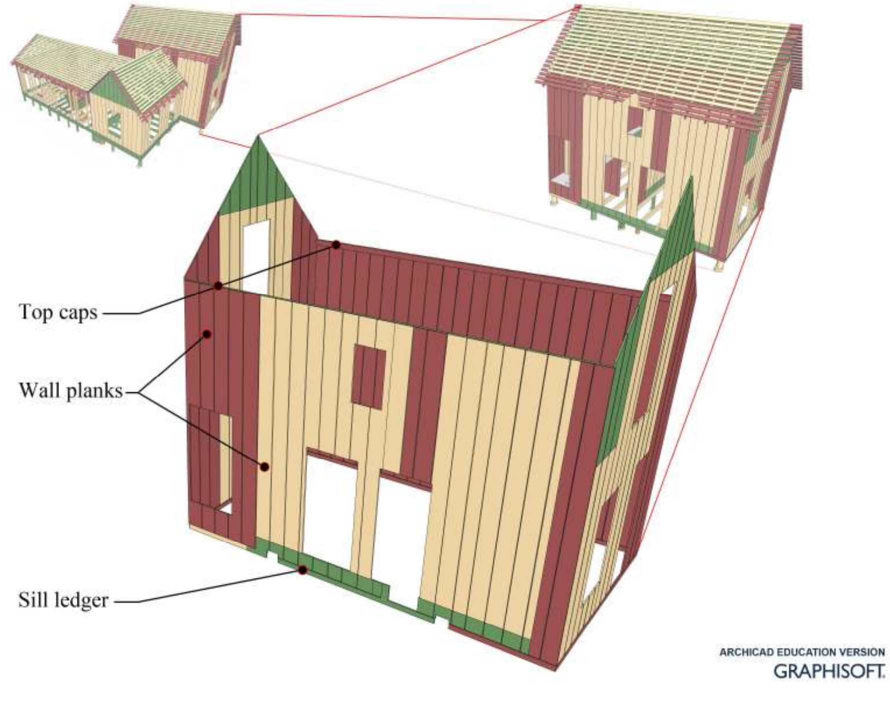

Figure 6.3. First Build Upright wall structure.

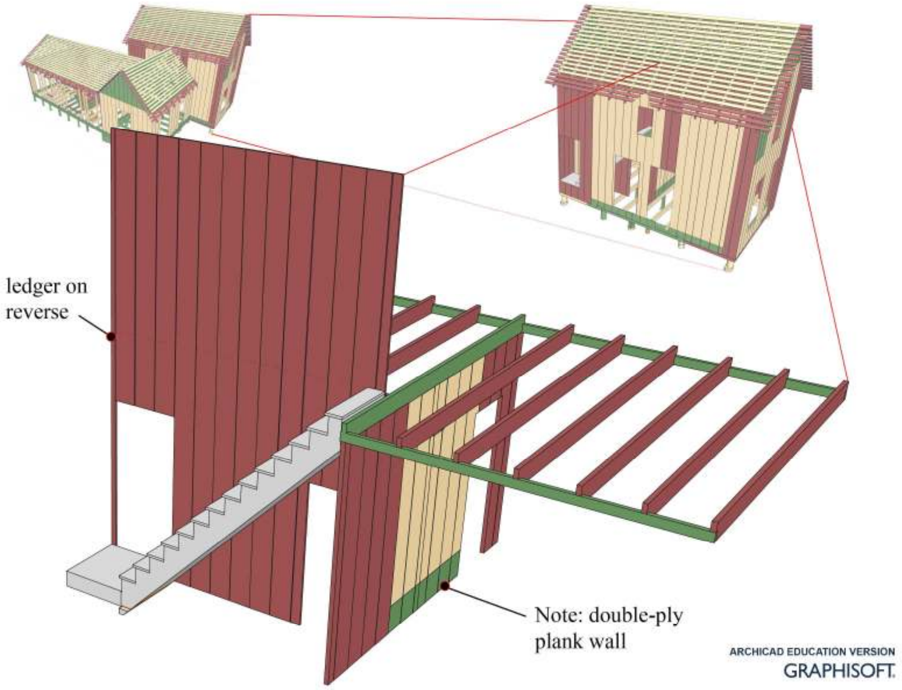

Figure 6.4. First Build Upright interior walls and upper floor.

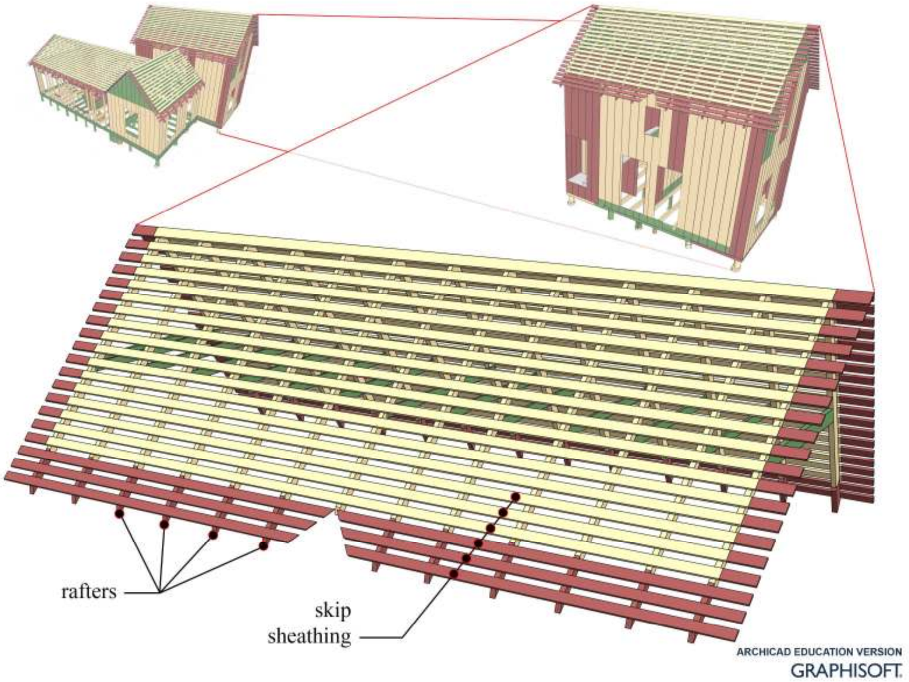

Figure 6.5. First Build Upright roof structure.

Table 6.3. Components of the First Build Wing portion.

FIRST BUILD WING (Figure 6.6)	
Foundation Structure (Figure 6.7)	
Posts	(2) each E-W sill, @ E end & midpoint (1) split log beneath each joist @ midpoint
Piers	stone
Sills	(2) E-W hewn logs, ± 9 ½” x ± 6 ½” high (1) N-S hewn log, ± 9 ½” x ± 6 ½” high E-W sills o/N-S sills w/half-lap joinery Pegged with single treenail at corners
Floor Joists	Roughsawn 2 ½” x 8” @ ± 24” o.c. Simple bearing on sills No blocking or rim joists
Wall Structure (Figure 6.8)	
Sill ledger	Roughsawn 1” x 4”
Wall planks	Roughsawn 1” thick x 9 ½” – 12” wide No pegging or splines Evidence of battens
Old deck ledger	Roughsawn 1” x 4”
Top Cap	Roughsawn 4” wide x 2” high
Roof Structure (Figure 6.9)	
Ties	Roughsawn ± 2” x 6” @ ± 24” o.c. Notched over top cap
Rafters	Roughsawn 2” x 4” @ ± 24” o.c. Roughsawn 2” x 4” high bird blocking (N side only)
Skip sheathing	Roughsawn 1” x ± 3” @ ± 5” o.c.

Figure 6.6. First Build Wing.

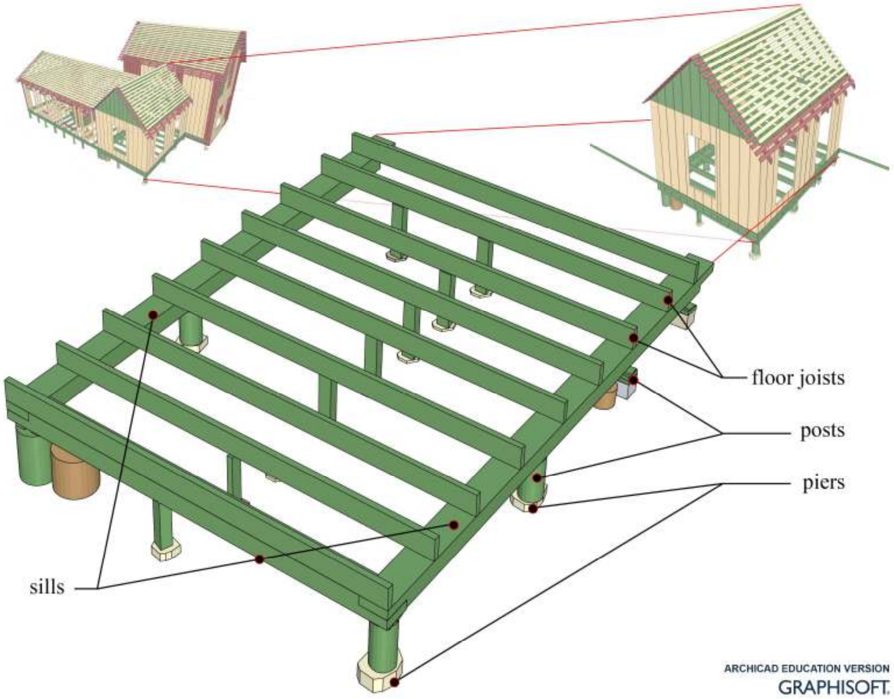

Figure 6.7. First Build Wing foundation structure.

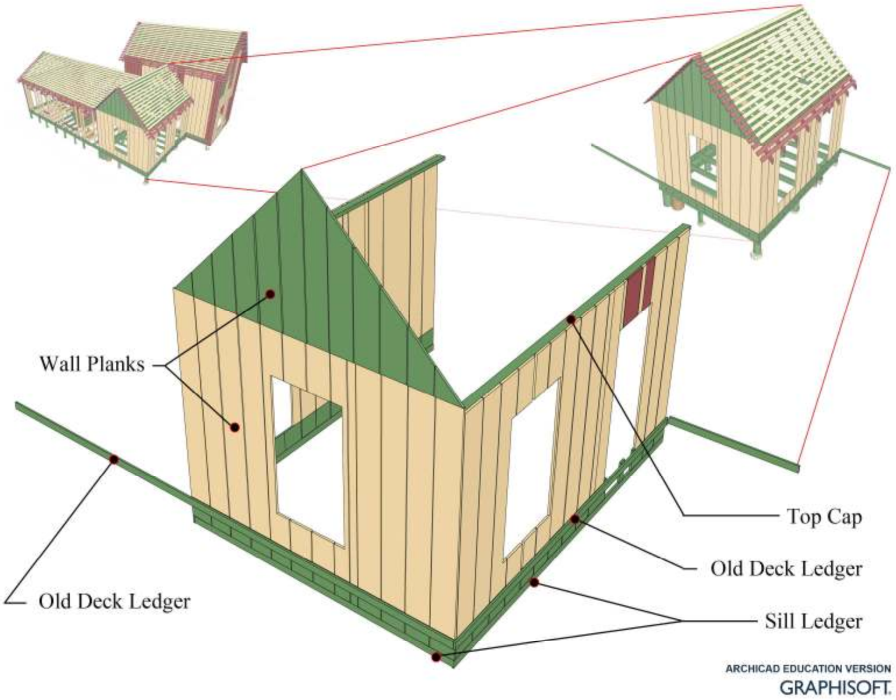

Figure 6.8. First Build Wing wall structure.

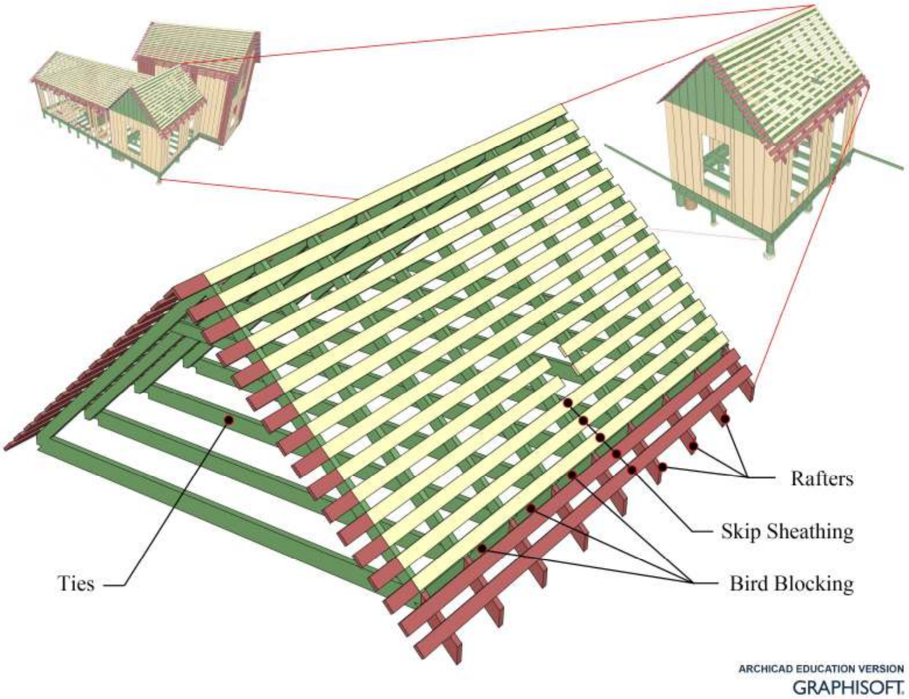

Figure 6.9. First Build Wing roof structure.

Second Build

The Second Build of the Briggs House (Figure 6.10) consists of the stud-framed single story portion built by George A. Dorris c. 1892.[69] The second build is a four-sided frame, carried on a three-sided substructure. Also bearing on posts and piers, the three sills are rough-sawn lumber, rather than hewn logs. Two long sills, oriented north-south, are tied at their south end by a shorter sill, and are connected with half lap joinery (no trunnels were found). There is no sill at the north end of the second build, but instead the terminal floor joist is affixed directly to the south face of the planking of the First Build Wing (Figure 6.11). Floor joists are set at regular intervals along the length of the substructure. No squash blocks or blocking were found anywhere in the substructure.

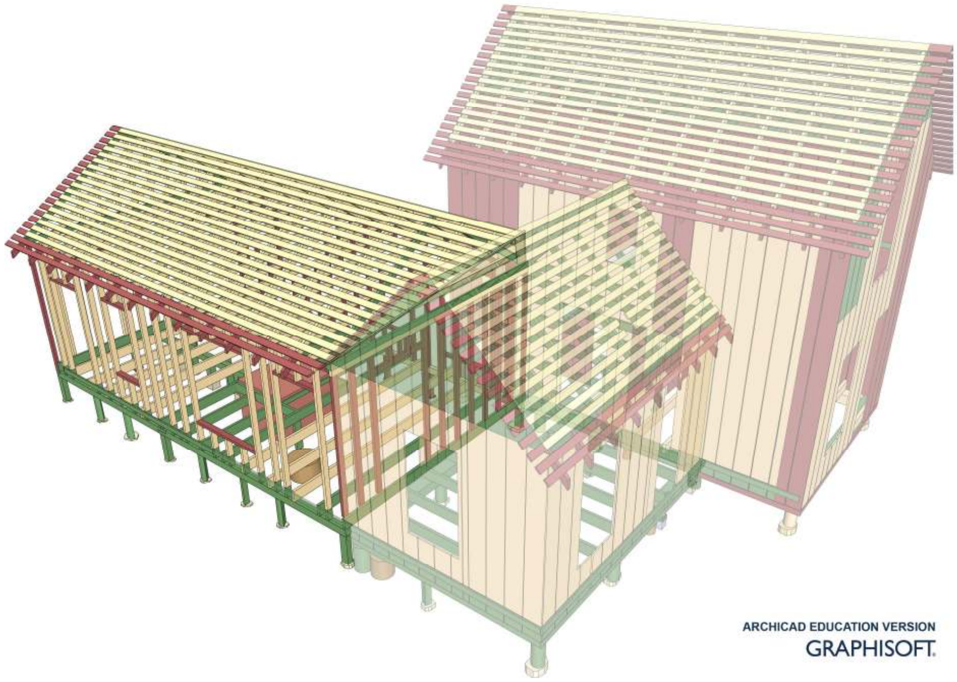

Figure 6.10. Second Build.

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[69] Carter, 7.

The north wall is flat-framed against the south wall of the planks of the wing, and bear on the terminal floor joist. The long walls and the south gable end wall are framed as cavity walls, with studs at regular intervals bearing directly on the sill. The north wall studs are capped with a top plate, and it is presumed that the east and west walls are capped similarly, but it was not possible to confirm this directly due to lack of access (Figure 6.13). The south wall studs extend to the roof plane. The north end of the second build roof is overframed onto the south plane of the wing roof. The roof rafters and ceiling joists bear on the top plates. Skip sheathing connects the rafters and supports the roofing. The east wall of the second build has two exterior doors. Viewed from the crawlspace, it can be seen that the area below each door is devoid of studs. The absence of studs where there are doors above suggests that both of these openings are original and not later modifications to the wall. The south wall also has two doorways, but the view of the stud layout from the crawlspace is obstructed by the placement of the terminal floor joist.

Table 6.4. Components of the Second Build portion.

SECOND BUILD (Figure 6.10)	
Foundation Structure (Figure 6.11)	
Posts	Roughsawn E sill @ ea.end & center w/split log intermediate supports Roughsawn post at N end of W sill (others not accessible) Modern posts median, south of fireplace
Piers	Stone Modern concrete median, S of fireplace
Sills	Roughsawn West, South, East faces No North sill East sill is of two pieces, half-lapped E-W sill over N-S sill w/half-lap Modern sill median, south of fireplace
Floor Joists	Roughsawn 2" x 8" @ ± 24" o.c. Simple bearing on sills No blocking or rim joists
Fireplace and chimney	Stone and brick
Wall Structure (Figure 6.12)	
Studs	Roughsawn ± 2" x 4" @ ± 16" o.c. No bottom plate
Top Plate	Roughsawn 2" x 4" flat, E and W only (postulated) Roughsawn 2" x 4" tall, N wall No top plate S wall
Old deck ledger (spliced)	Roughsawn 1" x 4"
Roof Structure (Figure 6.13)	
Ties	Roughsawn 2"x4" @ ± 18" o.c.
Rafters	Roughsawn 2"x4" @ ± 24" o.c.
Skip sheathing	Roughsawn 1"x3 1/2" @ ± 5" o.c.
Chimney	Broken off, capped

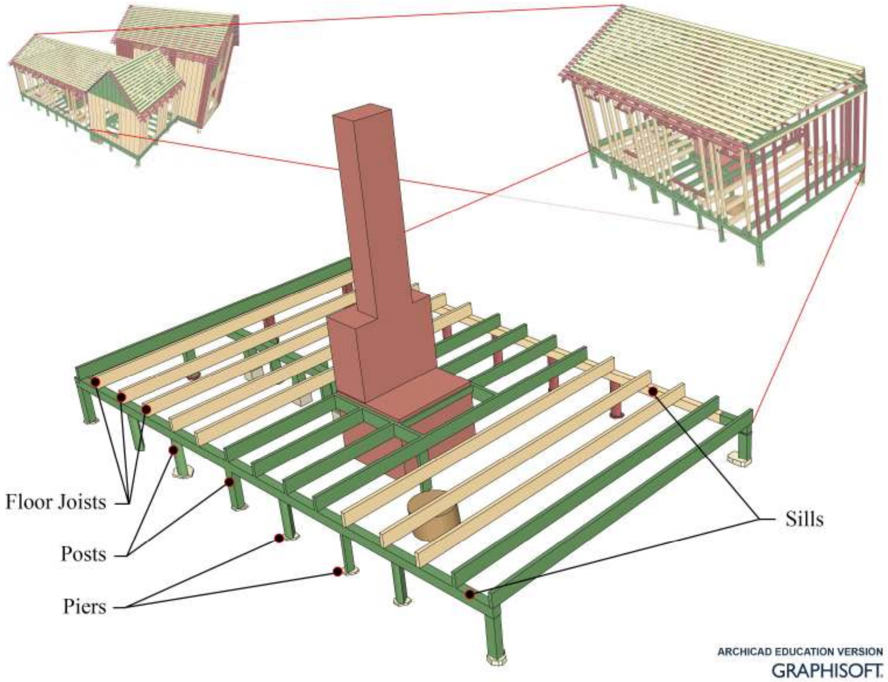

Figure 6.11. Second Build foundation structure.

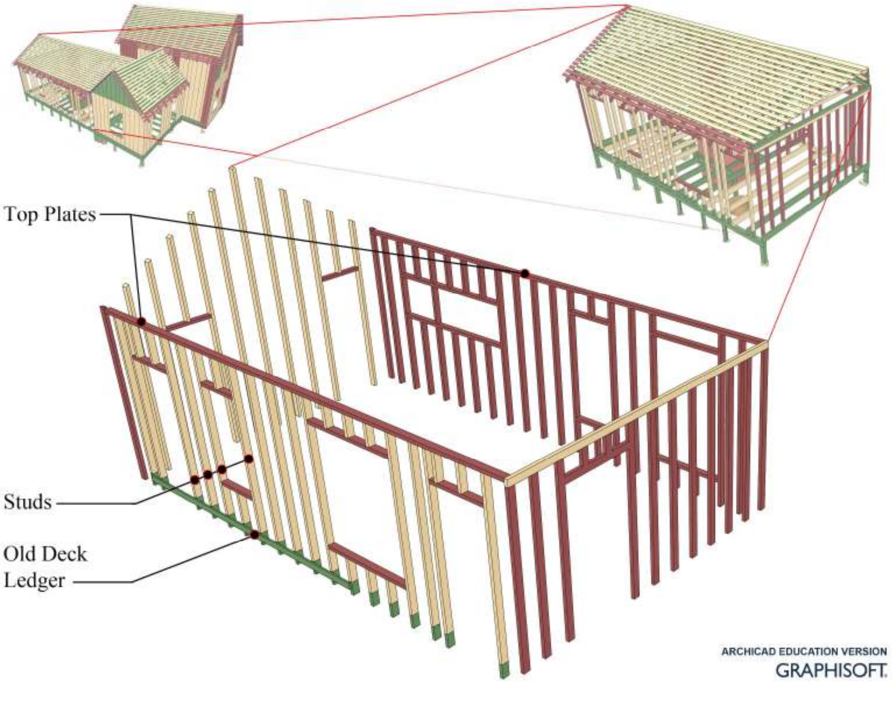

Figure 6.12. Second Build wall structure.

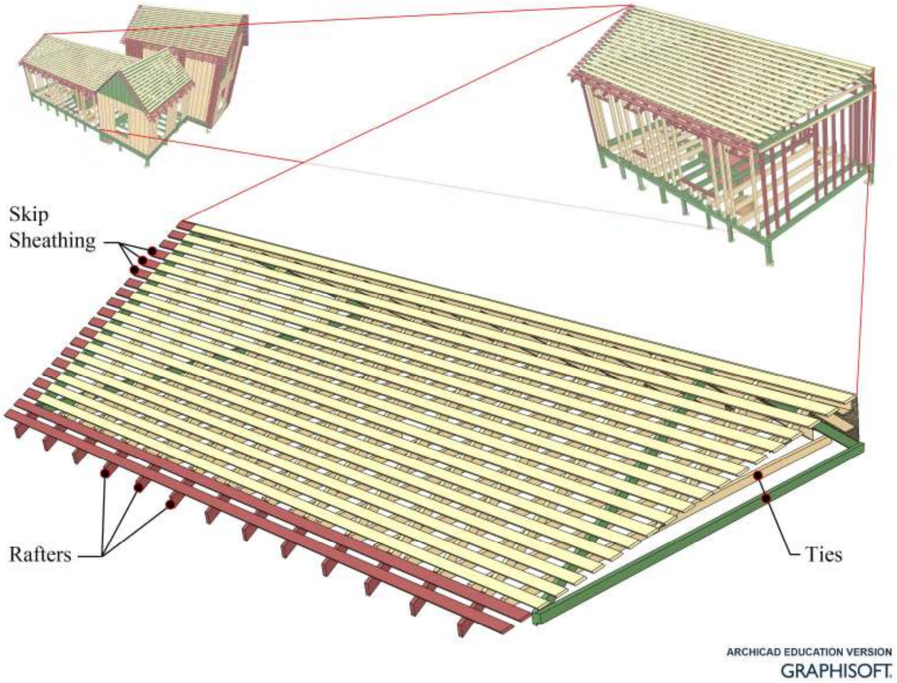

Figure 6.13. Second Build roof structure.

Later Additions

Several later additions to the Briggs House include a 1920s-era attached garage on the north face, later shed-roofed additions to the south and west facades (and to the north face of the garage), and the replacement of the north- and east-facing wraparound porch.[70] These additions were investigated only peripherally. Their modeled forms reflect this degree of investigation, and are modeled as simple massing (Figure 6.14).

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[70] Carter, 7.

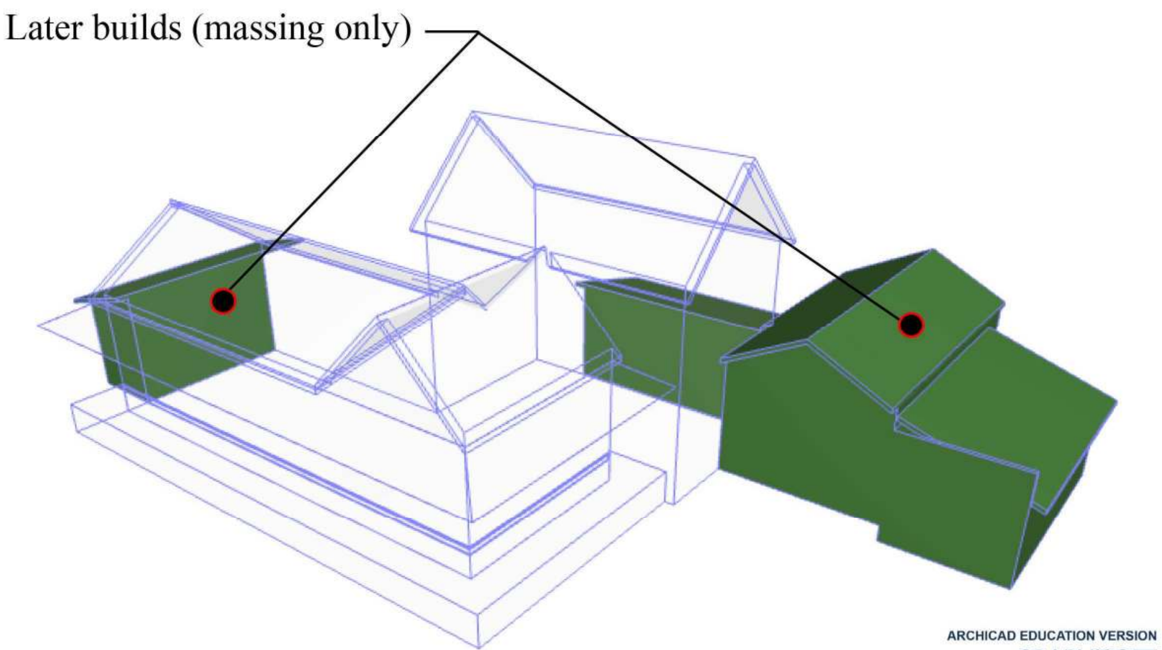

Figure 6.14. Later Builds.

Upright and Wing Openings

Several window and door openings in the upright and wing were at some time in the past closed off, and later revealed by the selective removal of interior finishes, as noted in the 2010 Briggs House report.[71] It appears that the openings for doors and windows were simply cut out of the plank walls, in situ. Often the cuts extend into the bracketing planks, rather than abutting one or both flanking boards (Figure 6.15). Further, while cuts made across the grain are uneven and irregular (as though made by hand saw *in situ*), cuts made along the grain are split or hewn.

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[71] Carter, 7.

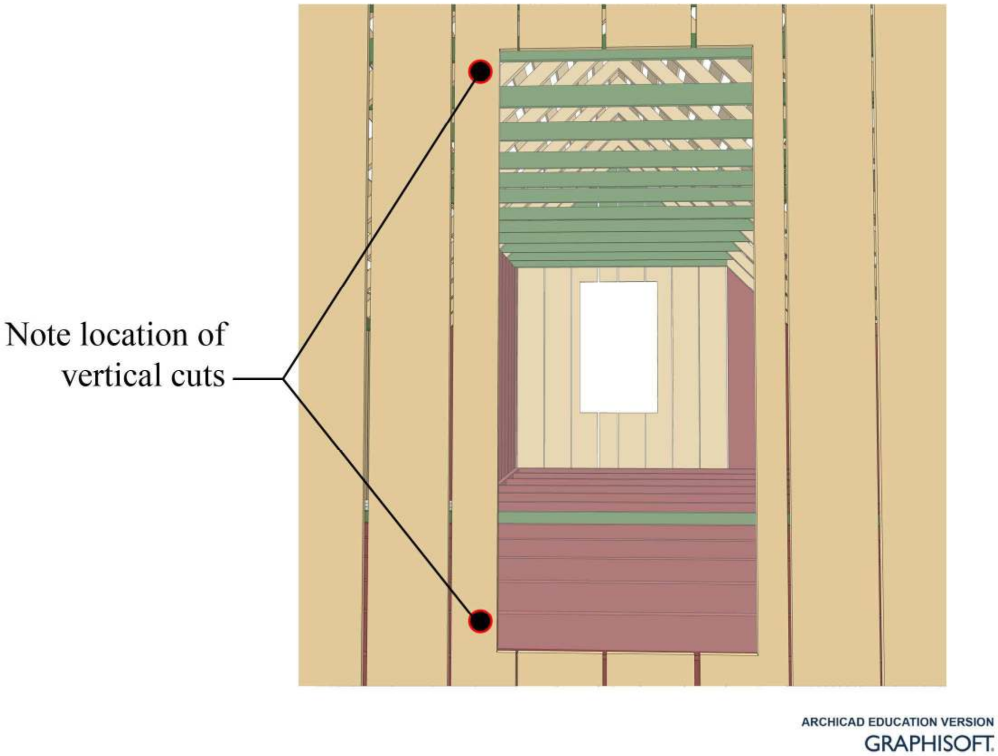

Figure 6.15. Vertical cuts in boards flanking openings.

Upright and Wing Doorways

From the crawlspace, it is possible to locate some of the doorways above, but not all of them. Two doorways in the first build are apparent from the crawlspace: the wing's original north entrance door, and the doorway between the wing and adjacent room to its west. In these two very specific areas, there is limited vertical planking below the floor plane, in contrast to the remainder of the perimeter of both the upright and the wing (Figure 6.16).

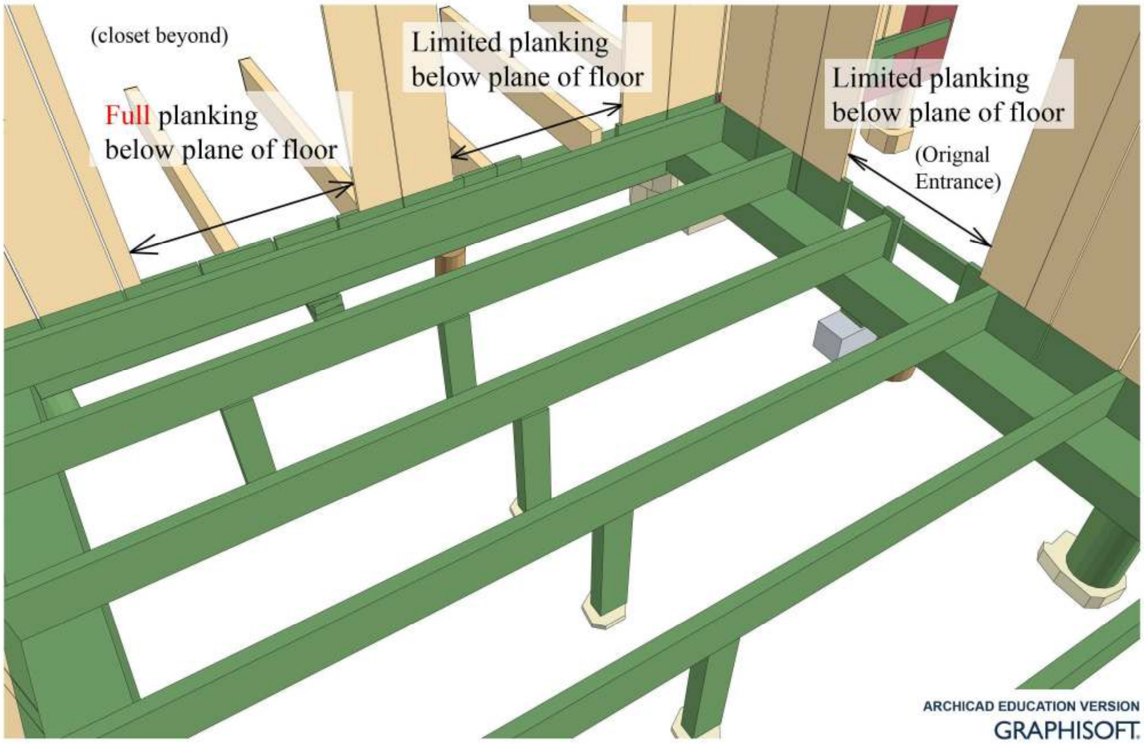

Figure 6.16. Planking at doorways into First Build Wing and original entrance.

Conversely, the door from the wing to the closet under the stairway is not detectable from the crawlspace, even though it is on an "outside" wall of the upright (Figure 6.16). Similarly, the wing's south door to the second build is not discernible from the crawlspace, as the sill below this door is uniformly covered with vertical planking, as are the bracketing areas (Figure 6.17).

Upright and Wing Interior Plank Walls

The interior wall dividing the north and south rooms of the ground floor and the west stair wall are plank construction, but the planks do not penetrate the floor plane and so are not visible from the crawlspace. The dividing wall consists of two layers of planks, while the stair wall is one plank thick. The two-ply plank wall aligns with a floor joist below and a

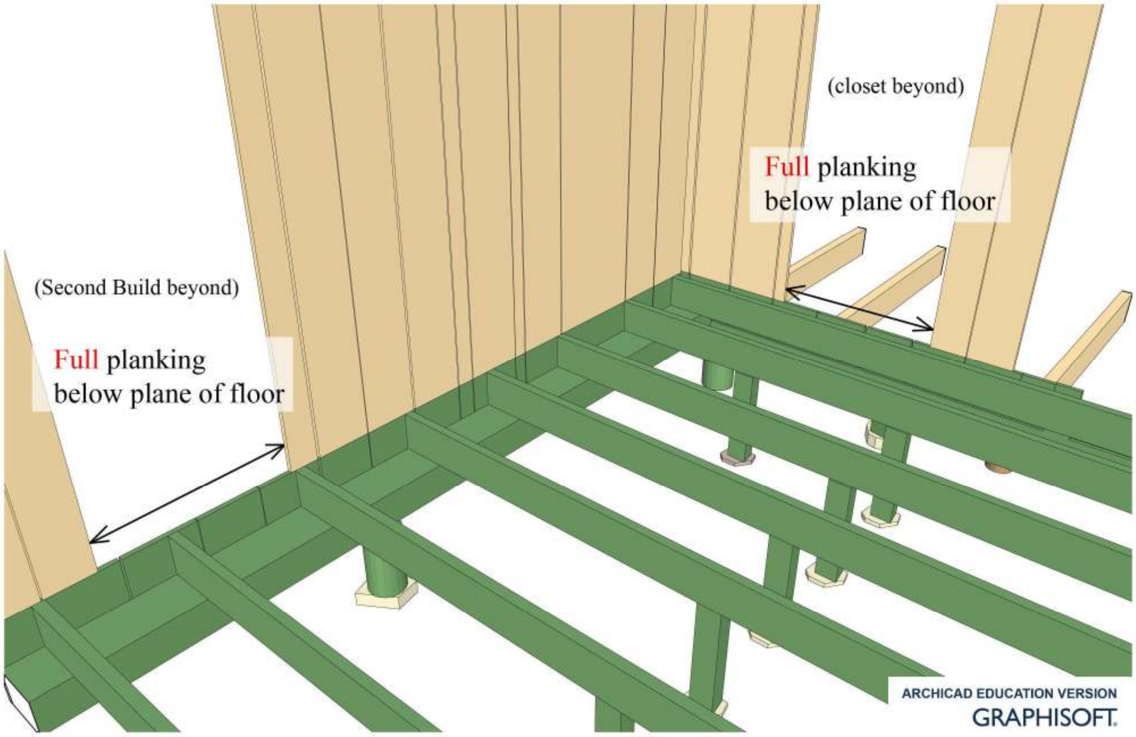

Figure 6.17. Planking at doorways into Second Build and understair of the First Build.

second-floor joist above, and is positioned to offer additional support to the stringers of the stairs. Although the support structures are not visible, it is probable that the wall to the west of the stairs supports the east end of the second floor joists and transfers their loads to the foundation (Figure 6.18).

The two-ply interior wall has a hole near the ceiling cut through both plies and, interestingly, it appears that the holes were cut independently through each layer of the wall. Roughly centered on the south wall of the wing is a similarly-sized and located hole. This hole falls within a stud bay of the flat-framed stud wall of the second build.

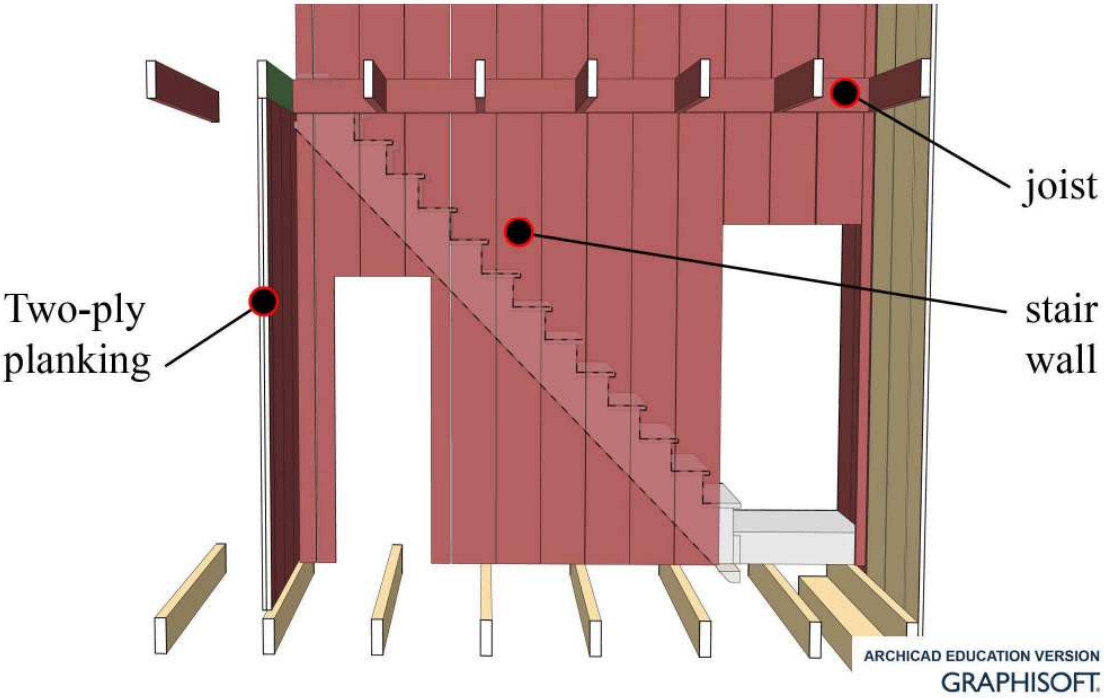

Figure 6.18. Location of two-ply planking in First Build Upright.

Irregularities and Questions

Previous investigations at the Briggs House in 2010 concluded that the box constructed upright and wing were built simultaneously, followed some time later by the second build of stud frame construction.[72] Investigation of the substructure of the house undertaken in this current study strongly supports this conclusion. However, some interesting connections between the three volumes —First Build Upright, First Build Wing, and Second Build— deserve special mention.

First, there are questions regarding the connection of the wing to the upright. The wing attic access door, located at the top of the stairs in the upright, appears to have been

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[72] Carter, 6-7.

moved or modified. The boards comprising the door are not those cut from the wall it closes. The second floor of the upright is substantially higher than the ceiling of the wing. What appear to be animal infiltration holes were discovered flanking this attic access door. Gnaw marks occur in the slight gap between a pair of adjacent planks were made from the side of the wing attic—or, what would have been the outside, east face of the planking, before the wing was in place. These discoveries invite further questions regarding the construction sequencing of the upright and wing, and hint that the construction sequence may be more complicated than currently thought (Figure 6.19).

Second, there are also questions regarding the connection of the First Build Wing to the Second Build. The skip sheathing of the south face of the wing roof, through which a hole has been cut for access to the second build attic space, bears no evidence of having ever been roofed–there are no nails or nail holes. Second, the skip sheathing in this area has not been patched in – it is continuous across the plane of the roof. Third, the skip sheathing around the access hole exhibits a significant amount of polishing wear, as though it had at one time been in regular use as a passageway between the two attics. Fourth, there is no evidence of bird blocking ever having been in place in the south plane of the wing roof (although bird blocking is in place on the north plane of the wing roof). These features suggest that the wing roof in this area has been overframed (covered by an the roof of an adjacent volume) since the time of its construction. On the other hand, the ends of the rafters of the south face of the wing roof appear to have been crudely removed in-situ, and several of the wall planks extend beyond the top plate by several inches. The latter features suggest that the addition of the second build required modifications to the wing after the wing had been built (Figure 6.20).

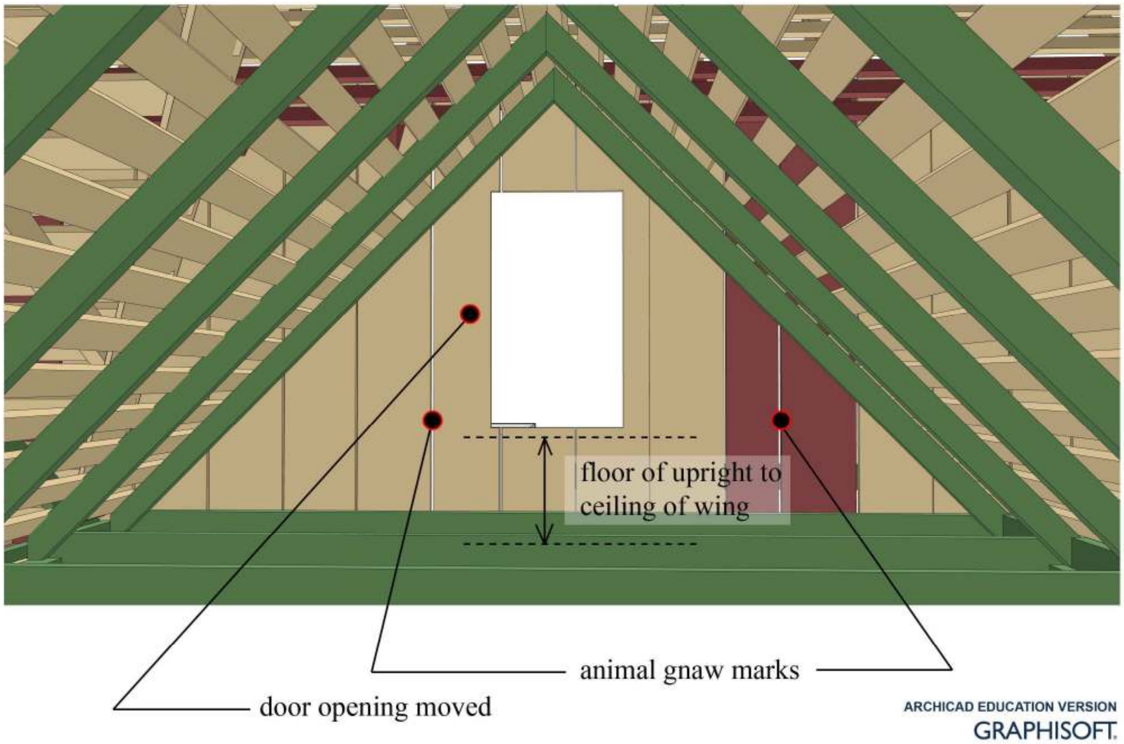

Figure 6.19. Wall of First Build Upright from attic of wing.

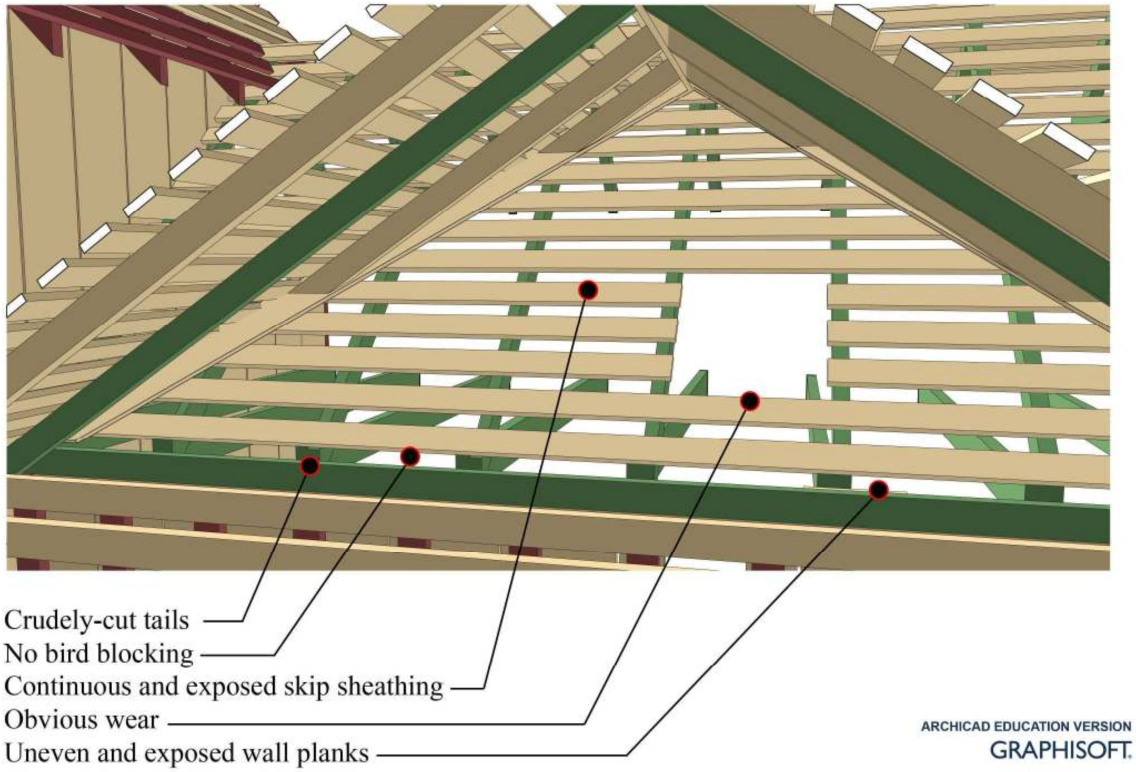

Figure 6.20. Roof of First Build Wing from attic of Second Build.

CHAPTER VII

CONCLUSIONS

This study expanded on the earlier study of the Briggs House that employed a traditional (non-digital) investigative approach. Due in large measure to the selective explorations conducted during this prior effort, it was possible to test BIM as a tool for modeling known discrete elements, interpolating and extrapolating between and from them, and proposing probable constructions for areas that could not be accessed. Further, the constructional complexity of the overall form of the Briggs House, constructed in phases over time, presented intersections and adjacencies that served well as a test for digital modeling in the service of Buildings Archaeology.

This study of the Briggs House also expands upon the earlier work of Shannon Bell on box construction, and presents a precise and accurate digital representation of a specific building representative of box construction in the Pacific Northwest. Given the advancing age of these wooden structures, it is hoped that additional studies of other examples of box construction will be undertaken to a similar degree of refinement in the future.

Limitations of BIM

There are a number of general limitations to BIM, as well as several limitations specific to this study, that became apparent early (Table 7.1). In writing about BIM, D.M. Foxe points out that "the certainty and precision of the model are only as powerful as the

Figure 7.1. A graphic depiction of the difference between precision and accuracy.

knowledge and accuracy that went into creating it."[73] This is certainly true, and a primary concern with the use of this technology is the potential to confuse the accuracy of a model with its precision (Figure 7.1). Due to the nature of digital modeling, a very high degree of precision is possible—much higher than can be readily measured in the field. Because of this, digitally modeled 3D elements appear to be accurate, but in fact may not be. Hand-drawn 2D projections, conversely, are inherently less precise and therefore are less likely to mislead the viewer into a false sense of the accuracy of the drawings. The breadth of a pencil line is sufficient to remind the viewer that the representation is not the same as what is being represented.

A second general shortcoming of BIM, especially in regard to recording vernacular

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[73] Foxe, 43.

structures, is the inability of BIM to readily model non-planar surfaces. While sawn lumber generally has six planar faces, any members hewn, split, or in the round will not. Though it is possible to approximate these uneven surfaces in BIM, it is far too time consuming to be practicable.

A third major concern with the use of BIM is a problem shared by all rapidly evolving electronic media: digital obsolescence.[74] While the digital model may be useful today, it will be worthless tomorrow without the means to read the file. As there is no feasible way to continually upgrade the files, software and hardware, it is of critical importance to generate durable physical output that can be archivally stored and retrieved. Beyond the above general limitations of BIM, this study encountered a number of specific limitations to the use of BIM in the field.

First and foremost, only one member of the recordation team is a trained operator of the software. This is an issue because it greatly slowed the input of data. If more than one team member could use BIM, multiple aspects of the building could be recorded simultaneously, either in a single, shared file or through the use of multiple files which could be later combined. It was also difficult to operate the software in the field, even when using a laptop and an optical mouse. A final software limitation was the inability of ArchiCAD to easily incorporate annotation (“marginal notes”) into 3D views of the model.

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[74] Hedstrom, Margaret Hedstrom, "Digital Preservation: A Time Bomb for Digital Libraries," *Computers and the Humanities* 31, no. 3 (1998).

Table 7.1. Limitations of BIM.

LIMITATIONS OF BIM	general BIM trait	specific to this study
Confusion of precision and accuracy	+	
Inability to quickly model uneven surfaces	+	
Digital obsolescence	+	
Too few trained software operators on project		+
Difficult to operate in inclement conditions		+
Cannot annotate 3D views in evolving model		+
Requires graphic indicators of completeness		+
Requires graphic indicators of certainty		+

Benefits of BIM

This study was designed to be experimental in nature, and unforeseen difficulties with the proposed methodologies and technologies were expected. The lessons learned in this project regarding field crew management, data collection, data entry, and modeling conventions are fairly simple and can be readily applied to subsequent studies. More critically, the utility of BIM as a tool for Buildings Archaeology was tested in multiple ways (Table 7.2).

Beyond the obvious visual and spatial comprehension benefits of using a 3D model to describe and exchange information, four related attributes of BIM found useful to this study are simply general characteristics of BIM. First, the model itself serves as the single repository of all information. This attribute is useful for its economy. Second, as the model is the sole basis for all output, all output is internally consistent. Third, BIM has the capability to rapidly generate any 2D view (elevation, plan, section, perspective or axonometric projection) of the model that is desired. Fourth, and not fully explored in this study, is the capacity of BIM to export to compatible software for further manipulation and

Table 7.2. Benefits of BIM.

BENEFITS OF BIM	serves process	serves product	gen. BIM trait	specific to this study
Model is single repository of all information		+	+	
Consistent basis for all output		+	+	
Generate any 2D view		+	+	
Create interpretive movies, 3D printouts, etc.		+	+	
Model can be widely shared		+	+	
Consolidate collected data	+			+
Demands understanding of 3D structure	+			+
Walkthrough inspection for completeness	+			+
Simultaneous cross-check of measurements	+			+
Expand from isolated data	+			+

interpretation such as the creation of 3D animations, demonstrations of construction sequencing, or any number of lighting, energy, or materials analyses.

In addition to the above generally applicable attributes, several features of BIM were harnessed in this study to serve the specific objectives of Buildings Archaeology. Used as a tool for the exploration, recordation, and analysis of an historic building, BIM can be considered a "3D virtual sketchbook" into which the full spectrum of information about the building is entered as it is uncovered in the process of a detailed study. BIM is without parallel in this regard, as it serves as a single, unified, and consistent repository for information on the dimensions, location, condition, and any number of additional parameters on elements of the subject building as they are discovered or uncovered. Additionally, the creation of a BIM model simultaneously allows and demands the user to understand the elements comprising the totality of the actual building as its virtual simulacrum is assembled, piece by piece. As eloquently expressed by John A. Burns, "…there is no way to appreciate an existing, working structure…like making a careful drawing of it."[75] This statement is even more true when the construction of a fully articulated 3D model of a structure is undertaken.

Further, the internal consistency of the BIM model is enormously valuable in the process of its construction, most especially if it can be done while in the presence of the actual resource. The model can be viewed in any of a multitude of projections and sections, and subjected to 3D manipulations to compare it against the building itself and inspect it for accuracy and completeness. Rather than relying on the process of preparing the final 2D measured drawings set as a way of correlating and reviewing the thoroughness of the data collected from site visits, the BIM model is cross-checked against itself and the actual resource for errors over the course of its development.

In addition, the BIM model allows for the simultaneous cross-checking of measurements across multiple dimensions. For example, measurements taken of interior rooms can be easily compared to measurements taken from the exterior of the building, not one elevation at a time but as a volume. Finally, perhaps the most useful aspect of BIM for Buildings Archaeology at an historic resource (that is not to be damaged) is its capacity to contain modeled partial elements suspended in an otherwise empty volume. In other words, isolated fragments of presumably contiguous structural elements can be located in the BIM model where they are identified in the resource, and checked for alignment and continuity.

Although it must be remembered that any suite of documentation is no replacement for the actual, original resource, there is no question that a good set of drawings can be an invaluable aid to the remote study of an historic building. As John A. Burns has noted,

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[75] John A. Burns, *Recording Historic Structures* (Washington, D.C.: American Institute Architects Press, 1989):viii.

"with the help of architectural and engineering documentation one can study a building…without necessarily visiting it."[76] While BIM is certainly capable of producing excellent drawings in a standardized format suitable for archival storage, there is an additional and hitherto underutilized attribute of 3D digital emulations of historic structures: the model *itself* can be shared with others, an attribute which allows unprecedented access by geographically distributed interested parties to minute details of the proxy resource.

Constructing a detailed model of any sort (be it basswood or digital) is an excellent means via which to *understand* the building being studied. It is a methodology of visual and cognitive dissection, a protocol for the careful examination of a building. John A. Burns writes in *Recording Historic Structures,* "quite apart from whatever value measured drawings may have as a historical record, the process of measuring and drawing careful records to scale is the most effective way to gain an understanding of a building's fabric."[77] This perceived value is noted elsewhere by Edward A. Chappell, who writes that "measuring a building encourages the recorder to recognize relationships *among different parts*"[78] (emphasis mine) and that "…doing measured drawings of a building is the best way to discover some of its consequential secrets."[79] A key component of Buildings Archaeology as an approach to the study of historic structures is this thorough understanding of the fabric and its parts, the careful and detailed inspection and recordation of which contributes to the unveiling of the "secrets" that they hold.

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[76] Burns, 1.

[77] Burns, viii.

[78] Edward A. Chappell, "Architectural Recording and the Open-Air Museum: A View from the Field," in *Perspectives in Vernacular Architecture, II*, ed. Camille Wells (Columbia, Mo: University of Missouri Press for the Vernacular Architecture Forum, 1986), 26.

[79] Chappell, 27.

New Information on the Briggs House

The 2010 report on the Briggs House included research into the historical background of the property, presented information on the structural system, and offered a preliminary condition assessment of the building. The present study contributes additional information on the structural system discovered through the use of BIM in the detailed investigation and rigorous recording of the structure of the Briggs House. New information discovered during this study that was not reported in the 2010 Briggs House study is summarized in Table 7.3.

The Utility of BIM in Buildings Archaeology

While some of the newly-recorded information noted above was discovered simply through close observation of the Briggs House, much is a direct demonstration of the strengths of BIM used as a tool in the investigation and recordation of this historic building. With reference to Table 7.2, multiple attributes of BIM contributed directly to the collection of new structural information at the Briggs House. Although these attributes are listed in Table 7.2 as independent features, the information gathered is a actually a result of their use in combination over the course of this study.

Study of the BIM model itself for completeness and potential omissions during its virtual construction led directly to questions about the assemblies and hierarchies in general, such as the nature of the connections of the hewn sills, the presence or absence of rim joists, and notably the asymmetrical presence of bird blocking in the wing attic. Further, the BIM model served as a vehicle to consolidate all of the data as it was being collected, including dimensions taken at multiple locations visually isolated by the presence of intermediate

Table 7.3. New information on the Briggs House.

FIRST BUILD	
Overall Construction	
The upright is built as a four-sided box The wing is built as a three-sided box	
Foundation Structure	
Posts	-
Piers	-
Sills	E-W sills over N-S sills, half-lap joinery Pegged with single treenail at corners
Floor Joists	No blocking or rim joists
Wall Structure	
Sill ledger	-
Wall planks	No pegging or splines
Old deck ledger	Roughsawn 1" x 4"
Top Cap	Roughsawn 2" wide x 4" high (upright) Roughsawn 4" wide x 2" high (wing)
Interior Walls and Upper Floor	
Single ply walls	No pegging or splines
Double ply wall	Positioned at a first-floor joist and the top of the stair stringers at a second-floor joist
Upper floor joists	2"x 8" @ 24" o.c. and, notched Bear on ledgers on plank walls
Stairwell	No evidence for other stair configuration
Roof Structure	
Ties	Wing ceiling joists 2"x 6" @ 24" o.c. Notched over top plate
Rafters	No bird blocking at south face wing roof Bird blocking at the north face wing roof Tails crudely removed south face wing
Skip sheathing	South face wing roof where overframed by the second build attic shows no evidence of shingles
Additional Information	
Door and window holes in the plank walls are notched into flanking planks Some doorways detectable from below due to the absence of plank tails Other doorways are not detectible from below	

assemblies such as floors or walls. This aspect of BIM is powerful, and led to the discovery of unsuspected material alignments, such as the vertical alignment of the double-layer plank wall with both a first-floor joist located in the crawlspace and a second floor joist located from within the wing attic, all of which corresponds to the position of the top of the stair stringers.

This capacity of BIM also served to demonstrate that the door and window holes in the plank walls are notched into flanking planks rather than being bracketed by full dimension planks. By locating and dimensioning plank tails in the crawlspace, and extrapolating them vertically, full height walls were constructed in the model. When these walls were overlaid with the window and door locations as measured from within the rooms, it was apparent that the holes were partially cut into boards adjacent to the openings.

Finally, through locating plank tails in the crawlspace, as well as areas along the length of a wall where there were *no* plank tails, and correlating this structural information with the measured locations of the doorways above, it was found that some doorways are detectable from the crawlspace while other doorways are not. In future studies of other box constructed houses, it may be possible to detect doorways hidden by finish material in the living space of the house without damaging the finish materials by looking for the absence of perimeter planking in the crawlspace below.

Future Studies

BIM is more than impressive renderings twirling around on a projection screen, though this is a common misconception. G. C. Skarmeas writes that “most people equate BIM to 3-D representations. However, it is the creation of a common database that can be shared by all project participants in both two and three dimensions…that makes BIM a major departure from the traditional way of producing a project.”[80] Further, “if the model is properly structured and can be used in the future, it can be the proper vehicle to monitor the behavior, performance, and deterioration of a building, using meaningful metrics that can

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[80] G.C. Skarmeas, "From HABS to BIM: Personal Experiences, Thoughts, and Reflections," *APT Bulletin* 41, no. 4 (2010):52.

help its long-term preservation."[81] It is certain that a well-constructed and supported BIM model can have an extended, and an expanded utility, in the service of Historic Preservation.

BIM can readily be used to record a building's original construction in preparation for its disassembly and later reconstruction, as often occurs with timber frame buildings. Further, any building facing full deconstruction would be well served by BIM recordation, most especially at the level of rigor required by Buildings Archaeology. Each building component can be accurately measured and located, and a complete digital model constructed that very closely emulates the original construction. Coupled with digital photographs, a very detailed approximation of the building can be assembled.

Finally, students working within the field of Historic Preservation who have not yet developed the drawing skills required to adequately describe a building graphically could well benefit from the use of BIM. Digital modeling is an excellent tool for learning to visualize complex shapes and their interactions, a skill that is of greater importance than simply tracing surficial information without a deeper structural understanding.

Nearly twenty years ago a technology in common use today was sufficiently novel to warrant the publication of a paper in the *APT Bulletin*. That technology was AutoCAD v1.1, and the title of the paper was "Computer Aided Recording: Proper Documentation for New Technology." Today, AutoCAD is *de rigueur*, but at the time there were many questions about the application of CAD to an endeavor that had previously been the exclusive province of hand drafting, including discussions about the precision afforded by the computer which far exceeded the accuracy of any measurements taken. "The use of computer-aided recording for drafting provides a new and more advantageous as-found

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[81] Skarmeas, 52.

record but requires a new way of thinking about the process and the product."[82] Of course, those "new ways" of thinking have been entirely absorbed into the functional toolbox of the preservation professional and are second nature to most any practitioner today. It is hoped that the techniques and technologies explored in the current study will be similarly familiar twenty years hence.

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[82] Hugh O'Brien, "Computer-Aided Recording: Proper Documentation for New Technology," *APT Bulletin* 26, no. 1 (1994): 52.

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