ABBREVIATED HISTORICAL STRUCTURE REPORT ON THE LUCAS MANSION IN HIDDENITE, NORTH CAROLINA

A Thesis
by
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Abstract

ABBREVIATED HISTORICAL STRUCTURE REPORT ON THE LUCAS MANSION
IN HIDDENITE, NORTH CAROLINA

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The primary aim of this study is to advise the responsible renovation of the gallery spaces of Lucas Mansion in Hiddenite, NC by evaluating the buildings architectural and historical significance and durability considerations. Lucas Mansion is a unique three-story wood framed house with a full two-story wrap-around porch that stands out among the relatively modest houses surrounding it. It is the only state or nationally registered historic building in Alexander County and is owned and cared for by the Hiddenite Arts and Heritage Center. The home was built in 1900 and expanded significantly during the first part of the twentieth century using an unusual method of raising the upper story and inserting a new story in the middle. This report includes an examination of the history of the building and its context, a survey of architectural elements, a whole building investigation of visible moisture degradation, and hygrothermal analysis of the exterior walls of the gallery spaces using WUFI®. Architectural recommendations made include retention of specific historic features, limited replacement in kind, reversal of inappropriate renovations, and the identification of expected concessions for programmatic needs. The applied treatment approach for this project is rehabilitation, as defined by the Secretary of the Interior. The moisture recommendations include the repair of identified

leaks and improvements in water disposal from the roof and site. Recommendations for wall assemblies were made based on hygrothermal analysis and industry standards. All recommendations made are in agreement with *The Secretary of the Interior's Standard of Rehabilitation.* The conclusion of this report contains specifications and recommendations that will assist the Hiddenite Art and Heritage Center in making informed decisions regarding the renovation of the gallery, and will help insure that proper care is taken in preservation efforts for this local historic landmark. This study also makes a concerted effort to gather known information about Lucas Mansion to support future research.

Acknowledgments

I would like to thank the Hiddenite Arts and Heritage Center for giving me the unique opportunity to research Lucas Mansion. I also want to extend a special thank you to Jody Servon and Pete Woods for making sure I had everything I needed to facilitate my research, and to Alison Houchins for sharing her unparalleled insight into the history of the Lucas Mansion.

I am enormously appreciative of the support of my thesis committee. Thank you to Dr. Andrew Windham for his patience in helping me work through the parts of my research with which I was the least familiar. Thank you to Dr. Marie Hoepfl for her guidance and support in both developing this document and navigating through my graduate career. A special thanks to my committee chair, Jason Miller, an encouraging mentor who assisted me in keeping my project manageable and reminded me that I am almost never as far behind as I feel.

I would like to thank my friend Jared for the very long and hard day of work he put in helping disassemble walls and for always being willing to let me get out a good vent, and to my friend Barry for helping me keep it all in perspective and being great company for the long hours I spent in coffee shops writing.

Most of all I would like to thank my family: my mom, sister, David, and Rusty have spent countless hours on the phone talking me through and reminding me of what I am capable. I have felt all of your love and support every step of the way.

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CHAPTER 1: INTRODUCTION

Introduction

This abbreviated Historic Structure Report of Lucas Mansion in Hiddenite, NC is targeted to inform a planned renovation of the building's second floor gallery space. Lucas Mansion is an architecturally unique regional landmark and the only state or nationally registered historic building in Alexander County. The Hiddenite Arts and Heritage Center, a non-profit organization that owns and maintains the mansion, manages different parts of the building for a variety of arts and cultural programming functions including a house museum, a permanent collections display, a rotating art gallery and gift shop, and the Alexander County welcome center (Hiddenite Arts & Heritage Center, 2016a). The Hiddenite Arts and Heritage Center wishes to renovate the rotating gallery section of the building, located on the second floor. Investigation of the history and current condition of the building is a critical precursor to any renovation of a historic property, to insure that educated decisions are made on appropriate architectural, constructive, or performance-improving treatments, greatly reducing the chances of accidently damaging significant irreplaceable features (McDonald, 1994).

This report includes an examination of the history of the building and its context, a survey of architectural elements, a whole building investigation of visible moisture degradation, and hygrothermal analysis of the exterior walls of the gallery spaces. Information regarding the history of the building and its context was gathered through the examination of primary and important secondary resources. An assessment of historically pertinent architectural elements was conducted in the historic sections of the building. The scope of the assessment was focused on elements that would help me gain a greater understanding of the gallery spaces where some of the original features were covered or removed. These elements included moldings, windows and doors, fireplaces, and interior finishes.

It was clear from my initial walk through that moisture is a prevalent problem throughout the building; a visual moisture survey spanning the historic section of the building was conducted in response to this observation. The survey created a record of current conditions and permitted a prioritized list of recommendations for further investigation to be produced. Additionally, two typical exterior walls in the gallery space were disassembled in order to gain information about the walls' make up. This information was then used to build hygrothermal models. WUFI, a software platform that calculates moisture and thermal transiency in building envelopes, was used to create the hygrothermal models of the current wall assembly as well as three alternate assemblies that are being considered for the renovation. Disassembling the walls provided the additional benefit of offering greater insight to the architectural and moisture investigations.

A Historic Structure Report is typically a comprehensive document that presents all known information about a property's history and existing condition, and makes treatment recommendations for a building as a whole. Due to resource constraints, the focus of this report is limited in focus on the present needs of the Hiddenite Arts and Heritage Center. The abbreviated nature of this report makes suggestions for future research an essential part of this document. This report aims to be a valuable resource for the property managers and future researchers of the Lucas Mansion.

Statement of the Problem

In the United States, historic wooden homes are demolished or condemned each year. This represents an irreplaceable loss to our cultural heritage. Many of these buildings exemplify architectural styles that are unique to the United States. A contributing factor to this problem is a lack of understanding of how these older wooden homes can meet modern comfort and environmental control standards without compromising their historical and structural integrity. The most significant threat to wooden buildings is poorly managed moisture. Wooden buildings will last for centuries if moisture is managed properly but can easily rot away in a single lifetime if neglected or mismanaged (Anthony, 2007). At the same time it is vitally important to our collective cultural heritage that these historic wooden building are maintained in a way that pays due respect to their history and character. A balance needs to be achieved between historic preservation and building science principles to support the stewardship and maintenance these important buildings deserve.

Lucas Mansion, in Hiddenite North Carolina, is a unique turn of the century home (Cross & Southern, 1981). This building embodies a brief time when American architecture transitioned out of the Victorian era. This era of American residential construction might be best characterized as creative eclecticism. A variety of co-opted styles was occurring simultaneously, ranging from neoclassical to Gothic Revival to Victorian to Arts and Crafts.

Lucas Mansion serves as a cultural center for the community and is the only registered historic building in the region (Hiddenite Arts & Heritage Center, 2016). The mansion, like so many other older buildings in the United States, is falling into disrepair due in part to inattention and misinformed renovations. Lucas Mansion has significant visible degradation due to moisture. The Hiddenite Arts and Heritage Center, which manages the property, wishes to renovate the building's gallery space. It is critical to thoroughly understand the building's historical significance and current condition in order to develop a responsible plan for renovation. Upon a preliminary walk through it was determined that a condition assessment to identify existing moisture problems, an analysis to identify appropriate wall assemblies, and historic investigation to identify character-defining elements of the space were all necessary to guide renovation work efforts.

Purpose of the Study

The purpose of this study was to enable the Hiddenite Art and Heritage Center to create an informed renovation plan for the second floor galleries that will increase the resiliency and respect the historic integrity of Lucas Mansion while at the same time addressing their programmatic needs. This abbreviated Historic Structure Report or "Preservation Plan" was prepared to deliver this information. The availability of this report will hopefully decrease the likelihood that inappropriate or possibly irreversible changes will be made in the proposed renovation that could damage the building's historic character or decrease its longevity (Slaton, 2005). This document should be an informative resource for Hiddenite Arts and Heritage Center in its efforts to preserve Lucas Mansion in the planned renovation and beyond. This document could also provide the Hiddenite Art and Heritage Center information to support fundraising and grant writing efforts. Additionally, this study lays the groundwork for future research in collaboration between the Hiddenite Arts and Heritage Center and the Department of Sustainable Technology and the Built Environment at Appalachian State University.

Research Questions

Question 1: What architectural elements/features define the historical character of the second floor gallery rooms of Lucas Mansion?

Question 2: What is the extent of visible moisture degradation in Lucas Mansion, and what are possible causes?

Question 3: How can renovations of the exterior walls of the gallery spaces on the second floor of the Lucas Mansion be carried out to address moisture and durability concerns?

Limitations of the Study

Due to a limited budget and time constraints, a full Historical Structure Report was not feasible. This abbreviated report was prepared with a focused investigation of the gallery space on the second floor and emphasis on the immediate renovation needs of the building to reduce instances of deterioration. Moisture was identified as a primary problem and therefore is a focus of the research into the building's resiliency. Incomplete records proved an obstacle to gaining a complete understanding of the building's maintenance and structural history.

Not all interior surfaces were fully visible during the room-by-room moisture survey. The building was still operating as a gallery and museum during the data collection phase of this research. The walls and windows in some rooms were obstructed by display cases or large pieces of historic furniture that could not be moved to access the surfaces behind. There were also large areas of the attic and crawlspace that were inaccessible to inspect because they were too small to access.

The applicability of this study is relatively narrow. It will be of great use to the Hiddenite Arts and Heritage Center in their efforts to preserve Lucas Mansion; however, it is not directly applicable to other historic buildings. All historic buildings are unique in their history, construction, and environment and therefore must be studied individually. The methodology of this study might be adapted successfully for use in other studies on historically significant buildings.

Significance of the Study

Lucas Mansion is an architectural novelty and an irreplaceable cultural resource. The Hiddenite Arts and Heritage Center's website calls Lucas Mansion "a part of our collective history and our shared future, serving as a beacon for the arts" (2017b, para. 7). The Center's

National Historic Register nomination form notes the significance of the building demonstrating a level of prosperity that was uncommon in the region during early 20th century. This building has been recognized at both the state and national level as being worthy of preservation. The findings of this study will assist members of the Hiddenite Center staff who have been charged with the responsibility of preserving Lucas Mansion to make decisions regarding its renovation and maintenance. The methodology of this abbreviated Historic Structure Report also provides a model of a flexible process for building owners and managers of other historic buildings who have limited resources available for evaluation.

CHAPTER 2: REVIEW OF LITERATURE

Value of Historic Buildings

Historic buildings lend their communities a physical biography and a sense of identity. Their preservation encourages regional reinvestment, promotes community pride, and creates a link to the past for future generations (Howard, 2007). These buildings are important pieces of our collective knowledge of our history and culture and should be respected and maintained with the same reverence as our museums and libraries, to be a resource for future research.

Turn of the Century North Carolinian Architecture

The transition from the 19^{th} to 20^{th} century was an interesting time in America. The Victorian era, marked by the reign of Queen Victoria (1837-1901), was ending and progress toward truly "American" forms of architecture was emerging. The Victorian era was a time of remarkable change in architecture, marked by an explosion of energy and creativity across cultures. Striking advances in art, industrialization, social awareness, and architecture developed in concert. At the time, architects in the United States were taking their cues from British and French designs and re-inventing them in wood (Boyd & Sieburg-Baker, 1984). The invention of the sawmill and mass producible wire nail led to Americans developing an entirely new way of building using light wood framing, which is still the predominant method of residential and light commercial construction in the U.S. today (Bishir, 2005).

The new method was flexible and quick. Ease of construction paired with newfound freedom of expression paved the way for exceptionally elaborate and ornate architecture. The most ostentatious of the time was the Queen Anne style, which first appeared in North Carolina in the 1880s. This style was late to arrive in North Carolina due to conservative tastes and economic conditions of the state. The style was never fully accepted in most rural communities. Houses built in this style in rural North Carolina tended to be less ornate than their urban counterparts. Despite being less expressive, Queen Anne style structures were often met with contentious response from these more conservative rural communities, and relatively few were built in these areas. This unabashed style was marked by tall hip roofs with protruding gables and dormers, a large number of diverse rooms, and a variety of materials and finishes. These houses were generally rectangle in plan and made remarkably irregular with the addition of bays, wings, and balconies. The Queen Anne's reign as a dominant style in North Carolina was relatively short-lived. In the late 19^{th} and early 20^{th} century there was a distinct movement toward simplification. Popular interest was renewed in symmetry and classical styles such as the Greek revival (Bishir, 2005).

Figure 1. Present-day photo of the Hiddenite Arts & Heritage Center (Lucas Mansion) (Hiddenite Arts & Heritage Center, 2017a).

Lucas Mansion

The construction of Lucas Mansion bridges this time of transition in American architecture. The mansion does not conform fully to the conventions of either architectural style

(Figure 1). The building's architecture is informed by three important influences: the Queen Anne Style, the early 20th century's return to symmetry, and the architectural vernacular of its rural location. The National Registry Nomination Form identifies Lucas Mansion as a Queen Anne style structure, but admits the building does not fit cleanly into this category (Cross & Southern, 1981).

Historical and Architectural Investigation

Experts in the field unanimously agree that historical and architectural investigation is a critical step before any treatment is applied to a historic property. A full investigation can insure that educated decisions are made on appropriate treatments and can reduce the chances of accidently damaging irreplaceable features. These investigations typically include history of construction and use, how the structure has changed over time, and an assessment of current levels of deterioration. Investigations can range wildly in scope from a simple one-hour walk-through to a multi-year project, depending on the available resources and the needs and complexity of the property. Historic research should be conducted in advance of physical investigation to provide context and direction to a physical investigation. All projects should begin with the simplest, non-destructive processes and proceed as necessary (McDonald, 1994).

Documentation of Historic Structures

The most common professional document for recording these investigations is a *Historic Structure Report.* Historic Structure Reports provide information about a property's history, existing condition, and recommendations for future use and care. A full report strives to collect all known information regarding the property in one document. Once created, these reports become an indispensable resource for property owners/managers and future researchers. Preparation of a report is the optimal first phase of any renovation project. It helps ensure that the history, significance, and condition of the property are thoroughly understood and that a truly appropriate treatment plan can be developed. These reports are meant to be living documents to which additional information can be added as physical work or research is conducted, or edited as more information becomes available (Slaton, 2005).

There are two principal sections to a Historic Structure Report. The first section is a narrative that documents the evolution of the building, its physical description, existing condition, results of research/testing, and an evaluation of its significance. The second section focuses on recommendations for a treatment approach. These recommendations are typically prioritized, explained, and grounded in historic preservation objectives (Slaton, 2005).

Abbreviated Historic Structure Reports

The scope of work and level of detail necessary in a Historic Structure Report is highly variable depending on the property's significance, condition, intended use, and available funding. The scope of a report can be narrowed to answer critical questions in a limited report (Slaton, 2005). These shorter reports are often called Preservation Plans.

Preservation plans are usually prepared when the scope of work is small enough that a full Historic Structure report is not justified, or if funds and resources are limited. Preservation plans are often utilized to assess and guide a proposed treatment and are therefore more targeted in nature. The scope of a preservation plan tends to be limited to only the research, condition assessment, and documentation required to substantiate recommendations for the proposed project (Hawkins, 2007).

Unlike a typical Historic Structure Report they are not meant to be a complete record of existing conditions, rather to provide information for responsible care and renovation. To identify whether a Historic Structure Report or a Preservation Plan is more appropriate, one must evaluate how the document will be utilized, the extent of proposed interventions, the level of significance of the structure, the availability of historical documentation, the condition of the property, and the available funding. Due to their limited scope, identification of areas of future research often becomes a critical part of preservation plans. Clearly defining areas of future research allows owner and property stewards to continue research endeavors as funds and resources become available (Hawkins, 2007).

Guidelines for Maintaining Historical Integrity

Secretary of the Interior's Standards and Guidelines

The Department of the Interior sets the standards for the treatment of historic properties in the United States. The Department has developed four treatment approaches for addressing historic structures: preservation, rehabilitation, restoration, and reconstruction. Preservation is the active process of sustaining a building's historic and structural integrity through repair and regular maintenance. Rehabilitation is altering the space to serve a new use while maintaining specific features that help express the space's architectural, cultural and historic value. Restoration is defined as an endeavor to accurately portray the space as it was in a particular time period. Reconstruction refers to the re-building of a non-surviving structure or landscape as a new construction project, with the purpose of replicating the appearance at a specific time. Buildings may employ more than one approach in different parts of the building (Hawkins, 2007).

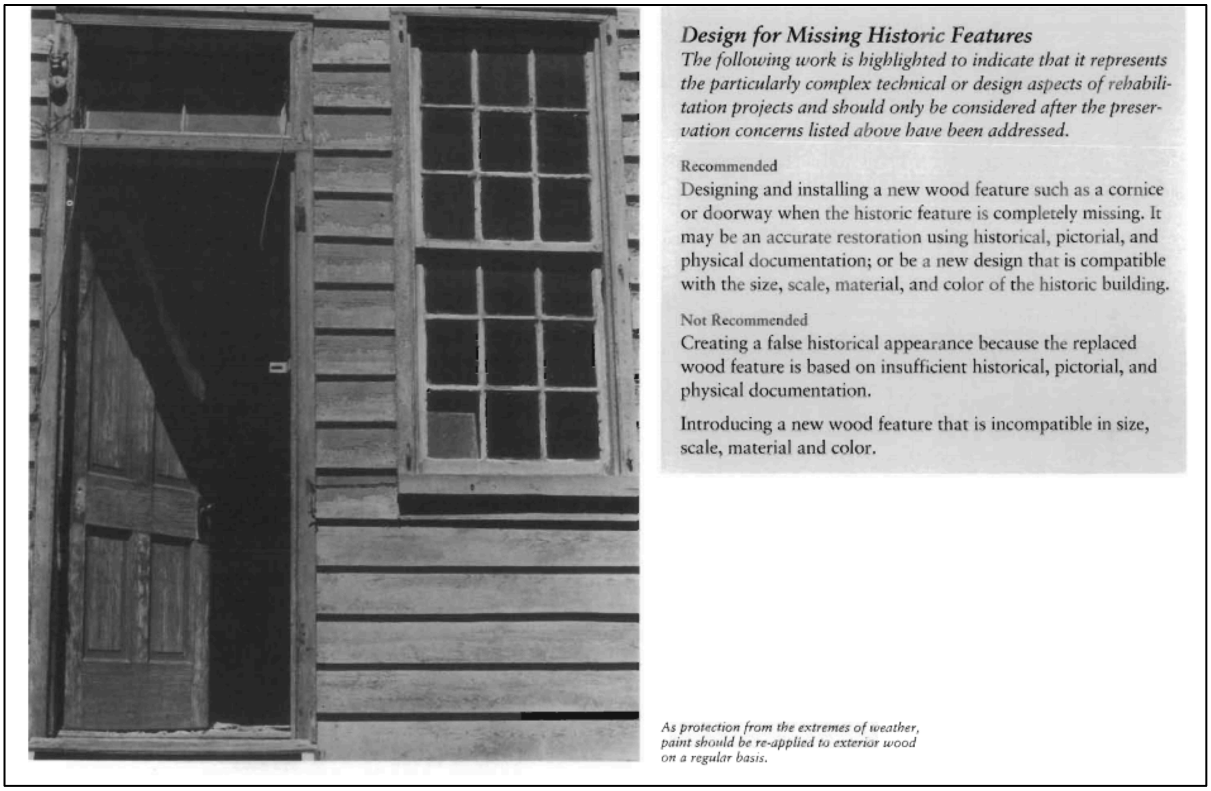
Secretary of the Interior's Standards for Rehabilitation

1. *A property shall be used for its historic purpose or be placed in a new use that requires minimal change to the defining characteristics of the building and its site and environment.*
2. *The historic character of a property shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize a property shall be avoided.*
3. *Each property shall be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or architectural elements from other buildings, shall not be undertaken..*
4. *Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved*
5. *Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a historic property shall be preserved.*
6. *Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.*
7. *Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the gentlest means possible.*
8. *Significant archeological resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.*
9. *New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.*
10. *New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired*

Figure 2. The Secretary of the Interior's standards for rehabilitation (Grimmer, Hensley, Petrella, & Tepper, 2011, p. viii-ix).

The Secretary of the Interior has developed a list of ten standards for building rehabilitation that must be observed in order to receive state or federal support for historic registered properties (Figure 2). The standards are designed to reduce destruction of materials, features, and finishes that define the building's historic character, and have been adopted by the historic preservation community as a gold standard. These standards put a high priority on preserving historical character, distinctive features, finishes, and construction techniques. In all cases it advises that removal or alteration of historic elements is to be avoided. Whenever possible, damaged historic features must be repaired rather than replaced. When replacement is deemed absolutely necessary, great care must be taken to match old features. These standards prohibit additions and changes that create a false sense of history or that obscure or destroy historic character. The standards acknowledge most properties undergo changes in use throughout their lives, stating that it is important that if a building is to have a new use this use must be compatible with the building, its site, and environment. This means the new use should involve minimal changes to defining characteristics of the building (Grimmer, Hensley, Petrella, & Tepper, 2011).

Unlike the *Secretary of the Interior's Standards for Rehabilitation*, the *Secretary of the Interior's Guidelines for Rehabilitation* are advisory, not regulatory. The guidelines are an extensive document that outlines suggestions of best practice. The guidelines were developed to help property owners and managers apply the *Secretary of the Interior's Standards for Rehabilitation*. These guidelines can help in delineating what element contributes to a building's historic character. All buildings are different, and must be studied individually, which is why the guidelines allow for flexibility in application (Grimmer, Hensley, Petrella, & Tepper, 2011). They are set up as lists of recommended and not recommended approaches, treatments, and techniques (Figure 3).



Design for Missing Historic Features

The following work is highlighted to indicate that it represents the particularly complex technical or design aspects of rehabilitation projects and should only be considered after the preservation concerns listed above have been addressed.

Recommended

Designing and installing a new wood feature such as a cornice or doorway when the historic feature is completely missing. It may be an accurate restoration using historical, pictorial, and physical documentation; or be a new design that is compatible with the size, scale, material, and color of the historic building.

Not Recommended

Creating a false historical appearance because the replaced wood feature is based on insufficient historical, pictorial, and physical documentation.

Introducing a new wood feature that is incompatible in size, scale, material and color.

As protection from the extremes of weather, paint should be re-applied to exterior wood on a regular basis.

Figure 3. Example page from the Secretary of the Interior's *Illustrated Guidelines for Rehabilitating Historic Buildings* (Grimmer, Hensley, Petrella, & Tepper, 2011, p. 15).

National Park Service Preservation Briefs

The National Park Service (NPS) is the arm of the U.S. Department of the Interior that is responsible for the preservation of historic properties. Their website in an indispensable resource for any work on a historic property. Not only can one find full versions of the Secretary of the Interior's standards and guidelines, the site also contains a plethora of additional resources on topics ranging from tax incentives to educational trainings to how-to guides. One of the most valuable resources on the NPS website is the Preservation Briefs. The Preservation Briefs are 48 separate documents written by experts in the field to provide guidance on preserving, rehabilitating, and restoring historic buildings. Each brief covers a different topic to help building owners recognize and address common problems in historic structures. Much like the Secretary of the Interior's Standards and Guidelines, the Preservation Briefs are especially useful for those interested in applying for grants and tax incentives, because they are in line with the nationally recognized approaches for maintaining historic buildings (National Park Service, 2017b).

State and National Registry of Historic Places

The Historic Preservation Act of 1966 established the National Register of Historic Places. The register is an official list of places and structures worth preserving. It was created to "support public and private efforts to identify, evaluate, and protect America's historic and archeological resources" (National Park Service, 2017a, p. 1). Their regulations act as an authoritative guide to identifying the nation's cultural resources. Properties are evaluated based on "the quality of significance in American history, architecture, archeology, engineering, and culture [as it] is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association" (National Park Service, 1981, p. 30). Listing private property in the Registry gives the owner more leverage when dealing with developers or other parties that might threaten the future of the property; however, being on the registry does not place any restrictions on what a private owner can do with the property. The language of their regulations states, "listing of private property on the National Register does not prohibit under Federal law or regulation any actions which may otherwise be taken by the property owner with respect to the property" (National Park Service, 1981, p. 4). There are, however, formal steps to follow if an owner wishes to alter a property's boundaries or relocate buildings.

The North Carolina State Registry has more strenuous regulations. Owners of listed properties must obtain a *certificate of appropriateness* prior to making any significant changes to the property, including additions, relocations, and demolitions. Certificates are not necessary for regular maintenance or interior renovation that does not change the design, material, or appearance of the building's exterior. Local preservation commissions issue these certificates. Commissions typically adopt or adapt design guidelines, often the *Secretary of the Interior's Standards,* which they use to judge the appropriateness of proposals. Commissions do not have jurisdiction over the interiors of privately owned buildings unless it is a designated landmark or the owner has given permission for interior review. Consent to interior review binds the future of the property regardless of change of ownership to continuing review (North Carolina State Historic Preservation Office [NCSHPO], 2013).

Building Codes

Most buildings considered for historic status or preservation preceded the establishment of modern building codes. When these buildings undergo any kind of intervention or changes that require building inspection, the entire building may be subject to the requirements of the full building code. This can create major roadblocks for an owner completing a project. Codes that most often present a challenge to preservation, renovation, replacement, or reconstruction projects include fire safety codes requiring fire blocking and two means of egress in public buildings. In buildings that have two or more levels, owners are often required to add a second staircase. In some cases, fire codes permit exceptions to some of their toughest provisions if a sprinkler system is installed (Tyler, Ligibel, & Tyler, 2009).

Accessibility codes also prove extremely challenging to satisfy. With passage of the Americans with Disabilities Act (1990), access to properties open to the public is now a civil right. Many historic buildings have raised entries with stairs; access ramps often have to be constructed to conform to the ADA. Adding such a dominant feature makes maintaining the historic character of a property a significant design challenge. Elevators are also often required in multi-story buildings. This can be difficult if there are no spaces that lend themselves to this type of addition.

Accessibility codes also require large restrooms to enable maneuverability for those persons using wheelchairs or walkers. The floor plans of historic buildings often do not lend themselves well to these requirements without altering the location of existing walls or removing existing plumbing fixtures. In some cases, it is not possible to comply fully with accessibility standards without damaging a building's appearance. In these instances, the ADA includes equivalent facilitation provisions that allow limited access to some parts of the building if an accessible alternate experience is available as a substitute (Tyler et al., 2009).

Rehabilitation Codes

Many states, including North Carolina, have recognized these difficulties and have adopted rehabilitation codes. These codes are meant to better address the unique problems associated with historic buildings. Rehabilitation codes recognize that standard building codes have been developed with new construction in mind and often do not translate well when applied to existing structures. These codes offer allowances for projects in order to encourage upgrading of buildings, and are more flexible for historic building projects (Mecklenburg County Code Enforcement [MCCE], 2006).

Requirements are based on the type of work rather than the extent of the work. The code contains six predefined categories of work that correspond to a list of required code compliances and allowances. The categories, listed from the least-stringent code requirements to the most stringent, are: repair, renovation, alteration, reconstruction, change of use, and additions. The repair category applies to projects that are simply replacing materials, systems, or components with similar or identical elements. Renovation projects can also include removal, replacement, or covering of existing interior or exterior finishes with a new material that serves the same purpose. Alteration codes apply when the project reconfigures the space by the construction or demolition of walls or partitions, change in ceiling height, or addition or elimination of any doors or windows. Alteration codes also apply to projects that install additional systems or equipment that introduces a new load to the building's structure. Reconstruction codes refer to projects with a scope of work that prohibits building occupancy while work is in progress and requires a new certificate of occupancy before the building can be reoccupied. A change of use project aims to make a building suitable for a different use, such as renovating a warehouse to be used for apartments. Finally, additions are projects that increase the footprint or number of stories of a building. Additions are classified as a type of new construction and are held to full scrutiny of the current building code (North Carolina Code Enforcement, 2014).

Assessing Historic Buildings

Assessing older buildings is a complex, multi-layered, and frequently interdisciplinary process. The investigator must act much like a detective, uncovering the layers of history. A multitude of methods are used to pull together bits of information from numerous sources to produce a complete story.

Architectural Significance

There are two distinct steps in assessing architectural significance: historical research and physical investigation. The research component includes gathering information about historic architectural vernacular of the local region. Stylistic periods are relatively subjective, because they generalize across huge geographical regions and time periods. Local variations in construction conventions and building styles must be investigated to properly understand the building's context. A detailed understanding of the history of the building must also be established (McDonald, 1994). This understanding emerges through the review of documentation of the building, historic photographs, news clippings, construction plans, local records, permits, and historic registry documents. Engaging in historic research first gives context to the physical investigation (Tyler et al., 2009).

Physical assessment is the methodical documentation of relevant physical attributes. When assessing the interior of a historic building the investigator must first take note of the sequence and relationship of the interior spaces, then record the size and space of individual rooms and, finally, document relevant architectural features. Interior features include such things as trim, decorative motifs, fireplaces, stairways, arched openings, balustrades, etc. These features should be documented on a room-by-room basis. All materials and finishes should be noted with their condition described (Jandl, 1988). This information may be documented through detailed field notes, annotated photos, and drawings (McDonald, 1994).

The information gathered in the physical assessment may be cross-referenced with the historical research to help identify the character-defining elements. According to Preservation Brief #17, published by the National Parks Service, character-defining elements are those that have qualities that "convey a sense of time and place" (Nelson, 1982, p. 1).

Infrared Thermography

Thermography is regularly used in building surveys to scan walls and quickly identify areas of concern that are in need of further investigation. This technique is particularly appealing for historic buildings because it is non-destructive in nature and allows investigators to be more targeted with invasive measures (Pinchin, 2008). The two primary uses for thermography in historic building assessments are identification of hidden construction details and detection of moisture. This tool can be useful in determining the position, shape, and dimension of elements such as studs, posts, and joists in structures with hollow cavity wood-stud walls (Rosina & Robison, 2002).

Moisture Assessment

Poorly managed moisture is the most common cause of deterioration of historic buildings. Moisture can lead directly to a diverse range of problems including erosion, rot, corrosion, and mold. If left unattended it will destroy materials, finishes, and structural components. To assess moisture, it is important to understand its patterns of movement. Moisture moves as a liquid or a vapor based on a variety of forces, with vapor pressure and air pressure being two important drivers of water vapor that can damage buildings without the pronounced signs of liquid water damage (Parks, 1996).

Historic buildings were designed to work with the movement of air. Misinformed attempts to modernize, increase the thermal resistance, or change the use of these buildings often cause chronic moisture conditions. Older buildings in the United States generally have a natural air exchange of between 1 and 4 air changes per hour (Parks, 1996, p. 4). In contrast with modern buildings, the moisture that enters these older buildings is also given a means of rapid drying. Air circulation and vapor diffusion are important means of drying that older buildings utilize. It is important to weigh these factors when considering approaches for increasing thermal resistance of exterior walls, such as insulation and air sealing, to make sure alternation will not create new problems (Parks, 1996).

Moisture is never eliminated in building structures. The goal is to mitigate the potential for damage by maintaining a balance between material wetting with moisture storage capacity and drying capability. This is most commonly achieved in historic buildings through regular maintenance, effective water drainage, air circulation, and ventilation. Diagnosing the cause of moisture problems requires not only an understanding of localized deterioration, but of the entire building and its relationship to its site. One must trace the path of visible degradation to the point where moisture is entering the building (Parks, 1996).

A visual survey of moisture-related deterioration is a rapid and effective means of identifying problem areas in need of further inspection. These investigations should be thorough, with room-by-room evaluations of the whole building, but focused attention should be given to common problem areas such as areas with visible decay or stains, roof penetrations, attic sheathing, wood in contact with the ground, floor joists and girders where they rest on exterior walls, fenestrations, and porches (Anthony, 2007).

Implications of Insulating and Air Sealing Historic Wall Systems

An energy retrofitting is often an important part of renovating historic homes to make them comfortable and to keep energy use affordable, but the addition of thermal insulation and air sealing can compound uncontrolled moisture. When assessing the impacts of moisture on the durability of a building it is less important how wet a building gets than how well it is able to dry out after becoming wet. Drying requires energy, usually in the form of heat or air movement, and a path for the moisture escape. Older buildings were built to breath, meaning that they allow air, moisture, and thermal energy to pass fairly easily through their structures. They can tolerate wetting because of their high drying potential that allows for rapid evaporation. Insulation reduces the amount of thermal energy moving through wall systems, and therefore reduces the drying potential of an assembly. Air sealing can block the pathways for moisture to escape (Lstiburek, 2016).

When combined with mechanical air-conditioning, the effects can be particularly destructive. Cooling and dehumidifying older buildings that are drafty or lack a vapor control layer during warm and humid conditions can cause the warmer air and higher-humidity air from outside to move toward areas with cooler air and lower humidity inside, effectively pulling moisture through the wall via vapor diffusion. When insulation is added to a wall it can change the dew point temperature in the wall, which leads to the vapor condensing inside the assembly.

This type of migration is limited in modern buildings by vapor retarders integrated into the wall assemblies at the time of construction. Historic buildings rarely contain vapor retarders. Adding an effective vapor control layer retroactively requires removal of a substantial amount of material. This is often a very expensive, difficult, and in many cases unfeasible process. Adding a vapor barrier retroactively can cause the destruction of irreplaceable original finishes. This type of retrofit also has the potential to make moisture problems worse if executed poorly, because it can trap moisture in the walls. It is often necessary to develop solutions that do not require a vapor barrier (Spotts, 2008).

In most historic wall systems, it is usually possible to navigate these problems to air seal and insulate responsibly, but it requires a great deal of understanding of material properties and moisture movement. A full hygrothermal analysis is advisable prior to developing a solution (Little, Ferraro, & Arregi, 2015).

Hygrothermal Analysis

Hygrothermal analysis is an extremely important step in planning a responsible energy retrofit of a historic building. A hygrothermal analysis is an analysis of how heat and moisture move through building assemblies. Historic buildings were built before building codes standardized the moisture and thermal control layer and, therefore, there is a huge range of wall make-ups with respect to moisture and temperature mitigation strategies. As explained above, applying modern retrofits to historic buildings without a firm understanding of its effects can result in serious moisture problems, making this sort of analysis imperative. There are two general methods for hygrothermal analysis used to assess condensation risk in building components: dew-point calculations and numerical simulation (Little et al., 2015).

The dew-point method utilizes steady-state calculations that decouple heat and moisture transport equations. The average of the conditions for each month of the year is used to calculate vapor pressure and determine if the inside of a wall reaches saturated vapor pressure, which would cause condensation. In order to do these calculations, broad assumptions have to be applied and data must be simplified. Additionally, these calculations look at vapor diffusion driven by the vapor pressure differential, leaving out other, possibly significant ways that moisture could be moving into the building systems (Little et al., 2015).

Numerical simulations use software, like WUFI®, to create complex computer-models to solve the coupled heat and moisture transport equations for each hour of the year. These calculations evaluate the full hygrothermal performance of a wall system, including temperature and both a liquid and vapor moisture, and do not require data to be simplified. This can produce more accurate results (Little et al., 2015). The primary drawbacks to numerical simulations are they require more inputs by the user and more time and skill to make a suitable model and to, in turn, interpret the results of that model. It is important to note that both of these analyses are only as accurate as the inputs and interpretation. It is therefore critical to ensure accurate data and to have the analysis done by a professional. For the highest level of accuracy, both methods should be used with data validation if at all possible (Straube & Schumacher, 2006).

WUFI®.

The Oak Ridge National Laboratory and the Fraunhofer Institute of Building Physics collaborated to create the software program WUFI®. This program helps researchers conduct complex hygrothermal analysis using computer modeling. It was designed to be intuitive without sacrificing function. The program is able to evaluate a wide range of building materials and climate conditions. WUFI® is available in the United States free of charge, making this effective building evaluation tool very accessible. It uses information about building material properties and local weather data to create a 1-D model that evaluates vapor diffusion, liquid transport, and phase changes. Together, these phenomena could account for 80% of total moisture load in building envelopes. WUFI® is a powerful tool for selecting an appropriate building envelope retrofit strategy. With the program the hygrothermal effects of several options can be quantified and compared, making WUFI® a great tool for the development and vetting of appropriate building envelope retrofitting strategies (Karagiozis, Kunzel, & Holm, 2001).

The material database incorporated into the WUFI® program contains most materials commonly used in North America. This allows the user to easily and accurately represent the composition of the wall. Application of this program requires knowledge about construction material properties to validate chosen material parameters. The program also requires the user to select weather data from an attached database or to load hourly weather data file that includes relative humidity, wind speeds/directions, driving rain, and solar radiation. Once this information is supplied to the program it can complete an hour-by-hour calculation of the evolution of temperature and moisture in the building components over a span of three years. The program produces several outputs from its calculations (Figure 4) (Karagiozis, Kunzel, Holm, 2001).

WUFI® Calculation Outputs
Heat flux densities through the interior and exterior surface, respectively
Temperatures and relative humidity at monitoring positions of your choice (e.g., at the interior and exterior surfaces, or in the middle of an insulation layer)
Mean moisture content of each material and the total moisture content of the entire building component
Temperature across the assembly,
Relative humidity across the assembly,
Moisture content across the assembly.
A film file, which contains the transient profiles over all time steps and thus allows to display the thermal and hygric processes in the building component as an animation

Figure 4. WUFI® calculation outputs (Karagiozis, Kunzel, & Holm, 2001, p. 5).

CHAPTER 3: METHODOLOGY

This methodology is designed to target key questions regarding the remodel of the gallery spaces on the second floor Lucas Mansion. The purpose of this study was to ensure informed decisions for appropriate treatment of these spaces are made within a composite framework of historic preservation goals and building science principles. This research included an examination of the history of the building and its context, field observation of architectural features, a survey of visible moisture degradation, a physical investigation of an exterior wall typical of the gallery rooms, and hygrothermal analysis of current and proposed exterior wall assemblies.

Data Collection Procedures

Historical Background and Context of Lucas Mansion

Research on the historical background and context of Lucas mansion was conducted in advance of physical investigation to provide a framework for the research (McDonald, 1994). Information regarding the building's architectural and cultural significance and the chronology of the building's use and ownership provided valuable context to the remainder of the study (Tyler et al., 2009). This information was gained through a review of historic photographs, written records, oral histories, architectural drawings, and other pertinent primary and secondary resources. This property has a National Historic Registry Nomination Form that was completed in 1981 (Cross & Southern, 1981) and which was a particularly valuable resource for determining architectural and cultural significance and for identifying primary resources. The Hiddenite Arts and Heritage Center has an extensive collection of photographs and documents relating to Lucas

Mansion and the surrounding community.[1] The Center also collected oral histories regarding Lucas Mansion.[2] All of these resources were examined and used to construct a narrative that clearly delivers information relevant to this study.

Prior treatment and maintenance efforts were also investigated. This was done through the review of architectural drawings, construction specification, written records, and interviews with Hiddenite Arts and Heritage Center staff members.[3] This information was also developed into a narrative (Hawkins, 2007).

In accordance with common practice in historic preservation documentation, all historic photographs, drawings, and documents that are cited in this report are also included in the appendices to allow for ease of future research (Hawkins, 2007).

Interior Architecture Investigation

It was necessary to conduct a detailed field observation of the entire building's interior architecture, because a renovation completed in the 1980s dramatically affected the historic character of the gallery rooms. The first step of the architectural investigation was to identify the character-defining elements still present in the gallery spaces and then to develop questions about what elements might be missing. Character-defining elements are those that have qualities that "convey a sense of time and place" (Nelson, 1982, p. 1). Architectural moldings, windows and door, fireplaces, and finishes were identified as character-defining elements that are still present or possibly were present in the gallery spaces. This is discussed further in the *Identification of Character Defining Features* section of Chapter 4. Detailed information about the form, material, finish, and condition of the identified features was documented through a methodical room-by-

[1] A number of photographs from the Hiddenite Arts and Heritage Center collection were digitized and are included in Appendix G (attached CD ROM).
[2] Oral histories cited in this document are included in Appendix G (attached CD ROM).
[3] Interviews conducted with Hiddenite Arts and Heritage Center staff members for this study were recorded. These recordings are included in Appendix G (attached CD ROM).

room observation of the entire building (Jandl, 1988). The information was cataloged in field notes, photographs, and sketches (McDonald, 1994). A field note checklist was developed based on the recommendations of three National Park Service Preservation Briefs, and this was used to guide these field notes.[4] This decreased the likelihood of oversight while also increasing the standardization of observations. Infrared images were also taken to help determine the wall structures and whether insulation is present[5] (Rosina & Robison, 2002).

Wood moldings around the doors and windows were noted as a particularly important part of preserving the character of the gallery space. Extra care was taken in their documentation. Detailed scaled drawings were created of every molding style found in the building and then cataloged by room. (Hawkins, 2007).

As-built schematic drawings were created of the entire building using Autodesk Revit, a building informational modeling (BIM) software program.[6] This was done both to be able to generate visual aids for my research and to be a resource for the Hiddenite Arts and Heritage Center's effort to support future research. The Revit model was created based on architectural drawings from the 1980s addition, and verified and edited based on field observations and measurements (Hawkins, 2007).

The photographs, to-scale molding drawings, and the schematic drawing set are included in the appendices for ease of future research. Additionally, the complete Revit model file of Lucas Mansion has been submitted to the Hiddenite Arts and Heritage Center.

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[4] Architectural field note checklist is included in Appendix A.
[5] Infrared images are cataloged by room and included in Appendix G (attached CD ROM).
[6] As-built drawing set is included in Appendix B and a full Revit working file is included in Appendix G (attached CD ROM).

Condition Assessment

A general condition assessment of interior spaces in the historic sections of the building was conducted as part of the room-by-room investigation. Interviews with the building caretaker were particularly valuable in developing a cohesive understanding of the building's condition. It was clear from a preliminary walk-through and from speaking to the building's caretakers that moisture is a significant and recurring facility management problem.

Moisture survey.

A room-by-room survey of all visible moisture-related deterioration was conducted in the historic sections of the building using a prepared worksheet made using Google forms. (Figure 5). In this worksheet each instance of moisture-related deterioration was assigned an identification number. The location was recorded by: (1) room number; (2) if the instance was on the ceiling, floor, north, south, east or west walls; and (3) its approximate location on that surface.

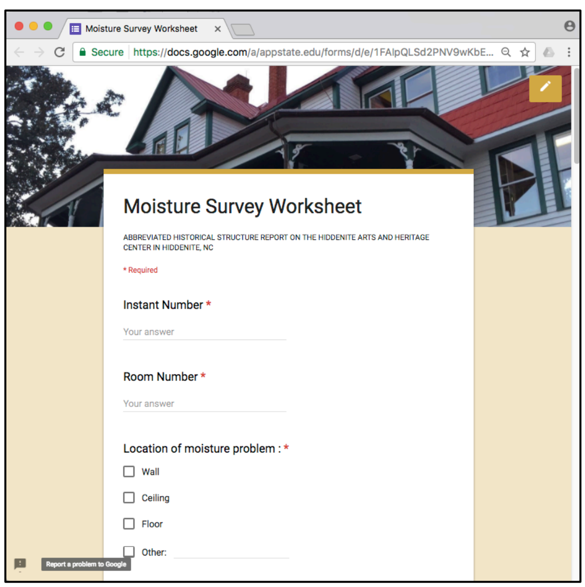

Figure 5. Screen shot of Google form moisture survey observation worksheet used to standardize observation and data collection.[7]

[7] Full copy of Google form included in Appendix A. The form can also be accessed online at https://goo.gl/forms/tJ5erAOJ6mkne6fY2

The approximate location of moisture damage on the surfaces was recorded by dividing the surface into a three-by-three grid. For walls the grid was divided by top, middle, and bottom vertically and left, middle, right horizontally. For ceilings and floors the grid was divided by north, center, and south vertically and west, center, east horizontally. If an moisture damage stretched into more than one zone it was recorded as separate instances for each zone in order to instances accounting for its size. The type of material, type of moisture problem, and severity of the problem was noted for each instance. Options for type of moisture problems included in the worksheet were presence of biological growth; water stains; eroding surfaces; efflorescence; flaking or blistering of finished surfaces; musty smells; rust; corrosion stains; cupped, warped, cracked, or rotted wood; sagging; holes; cracks; and peeling paint (Anthony, 2007). Severity of the damage was rated from one to five, with one (1) being easily repairable, and five (5) needing replacement. It was also recorded if the instance was proximal to a penetration or building material transition. For walls, the form also asked if they contained an exterior door or windows, if those fenestrations were covered, and if the moisture instance was adjacent to them. At the end of the form there was a place for additional notes if necessary to clarify the answers to the formatted questions. A photograph of each moisture instance was taken at the time of the survey and given a number stamp that corresponded to the instance identification number.[8] The attic and crawlspace were generally assessed, but these areas were outside the scope of the detailed survey. In this research moisture damage on the exterior of the building was only assessed as it pertained to damage found in the interior.

It is important to note that the purpose of the visible moisture survey was not to quantify the moisture degradation of the building but rather to help identify general problem

[8] Images of documented instances in moisture survey and collected data are included in Appendix D.

areas in the building and their relationship to each other so that potential causes and areas of further investigation can be determined effectively. This survey was also meant to provide the Hiddenite Art and Heritage Center with a snapshot of the moisture-related deterioration to allow them to track the progression of problem areas.

Physical investigation of exterior wall.

Interior finishes of the two exterior walls in gallery room 217 were removed to expose the interior of the wall (Figure 6). Like the other gallery spaces, room 217 is a relatively small five-foot by fourteen-foot space that contains two exterior walls, two interior walls, a door, and three windows that are covered over from the inside. The floors and walls, including the doors and windows, were carpeted in a previous (1981) renovation. The windows are fully covered and indistinguishable from the surrounding wall and the doors have a second door covering them from the inside that closes flush with the wall. The doors are still operable, but the windows are not. Exhibition room 217 was chosen for this portion of the study for a variety of reasons. First, the room contains elements, finishes, and problems typical of all the other gallery rooms (i.e., it is representative of the gallery space as a whole). Second, restricting the destructive investigation to a small room limited the potential damage to historic materials. Lastly, Room 217 is located such that the remaining second-floor gallery spaces operated normally while the study was going on. The west and north walls were chosen because they are adjacent exterior walls. Their adjacency allowed for the evaluation of exterior corner conditions. The condition of the three historic windows and door was also evaluated. The window and door conditions, the assembly materials, the size of members, and the construction style were recorded in field notes and photographs.[9]

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[9] Before, after, and demolition process photos are included in appendix G (CD ROM)

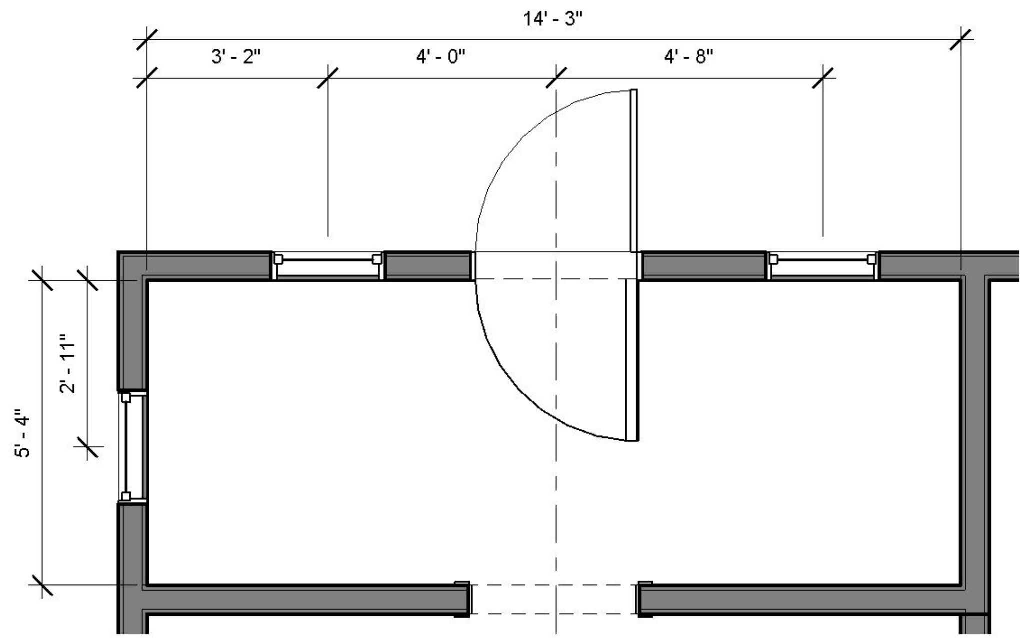

Figure 6. Floor plan of room 217.

Hygrothermal Analysis

WUFI® Pro 5.3 was used to create models for a comprehensive hygrothermal analysis of current and proposed exterior wall assemblies for second floor galleries of Lucas Mansion. WUFI® Pro accounts for climate conditions, built-in moisture, driving rain, solar radiation, long-wave radiation, capillary transport, and summer condensation to create a one-dimensional hygrothermal calculation across a cross-section of a building assembly (WUFI, 2017). The selection of accurate climate conditions and material properties is vital to attaining acceptable WUFI® models outputs (Straube & Schumacher, 2016).

Each input of the models tested was carefully selected. A north orientation was chosen for the models. The orientation of the assembly affects its interaction with sun, wind, and rain exposure. Although exterior walls facing each cardinal direction will be modified in the future renovation scope of work, the vast majority of the exterior walls that will be altered are north facing. Additionally, it is preferable to choose the worst-case orientation for evaluation scenarios

(Mantha & Arena, 2012). A northern orientation will help represent the reduced sun exposure and drying potential these walls experience due to the deep wrap-around porch on the second floor of Lucas Mansion. The building was identified as "short," with a height less than 33-feet. Lucas Mansion has steep pitched roofs that bring its overall height above 33 feet, but all the exterior walls of the building stay below this threshold. The inclination of the surface was set to 90 degrees to represent a wall.

A WUFI® climate data file was not available for Hiddenite, NC, the location of Lucas Mansion. To determine an appropriate location to use in its place, data from the five closest locations in climate zone four with an available WUFI® climate data were evaluated. These locations are Baltimore, MD; Roanoke, VA; Lexington, KY; Knoxville, TN; and Nashville, TN (Figure 7). Weather data from Hickory, NC, a town approximately 20 miles from Hiddenite, was used for the comparisons. TMY3 data files used in this analysis were retrieved from the National Solar Radiation Data Base, which is maintained by the Nation Renewable Energy Laboratory (National Renewable Energy Laboratory [NREL], 2005). TMY stands for typical meteorological year. These data sets contain hourly meteorological data that typify a location's conditions over a long period of time, usually multiple decades (Wilcox & Marion, 2008).

An analysis was run on dry bulb temperature and dew point since they can characterize sensible and latent conditions, respectively. The Pearson's correlation coefficient formula was used to compare Hickory data with the potential WUFI climate data sites. Rainfall and solar exposure were determined to be negligible factors, because of the 5 to 16-foot overhangs that surround the entire second floor, and were therefore not evaluated. The Pearson's correlation coefficient formula calculates r. A correlation coefficient value of 0 represents no correlation and a value of 1 represent a perfect correlation. The standard mean error (SME) was also calculated for both dry bulb temperature and dew point. The greater this value, the larger the deviation between the data sets. Based on these points of comparisons Roanoke, VA, was chosen as a closest climate match to Hiddenite (Table 1).

For the interior climate data, the EN 15026 method, as defined by ASHRAE and built into the WUFI® software, was used to find the conditions based on the Roanoke, VA, location.

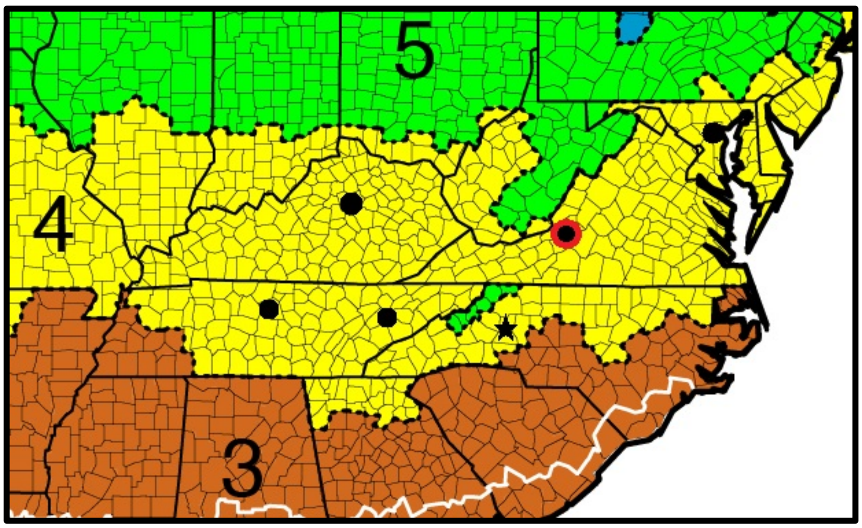

Figure 7. Climate zone map with compared locations marked; From left to right: Nashville TN, Lexington KY, Knoxville TN, Hickory NC (star), Roanoke VA (red circle), and Baltimore MD (U.S. Department of Energy [DOE], 2012).[10]

Table 1. *Comparison of Hickory, NC and Select City's TMY3 Weather Data Files*

Location	Dry Bulb Correlation (r)	Dry Bulb (SME)	Due Point Correlation (r)	Due Point (SME)
Knoxville, TN	0.78	4.97	0.70	5.91
Nashville, TN	0.79	5.08	0.71	6.08
Roanoke, VA	.80	4.85	.71	6.35
Baltimore, MD	.80	5.09	.72	6.31
Lexington, KY	.77	5.64	.69	6.39

The process of defining the properties of the materials that make up the existing wall was started by reviewing WUFI® pro's material databases. The majority of the construction materials commonly used in North America are preloaded into these databases. The most

[10] Map was adapted from the 2012 International Energy Conservation Code's climate zone map.

exterior layer of this wall is oil paint, which was difficult to model accurately. Several approaches were compared. In the first approach the paint was accounted for in the model as a surface transfer coefficient of the exterior surface. According to a WUFI® administrator this should give the same result because the thermal resistance and the thermal capacity of exterior paint is negligible (WUFI administrator, 2005). To represent the material as a surface transfer coefficient, the perm rating had to be entered. According to the Building Science Cooperation, three coats of exterior oil-based paint has a perm rating between 0.3 and 1 (2015). The paint on the exterior of Lucas Mansion is thickly applied, so a value on the lowest end of the range, perm 0.3, was selected. When this model ran it was clearly inaccurate. The siding layer reached over 90% moisture content, which indicated that the wood would be degenerating. This is a problem that has been documented by other WUFI® users (Anthan, 2011). In the next attempt, the paint was modeled as an explicit layer, with a perm rating of 0.3, a porosity of 0.001, and a 0.03 thickness. The other properties are unimportant because the layer is very thin. This produced a dramatic difference in water content. The moisture content of the siding dropped from 24.90 to 2.99 lb/ft^3. The last method attempted did not model the paint at all. The moisture content of the siding went back up to 12.85 lb/ft^3. The no paint model was selected as the most appropriate option for the comparison testing as it represents a realistic worst-case scenario for moisture infiltration, but the actual moisture content of the siding is likely somewhere between the results for the model with the paint layer and the model with no paint.

The next layer in the model is the wood that makes up the clapboard siding. In the disassembly of room 217 it was found that the siding and framing are pine. For this layer, eastern yellow pine was chosen from the material database. The thickness of clapboard siding varies, so an average of its thickest and thinnest points was used as the material thickness. The thinnest part of the siding is approximately 0.19 inches and thickest 0.75 inches, making the average approximately 0.47 inches. During the physical investigation a layer of thin black material was found between the siding and the diagonal sheathing boards. It could only be seen though the small gaps between the diagonal sheathing boards from the interior, so a thorough examination of the material was not possible (Figure 8). Based on what could be seen, this material was presumed to be asphalt paper or roofing felt, and exact material parameters are not known. The WUFI® North American material database has four materials that could possibly be used to represent this layer: 10, 20, and 60 min asphalt impregnated paper, and bituminous paper #15 felt. Preliminary tests were run with each of these materials and negligible differences of less than 1% were found in the end and max moisture content calculation for the siding, sheathing and fiberglass batt insulation. The 30-min asphalt impregnated paper had the highest moisture content readings and was used for the final runs, to represent a worst-case scenario.

Figure 8. Thin layer of black paper-like material found between siding and sheathing.[11]

The diagonal board sheathing was assigned as eastern yellow pine for the same reasons as the siding. Field measurements revealed the sheathing to be approximately one inch thick.

[11] Except as otherwise cited, all photographs are by author.

The WUFI® material database had options that matched the next four layers, low-density fiberglass batt insulation, Kraft paper, plywood, and hardboard, but the final layer, carpeting, was not an option in any of the material databases. Carpeting is considered vapor permeable when it is installed without a carpet pad. Carpet has high porosity, low density, and low thermal conductivity (Home Innovation Research Labs, 2014). It was determined that of the materials available in WUFI® carpeting with a backing is most similar to low-density fiberglass batt. Material properties used in the model of the existing wall are shown in Table 2.

The three alternative wall assemblies were tested with the same control and climate parameters. All three assemblies have an interior cladding of plywood-backed gypsum wallboard. This was to meet the programmatic needs of the gallery space. The first assembly involved removal of the hardboard and carpet and applying gypsum wallboard directly over the existing plywood. WUFI® database's material properties for USA gypsum board was used to represent this in the model. Material properties used in the model of alternative wall # 1 are shown in Table 3. In the second assembly the plywood and existing R-11 insulation were removed and replaced with a high-density R-15 batt and a thinner ½" plywood. The same material parameters where used for the plywood; only the thickness changed. The WUFI® database does not contain an option for high-density fiberglass-batt insulation, so the low-density batt option was edited to properly represent the difference in density, thermal conductivity, and permeability of a high-density batt. The density was found by dividing weight by volume found in the product specification sheet of an Owens Corning R-15 high density EcoTouch® unfaced fiberglass batt. Each package of batt material has a 103.98 ft^2 coverage area, a thickness of 3.5 inches and package weight of 39 lb. The thermal conductivity was calculated based on the R-value and material thickness. It was found in the product specification that these batts are approximately a perm-50 in accordance with ASTM E96 (Owens Corning, 2014). Material properties used in the model of alternative wall # 2 are shown in Table 4. The last alternative assembly was identical to the second, with the exception of its insulation type. This assembly was insulated with closed cell spray foam. WUFI® database's material properties for closed cell spray foam were used to represent this in the model. Material properties used in the model of alternative wall # 3 are shown in Table 5.

Table 2. *Existing Wall Material Properties Used in WUFI Model. Note that material are ordered from exterior of interior side from top to bottom. Typical.*

Material Layer	**Thickness (inches)**	**Bulk density (lb/ft³)**	**Porosity (ft³/ft³)**	**Specific Heat Capacity, dry (Btu/lb °F)**	**Dry Thermal Conductivity (BTU/h ft °F)**	**Permeability (perm)**	**Initial Water Content (lb/ft³)**
Wood Siding	0.47	28.7169	0.81	0.449	0.0537	0.0291	2.98
Asphalt Paper	0.008	56.747	0.001	0.3583	5.7779	0.0601	0.0
Diagonal Board Sheathing	1	28.7169	0.81	0.449	0.0537	0.0291	2.98
Fiberglass R-11 Batt	3.5	0.5494	0.999	0.2006	0.0248	106.4463	0.03
Kraft Paper	0.04	7.4914	0.6	0.3583	0.2427	0.0429	0.11
Plywood ¾"	.75	29.3411	0.69	0.449	0.0485	0.1195	4.02
Hardboard	.25	19.977	0.97	0.449	0.0306	7.6667	2.21
Carpet	.125	0.5494	0.999	0.2006	0.0248	106.4463	0.03

Table 3. *Alternative Wall #1 Material Properties Used in WUFI Model*

Material Layer	Thickness (inches)	Bulk density (lb/ft³)	Porosity (ft³/ft³)	Specific Heat Capacity, dry (Btu/lb ˚F)	Dry Thermal Conductivity (BTU/h ft ˚F)	Permeability (perm)	Initial Water Content (lb/ft³)
Wood Siding	0.47	28.7169	0.81	0.449	0.0537	0.0291	2.98
Tar Paper	0.008	56.747	0.001	0.3583	5.7779	0.0601	0.0
Diagonal Board Sheathing	1	28.7169	0.81	0.449	0.0537	0.0291	2.98
Fiberglass R-11 Batt	3.5	0.5494	0.999	0.2006	0.0248	106.4463	0.03
Kraft Paper	0.04	7.4914	0.6	0.3583	0.2427	0.0429	0.11
Plywood ¾"	.75	29.3411	0.69	0.449	0.0485	0.1195	4.02
Gypsum Wall Board	.5	53.0638	0.65	0.2078	0.0942	21.4667	0.39

Table 4. *Alternative Wall #2 Material Properties Used in WUFI Model*

Material Layer	Thickness (inches)	Bulk density (lb/ft³)	Porosity (ft³/ft³)	Specific Heat Capacity, dry (Btu/lb ˚F)	Dry Thermal Conductivity (BTU/h ft ˚F)	Permeability (perm)	Initial Water Content (lb/ft³)
Wood Siding	0.47	28.7169	0.81	0.449	0.0537	0.0291	2.98
Tar Paper	0.008	56.747	0.001	0.3583	5.7779	0.0601	0.0
Diagonal Board Sheathing	1	28.7169	0.81	0.449	0.0537	0.0291	2.98
Fiberglass R-15 Batt	3.5	1.28596	0.999	0.2006	0.01945	50	0.03
Kraft Paper	0.04	14	0.6	0.3583	0.2427	0.0429	0.11
Plywood ½"	.5	29.3411	0.69	0.449	0.0485	0.1195	4.02
Gypsum Wall Board	.5	53.0638	0.65	0.2078	0.0942	21.4667	0.39

Table 5. *Alternative Wall #3 Material Properties Used in WUFI Model*

Material Layer	Thickness (inches)	Bulk density (lb/ft³)	Porosity (ft³/ft³)	Specific Heat Capacity, dry (Btu/lb ˚F)	Dry Thermal Conductivity (BTU/h ft ˚F)	Permeability (perm)	Initial Water Content (lb/ft³)
Wood Siding	0.47	28.7169	0.81	0.449	0.0537	0.0291	2.98
Tar Paper	0.008	56.747	0.001	0.3583	5.7779	0.0601	0.0
Diagonal Board Sheathing	1	28.7169	0.81	0.449	0.0537	0.0291	2.98
Closed Cell Spray Foam	3.5	2.4347	0.99	0.3511	0.0144	1.4483	0.07
Plywood ½”	.5	29.3411	0.69	0.449	0.0485	0.1195	4.02
Gypsum Wall Board	.5	53.0638	0.65	0.2078	0.0942	21.4667	0.39

Each assembly was tested with a three-year calculation period. This approach is recommended in order to give the wall assembly model enough time to acclimate, reducing the effect of the assumed initial moisture content and temperature (Mantha & Arena, 2012). Heat and moisture transport were both selected for the modes of calculation. Thermal conductivity was set to be dependent on temperature and moisture. The rest of the numeric controls were left on default.

Raw export of selected inputs in the WUFI® generated report and a copy of the full WUFI® working file are included in Appendix G (CD ROM).

Data Analysis Procedures

Identify Treatment Approach

A statement of the recommended treatment approach for the gallery space based on the Secretary of the Interior’s treatment definitions was produced and the rationale of proposed treatment outlined. The rationale discussion includes advantages and disadvantages of the chosen approach, as well as potential impacts. The boundary area of treatment was clearly articulated with a floor plan. Defining the treatment approach and boundary had to be completed first in order to apply both the Secretary of the Interior and National Park Service's recommendations (Hawkins, 2007).

Field Observations

Architectural field observations were examined alongside information gathered about the history and architecture of the building and region. This provided a better understanding of the context and significance of architectural features. The data gathering in the gallery spaces was cross referenced with data gathering in the other historic parts of the building to better understand what has been changed about the space and what architectural features might be missing. The *Secretary of the Interior's Standards* were used to identify which features should be retained in the renovation. The Secretary of the Interior's Guidelines for Rehabilitation and the National Park Service Preservation Briefs provided the parameters used to determine responsible treatment. The recommendations for treatment and their reasoning were separated by element type (e.g., moldings, windows and doors, fireplaces, finishes). All suggestions were intended to maximize the retention of historic character and to meet the Secretary of the Interior's Standards (Hawkins, 2007).

Moisture Survey

Moisture instances were evaluated based on location, type of moisture problems, and severity to identify patterns. These data were cross-referenced with information gathered about prior maintenance of the building in order to speculate on potential causes and to develop recommendations for further investigation. Importance was placed on identifying problems directly affecting the gallery spaces and/or those problems that could be resolved as part of the gallery renovation. The whole building was evaluated because diagnosing the cause of moisture problems required not only an understanding of localized deterioration but of the moisture path through the building. The data points were used to help trace the path of visible degradation to the point where moisture could possibly be entering the building (Parks, 1996).

Hygrothermal Modeling

The data produced by the four WUFI® runs were evaluated individually for their compliance with failure criteria for wood rot/decay, mold growth potential, condensation potential, and water content (Mantha & Arena, 2012). The data from the WUFI® runs was exported as an .ASC file processed using standard spreadsheet tools.

The first criterion examined was the water content of the wall assembly. This method was used to evaluate whether an assembly was accumulating moisture over time or was drying; this was done by comparing the initial water content with the final water content of the assembly. In a healthy wall system, the ending water content of each layer should be either similar to or lower than the initial water content (Mantha & Arena, 2012). The water content may drop off at first, but as the materials acclimate each layer should stabilize and reach a dynamic steady state that usually shifts seasonally. Each layer must be examined individually because an equilibrium overall does not necessarily mean that each layer has stabilized (Zirkelbach, Schmidt, Kehrer, & Kunzel, 2016).

The minimum water content required for the growth of surface mold is 20%. It is recommended that 20% water content be used as a conservative indicator of an elevated risk for fungal growth and decay of wood (Zirkelbach et al., 2016). To evaluate if the water content of the wood components of the assembly exceeded this threshold the water content (lb/ft^3) was converted to mass-percent (M-%). This was done by dividing the water content (lb/ft^3) of the material layer by the material's density (lb/ft^3) (Mantha & Arena, 2012).

Condensation potential was evaluated by comparing the dew point to the dry bulb temperatures at the surface of each sheathing layer. Condensation is likely to occur if the surface temperature of the layer is lower than the dew point temperature. The longer this is true, the greater the risk of damage. To do this comparison the dew point had to be calculated using the temperature and the relative humidity of each data point. The instances when the surface temperature went below the dew point were then counted. This gave the number of hours that condensation potential existed on that surface during the three-year testing period (Mantha & Arena, 2012; Zirkelbach et al., 2016).

Mold growth potential was evaluated using both the isopleths and critical water content methods. The isopleths method uses a graph plotted by WUFI® program to identify potential mold growth on the interior surface. This system accounts for germination time and growth rates of mold in relation to the fluctuation of humidity and temperature. WUFI® finds the 'Lowest lsopeth for Mold' (LIM). This represents the lowest temperature-dependent relative humidity under which no fungus activity is expected (Mantha & Arena, 2012). Over the LIM curve, WUFI® plots the hourly points of hygrothermal conditions (relative humidity against dry bulb temp) of the interior surface. If conditions extend above the LIM lines, there is a potential for mold growth. This graph was evaluated for four sheathing materials: diagonal board sheathing, hardboard, plywood, and gypsum wallboard (Zirkelbach et al., 2016).

To execute the critical moisture content method for evaluating mold growth potential, a post-processor called WUFI-Bio was used. WUFI-Bio uses transient ambient conditions, the LIM, and a moisture storage function for spores to identify if the critical water content necessary for mold to germinate is reached on any surface across the assembly. WUFI-Bio generates a graph that plots a line for the critical water content and the water content of the spore. An image of a traffic light at the top of the graph indicates mold growth risk: a green light denotes the potential mold growth is below 1.96 in/year, which is considered acceptable performance. A yellow light denotes the potential is between 1.96 in/year and 7.87 in/year, meaning additional investigation is needed. A red light indicates that mold growth exceeds 7.87 in/year, which is considered unacceptable (Mantha & Arena, 2012).

Developing Recommendations for Gallery Renovation

All the collected information had to be looked at together in order to create a cohesive recommendation that will meet the programmatic, historic preservation, and moisture mitigation needs of the space. This information formed the basis of a concise and prioritized set of recommendations for use by the Hiddenite Arts and Heritage Center to develop appropriate plans for renovation. Priority was given in this order: (1) occupant health and safety, (2) protection of the building from further deterioration, (3) retaining existing historic character, and (4) programmatic needs (Hawkins, 2007).

CHAPTER 4: RESEARCH FINDINGS

Historical Background and Context of Lucas Mansion

Architectural and Cultural Significance

Lucas Mansion in Alexander County, North Carolina is a unique turn of the century home (Figure 9). This large three-story wood framed house with a full two-story wrap-around porch stands out among the relatively modest houses that surround it. Built in 1900 and heavily remodeled during the first part of the twentieth century, its construction straddled a time of architectural change and its style does not fit cleanly into any architectural category. Irregularity of form, plan, and detail characterize the mansion. The building roughly follows a cruciform plan. Its irregular floor plan and steep hipped roof with protruding gables are features affiliated with the Queen Anne style; however, its relatively subdued ornamentation and symmetry directly oppose the Queen Anne style. Nevertheless, Lucas Mansion was categorized as Queen Anne-derived in its *National Register of Historic Places Inventory Nomination Form* (Cross & Southern, 1981).

Figure 9. Present-day photo of Lucas Mansion from street facing side.

The form of the building's exterior is primarily defined by it deep wraparound porches. The porches are adorned with turned post and balusters, molded handrails, and scrollwork brackets. The first floor porch also has a spindle frieze set above the brackets. The second story's balustrades contain hinged gates that were reportedly used for hoisting large items to the second floor that would not fit up the narrow interior stair.

Windows and doors are laid out irregularly over the exterior of the building. The majority of the windows are single pane double-hung set low in the wall, or small square casement windows set high in the wall. Both varieties of windows have operable louvered shutters. The vast majority of the windows in the building appear to be original. French and single doors open onto the porches on both the first and second floors. All of the exterior doors on the historic section of the building contain glazing.

Figure 10. Neighboring building built within 5-10 years of Lucas Mansion.

Lucas Mansion's size and elaborate structure represented the level of exclusive wealth enjoyed by its long-time owner, James Paul Lucas. The building far exceeded the economic prosperity of this geographical region at the time of its construction. This is evident when one visits Hiddenite. The Lucas Mansion dwarfs all of the early 20th century buildings that surround it. The building directly neighboring Lucas Mansion (Figure 10) is believed to have been built around the same time and possibly by the same builder, because it has nearly identical scrollwork; however, this contemporary structure is less than a third the size of the Lucas Mansion.

Chronology of Use, Ownership, and Alteration

The history of Lucas Mansion has been maintained as a mix of concrete documentation and oral history. It is difficult to tease legend from history when putting together a chronology of this building that has stood as a landmark in its community for a century. Local lore maintains the building was constructed in 1900 by a young man for his bride to be, but he sold that house when they ended the engagement due to irreconcilable political differences (Houchins, 2015, November). There is no evidence of this story except from local records. It is known that the original building was constructed as a small cottage between 1900 and 1906. The cottage changed hands several times during its first decade. According to Alexander Country deed books it was owned variously by W. F. Hollar, A. G. Matlock, and M.F Patterson before the cottage and the surrounding 50 acres were sold to James Paul Lucas on December 12, 1908 (Cross & Southern, 1981).

To understand Lucas Mansion one must have an understanding of James Paul Lucas, the building's longest owner, who had an immense impact on the property. Better known as Diamond Jim, he was a man with an ostentatious lifestyle (Sharpe, 1984). Originally from South Carolina, Lucas started his career as a traveling umbrella and walking stick salesman, but he soon moved in to the diamond export business working for Samstag and Hilder Brothers, headquartered in New York State (Cross & Southern, 1981). As a diamond salesman Lucas had great success and traveled widely. It is believed that Lucas became acquainted with the area by staying at the White Davis Sulphur Springs, a nearby hotel and resort; he later decided to buy a property in the area for his retirement (Houchins, 2015, November; Cross, Southern, 1981). After Lucas bought the property he moved his parents in, but he continued to travel and work in the diamond business for nearly two decades after. Lucas' widowed niece also moved in and acted as hostess of the house (Cross, Southern, 1981).

While his parents were living in the house Lucas started on extensive remodeling of the interior and exterior. A large part of the reason for Lucas Mansion's unique style is the unusual method by which Lucas enlarged the house. The historic house was built in two or three stages. An early 20th century photo shows the house as a one-and-a-half story Victorian bungalow of roughly the same plan and roof configuration as it has today (Figure 11). Anecdotal lore reports

Figure 11. Early 20th century photo of Lucas Mansion (Hiddenite Arts & Heritage Center, 2017b).

the small cottage was enlarged twice using an unusual method of raising the upper story on cribs and inserting a story in the middle. There is concrete evidence that this happened at least once (Bishir, Southern, & Martin, 1999). A second photograph (Figure 12) shows the building in the process of this addition, with its top story on cribs (Hiddenite Arts and Heritage Center, 2017b).

There is a third photograph that appears to show construction workers celebrating their achievement after the new second floor was built (Figure 13). Several people living in Hiddenite who were interviewed for the early 1981 National Historic Registry nomination process remembered the unconventional method of enlarging the mansion. The architecture also supports these accounts. The window and interior finishes on the first and third floors are remarkably similar to each other, but differ substantially from those on the second floor. During a 1980s renovation, a second set of joists was discovered between the first and second floor that further corroborates this story. The addition of the second floor was completed sometime between 1910 and 1928 (Cross & Southern, 1981). This feat was a demonstration of Lucas' larger than life personality (Houchins, 2015, November).

Figure 12. Photograph of Lucas Mansion showing the unusual method used to enlarge the building (Hiddenite Arts & Heritage Center, 2017b).

Figure 13. Photograph of Lucas Mansion with worker on the porch after the building was enlarged (Sharpe, 1982, p. 29).

Figure 14. Lucas mansion shortly after it was enlarged (scanned copy of photograph in the Hiddenite Arts and Heritage Center's Archival collection)

In addition to this increasable feat, Lucas added elaborate gardens to the grounds, an extensive electric bell system, a hydraulic pumping system that supplied water to all three floors, a fire suppression system on each floor, and an on-property fuel burning power plant that supplied electricity to all the buildings on his property and the nearby Hiddenite Baptist Church (Figure 14) (Sharpe, 1984).

Lucas's lifestyle also brought notoriety to his home. He was said to be a lover and collector of the eccentric, rare, and exotic. He had extensive collections from his worldwide travels. Virginia McMann, who remembered visiting his home as a girl, said that every room was crammed with incredible pieces. She remembered art, taxidermy, antique guns, chalices, crucifixes, beautiful clothes, and magnificent jewelry (McMann, 2015). Many who visited the house while Lucas was still alive recall an immense clock collection (Cross & Southern, 1981; Houchins, 2015, November). The house was said to shake on the hour and the half hour due to the synchronized chiming of hundreds of clocks (Houchins, 2015, November).

After Lucas' death on July 15, 1952 his collections and home were sold at a public auction in Hickory, NC. Two out-of-state families bought Lucas' house and used it as a summer home and hunting lodge for years. Eventually the house stood vacant, falling into disrepair (Figure 15) until Eileen Lackey Sharpe of Winston-Salem bought it in spring 1981 (Cross & Southern, 1981). Sharpe described Lucas Mansion at the time she purchased it in her book as a "dilapidated twenty-two room mansion encased with brambles, briers, and kudzu, and surrounded by privet hedge and broken down fence" (1984, p. 9).

Figure 15. Lucas Mansion fell into disrepair for several years (Approx. 1980) (scanned copy of photograph in the Hiddenite Arts and Heritage Center's archival collection).

Sharpe quickly made plans to restore the building and added an addition to support the building's adaptive use as the Hiddenite Arts and Heritage Center. For more than 30 years the Hiddenite Arts and Heritage Center has served the community as the cultural hub for the county (Hiddenite Arts and Heritage Center, 2017a).

Prior Preservation Efforts

After Mrs. Sharpe purchased the Lucas Mansion she began work toward its preservation. She immediately sought recognition of the building in the National and State Historic registries. Both registries accepted the building's nomination (Cross, Southern, 1981). She also started work on stabilizing the structure, by repainting and making various repairs to the exterior, which were necessary after its years of vacancy (Figure 16). The interior rooms had been painted several different shades of pink and green. She had the interior painted a cream color. The building originally had wood graining on all the trim and woodwork in the building, but much of it had been painted over or was peeling off when Mrs. Sharpe acquired the house. The only original wood graining that could be retained was in the historic entry and study (room 114 & 115). Local craftsmen redid the wood graining in all other rooms at the mansion (Houchins, December 12, 2016). The work appears to have been completed in two stages. The wood graining in the old section of the first floor is more similar in color and pattern to the surviving original finish. The wood graining on the other floors and in the addition is lighter in color and has a noticeably different pattern.

Figure 16. Left: Lucas Mansion after vegetation was removed, but before work was done on the building (Cross & Southern, 1981 p. 12). Right: Lucas Mansion after initial work to stabilize the building's condition was done (scanned copy of photograph in the Hiddenite Arts and Heritage Center's Archival collection). Both photographs were taken in 1981.

Mrs. Sharpe first hired an experienced architect from Winston-Salem named Charles Phillips to advise the restoration of the mansion and to design an addition that would provide space for offices, storage, and elements necessary to meet accessibility requirements and the fire code such as an elevator, accessible restrooms, a sprinkler system, and a second primary staircase. She was very unhappy with the Phillips' design and chose to buy out his contract; she then hired architect Chuck Goode from Statesville. Chuck Goode designed the more extensive renovation on the second floor and the addition seen today. This was Goode's first large project, but he had a strong interest in historic preservation (A. Houchins, personal communication, December 12, 2016).

The second floor was renovated to be a gallery space (Figure 17). Two walls were removed to make three smaller rooms into one large room. In most of the rooms on the second floor the beadboard that was on the walls was removed and carpeting replaced it. Carpeted plywood inserts placed over the windows made them indistinguishable from the wall surface on the interior. A second set of doors that closed flush to the interior walls were installed over the historic exterior doors. These doors also received the carpet finish. Mrs. Sharp decided on the carpet wall finish based on precedents established by other similar projects being done at the time. The floors were also carpeted. The original baseboards, interior door molding, fireplaces and beadboard ceilings were retained (A. Houchins, personal communication, December 12, 2016).

Goode also designed and oversaw the construction of an attached four-story tower that added more than 3,600 square feet, more than doubling the size of the building (Figure 18). The addition was designed to match the existing building architecturally and incuded accessible restrooms, elevators, a staircase, reception areas, display space, storage space, and offices (Coley, 1990).

Figure 17. Current photo of large gallery room.

Figure 18. Photo taken shortly after the completion of the addition (scanned copy of photograph from the North Carolina Preservation Office's file on Lucas Mansion).[12]

Prior Maintenance Efforts

The maintenance of Lucas Mansion has been a concerted and continuous effort for the Hiddenite Arts and Heritage Center's board of directors since the Center's founding in 1981. They have encountered many substantial threats to the structure in recent decades, including a faulty sprinkler system, burst pipes, roof leaks, and foundation settling. The following chronology of the maintenance to address these problems was put together based on building status reports that were issued to the Hiddenite Center's board of directors every few months

[12] Additional photographs from the North Carolina Preservation Office's file on Lucas Mansion included in Appendix G (CD ROM).

from 2012 to 2015, and from interviews with Alison Houchins, who has worked for the Hiddenite Arts and Heritage Center in Lucas Mansion since its renovation in the early 1980s (A. Houchins, personal communication, March 27, 2017).[13] This is not meant to be an exhaustive list of all maintenance on the building, but rather provides an overview of the most significant work that has been done. Understanding the history of maintenance is important to delineating ongoing problems from those that have been addressed.

During the 1980s restoration of the historic building a sprinkler system was added to the building to satisfy fire code requirements. This system was installed inside the ceiling cavities to minimize its visual impact on the historic character of the interior. This was a wet system, meaning the water was held in the lines. In 1985, some of the pipes on the first floor burst after a sustained period of unusually low temperatures (A. Houchins, personal communication, December 12, 2016). The majority of the damage sustained by the leak was in the historic parlor on the first floor (room 113).[14] This damage is still visible on the parlor ceiling because the original beadboard was not replaced (A. Houchins, personal communication, March 27, 2017). In the early 2000s, the sprinkler system malfunctioned in the main gallery of the second floor, drenching a large section of the building. A sprinkler head in the northeast section of the main gallery room was the primary source of water. Houchins recounted that the firemen had told her that when they arrived at the scene there was a waterfall off the second floor porch that was shooting out four feet past the porch edge before falling to the ground (A. Houchins, personal communication, December 12, 2016). On this occasion the ceiling and floors of the east end of the main gallery sustained damage, as well as room 215 of the historic bath (room 107) and bedroom (room 108) located directly below. In 2012, the sprinkler malfunctioned again in the

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[13] Personal communications with Alison Houchins on December 12, 2016 and March 27, 2017 were recorded and are included in appendix G (CD ROM)

[14] All room numbers refer to as built drawing created by the author. Drawing can be found in appendix B.

same location, causing more damage to the same areas. Each time, the Hiddenite Arts and Heritage Center had the building professionally dried out. The ceilings on the second and first floor sustained substantial damage from these events, but no historic material was replaced (A. Houchins, personal communication, March 27, 2017).

Due to concerns about the repeated sprinkler system malfunctions, the Hiddenite Arts and Heritage Center had the system inspected. It was discovered that the system was not installed correctly in several areas. A mysterious hot spot of unknown origin was found with a temperature probe in the ceiling of the gallery where the system had malfunctioned twice (Houchins, 2013, July). It was determined that the entire system needed to be replaced. In July 2014, the installation of a new system was completed and the old system was decommissioned. The new system was a dry suppression system, meaning water is kept under pressure in holding tanks at ground level rather than in the actual lines (Houchins, 2014, April).

Lucas Mansion has had several roof leaks over the years, but the most significant leak was around the northeast chimney protruding through the valley created by two large side-by-side gables on the east side of the building. The shape of the roof in this location funnels water directly towards the chimney's roof penetration. This chimney was built without proper support at the base and has been the site of settling problems that likely translated into stress on the flashing at the roof penetration. A building status report in July 2013 noted the leak was so bad that a 60-gallon trashcan placed under the leak filled in less than a day (Houchins, 2013, July). This area was repaired several times and before a lasting repair was found. In September 2013, a vinyl membrane was installed over the existing roof down the full length of the roof valley and around the chimney (Building status report, October 14, 2013). Since this repair was completed no water leaks have been observed in this area. Damage from this leaking condition occurred on all three floors of Lucas mansion. On the third and second floors the damage was mostly contained to the closets off the hallways. On the second floor there was also damage done to carpet and wood flooring under it in the southeast corner of the main gallery (room 216). On the first floor damage from this leak can be seen on the ceiling and walls of the historic kitchen (room 110) and bedroom (room 108) (A. Houchins, personal communication, March 27, 2017).

Two other notable leaks in the building have been repaired. The kitchenette (room 212) on the second floor had a leak coming through the ceiling that caused some damage to the ceiling and walls. This leak originated with a flashing failure on the second story roof. An attempt was made to repair this area by adding new sealant in 2014, but the area continues to leak. A larger leak in the copy room (room 209), also caused by a flashing failure of the second story roof, has been documented. This troublesome area is located directly below the termination of the valley of the double gables on the east side. Water from both of the gables flow to the valley then down on to the second floor roof. The gypsum board on the ceiling of the copy room below developed a considerable amount of mold as a result of the leak. This leak was repaired in summer 2016. The tin roofing tiles in this area were completely pulled up and replaced with matching tiles found under the building that were in better condition. The siding above the roof was pulled up and new flashing installed. A gutter system that helped direct the water from the upper roof's valley toward the second story roof's gutters was also installed (Figure 19). This area of the roof was repainted and the gypsum board in the copy room was replaced (A. Houchins, personal communication, March 27, 2017).

There has been consistent moisture damage on the exterior of the building as well, particularly along the wraparound porches. Many posts, balusters, cornices, spindles, deck boards, fascia boards, deck boards, and soffits have needed replacement over the years due to rot. There has been rot on all sides of the porch; the fastest progressing damage is on the west side of the building (A. Houchins, personal communication, March 27, 2017). In 2013 several rotten porch posts, railings, ceiling panels, a few porch boards and some trim pieces were replaced on the west side of the building (Houchins, 2013, October). Replaced pieces in this area are already exhibiting considerable rot.

Figure 19. Repair done to second floor roof above copy room (room 209).

Foundation settling has been a long-term and ongoing problem for Lucas Mansion. A report from the North Carolina Preservation Office completed shortly after Mrs. Sharpe acquired the building but before restoration work was started cited foundation settling as an area of concern (Swaim, 1981). Additional foundation support was not added when James Lucas enlarged the building. As a result, the building has struggled to bear its own weight. It is unclear what, if any, work was done to the foundation as part of the 1980s restoration. In the mid-2000s an I-beam that spans 12 feet from north to south was installed under the house to help support the center of the building, where it was tending to settle in on itself. In 2014, a building caretaker noticed a sag in the floor of one of the doll galleries (room 311) had considerably worsened. The sag had begun to show up in the ceiling of the gallery room directly below (room 215) (Houchins, 2014, January). The contractor called to inspect the building made some disconcerting discoveries in the crawlspace.

The I-beam placed seven to eight years prior was installed improperly. It appeared that the job had been left incomplete. No footings had been poured. The beam was held up by a makeshift system of stacked lumber, cinder blocks, and a 20-ton jack. It was also discovered that two of the house's three brick chimneys were not supported to the ground. The southeast chimney supported by the west wall of the historic kitchen (room 110) had no foundational supports directly under it. The northeast chimney was set directly on the floor joists of the north side of the kitchen, also without foundational supports directly beneath it (A. Houchins, personal communication, December 12, 2016; Houchins, 2014, January). These factors were likely major contributors to the inward settling the house has undergone over the years. New concrete piers and footings were added under the I-beam and both chimneys in February of 2014 (Houchins, 2014, December). In the process of jacking up the building and setting it onto the beam, new stress cracks were created in many of the walls on the first floor. These cracks are particularly pronounced in the historic kitchen (room 110). Supports were also added in the ceiling of the second floor gallery (room 215), directly below where the sagging floor was found in room 311, to stabilize this area (A. Houchins, personal communications, March 27, 2017).

Interior Architecture Investigation

Identification of Character-Defining Features

The interior of Lucas Mansion has several distinct features and finishes that contribute to its character. The materials and craft practices used in the building represent a mixture of local vernacular and imported architecture style (Cross & Southern, 1981). According to the Secretary of the Interior's Standards, interior elements that tend to be character-defining in single-family homes include: the basic floor plan and layout; floor to ceiling height; fireplaces; architectural detailing (window and door trim, baseboards, picture rails, cornices, etc.); doors and windows; flooring; hardware; and fixtures (Morton, Hume, Weeks, & Jandl, 1997). Based on this list and an initial assessment of the building, areas of focus that would benefit from the understanding of the character of the gallery spaces were identified. Many character-defining features were removed from the gallery spaces during the 1980s renovation, so in addition to observing their absence in the gallery space these features had to be assessed by comparison to photographs, existing records, and visual surveys of other areas in the building (Figure 20). The focus areas identified for this investigation include molding, windows and doors, fireplaces, and finishes.

Figure 20. Left: photograph of room 313, which has most of its historical character intact. Right: photograph of the main gallery room (room 215), which had a significant amount of its character-defining elements removed or covered.

Moldings.

Lucas Mansion has wood baseboards, window trim, and door trim in every room. These have several different styles and profiles. In some cases, multiple profiles are used in a single room and in a few cases there is more than one profile used in the framing of a single window framing. The moldings in every room are characterized by the contrast between their dark finish and the light wall color. The doors and windows on the first and third floors have very similar molding styles. Both floors contain several different window and door moldings, but primarily utilize an identical molding profile, with plain corner blocks. The second floor uses a different profile but is more consistent with itself, in that windows and doors on this floor nearly all employ only one profile. The primary window and door trim used on the second floor has a noticeably different profile than that used on the first and third floors (Figure 21). The trim on the second floor has oversized corner blocks with simple bull's-eye rosettes and decorative plinth blocks at the base of doorframes.

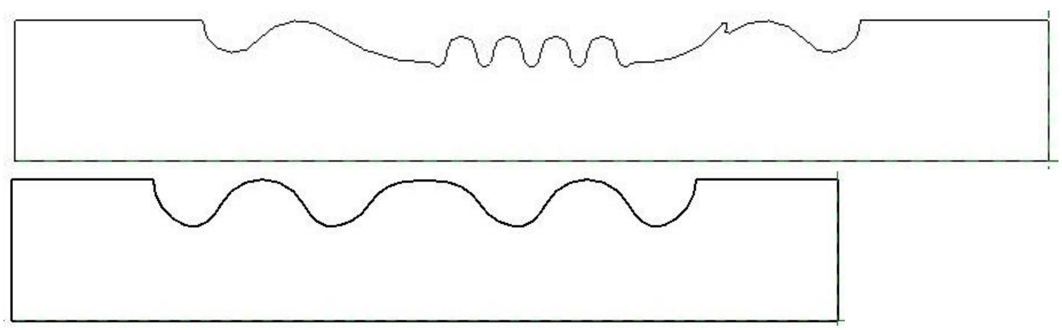

Figure 21. Drawings of the two most common casement molding profiles in the historic section for the building. Top: profile primarily used on the first and third floors. Bottom: profile used exclusively on the second floor.[15]

The window and door trims on the exterior walls of the gallery space were removed during the 1980s renovation. The removal of this trim unquestionably impacted the character of the space. These rooms now feel lopsided, with the heavy visual impact of wood only on their interior sides. The original baseboards were kept in the gallery spaces, but when compared to photos from the early 1980s it appears that the shoe mold that sat on top of the baseboard was

[15] Drawings of all molding profiles found in the historic section of Lucas Mansion are included in the drawing set found in appendix B. The profiles are cataloged by room in the finishes spreadsheet found in appendix C.

removed at some point after the renovation (Figure 22). Considering baseboards in the building that were not carpeted, it is also likely that the baseboards originally had a base shoe mold as well (A. Houchins, personal communication, December 10, 2016).

All of the trim and baseboards in the building were originally wood grained. Wood graining is a decorative paint technique that imitates the look of wood. This technique is used to make non-wood surfaces look like wood or to make cheaper wood look like a more desirable species. The only places in the building where the original wood gaining survives are the two front rooms (rooms115 & 114) on the first floor. When Mrs. Sharpe bought the building some of the trim had been painted over and many other areas were pealing beyond repair. The majority of the moldings, doors, and fireplaces in the building had to be stripped down to the wood and redone with wood grained finish in the 1980s renovation (Cross & Southern, 1981; A. Houchins, personal communication, March 27, 2017). The appearance of the restored wood graining on the second and third floors is clearly different from the original (Figure 23).

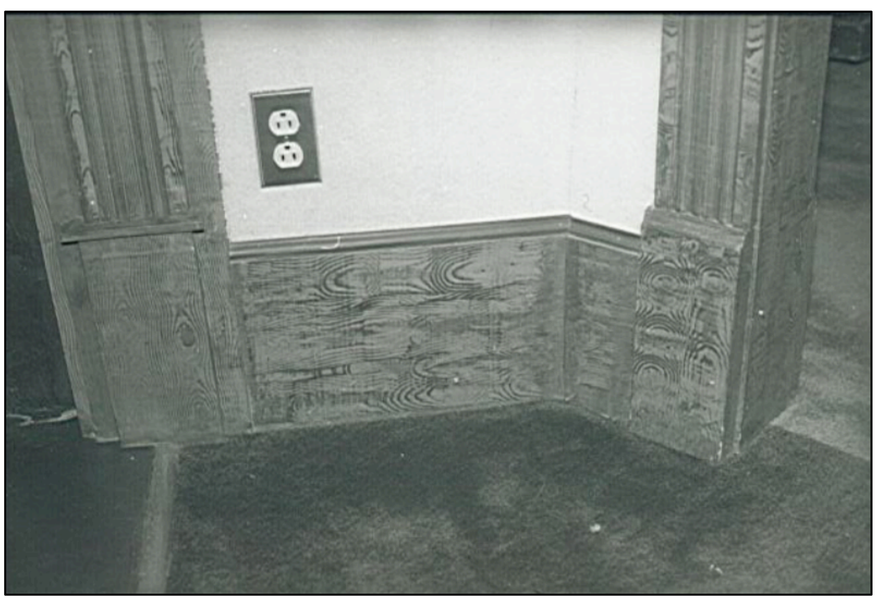

Figure 22. Photograph from early 1980s of baseboard, base of doorframe, and base of fireplace in gallery room 216 (scanned copy of photograph from the North Carolina Preservation Office's file on Lucas Mansion).

Figure 23. Left: Original wood graining on a doorframe in the historic entry (room 115) on the first floor. Right: redone wood graining in main gallery (room 215) on the second floor.

Windows and doors.

The doors and windows of the gallery space were significantly impacted by the 1980s renovation. The windows were covered over by the carpet finish of the gallery wall so that they were indistinguishable from the interior walls, but were unaffected on the exterior. The majority of the windows off the gallery rooms are small, square casement windows set high in the wall, but there are two large double-hung windows on the south wall of room 213. The windows all appear to be original; they are single-paned and some have wavy glass, an indication of age and kiln temperature. The presence of waves in the glass shows a low firing temperature, which causes the glass to sag over time. Overall the windows are in good condition. A few of them have minor repairable damage to their sash, and peeling paint. The most eastern window in the north wall of the main gallery (room 215) has broken glass that needs to be replaced. The two windows on the west wall of one of the smaller gallery rooms (room 216) have a decorative film on them that has deteriorated and is peeling off (Figure 24). It is unclear if this film is original but, based on its current condition, it is unlikely it can be salvaged. Removing the interior sheathing in room 217 exposed the interior side of three casement windows. Each of these windows is painted shut. Both windows had two hinges on one side and a simple bolt latch on the opposite side. The hardware was also painted over.

Figure 24. Windows on the west wall room 216 that have a decorative film that has deteriorated.

The exterior doors of the gallery rooms had a second door installed over them during the interior in the 1980s renovation (Figure 25). These doors are painted solid black to the exterior side and have the same carpet finish as the walls to the interior side. The carpeted doors close flush to the interior walls, with the baseboards continuing across their base, and have no hardware except a bolt latch in their upper corner. These doors are extremely well sealed with continuous weather stripping all the way around them. All four of the exterior doors off the gallery space received this treatment. The original doors underneath are paneled glass that is wood grained on the interior and painted white on the exterior. Three are single doors and one is a French door. The original doors have a mix of original and new hardware. Each door has a newer brass-colored dead bolt, but the handles and hinges appear to be original.

Most of the interior doors on the second floor appear to have been removed. There are no interior doors in the gallery rooms currently; however, each of the cased openings shows signs that it once contained doors, including shadows of jambs and repair marks where hinges and latches once were.

Figure 25. Exterior doors of the gallery spaces.

Fireplaces.

Each floor of Lucas Mansion has two fireplaces set back-to-back in different rooms around a single chimney. The fireplaces in the house are coal burning. This was extremely unusual in the region, leading many to believe that a contractor familiar with the building practices of the northern states built the original house (A. Houchins, personal communication, December 12, 2016). Each fireplace has an ornate cast metal insert with gold highlighted details. The mantels and fireplace surrounds vary in detail from floor to floor, but all have reeded pilasters, corbels, and wide friezes. Like the window and door moldings, the first and third floor fireplaces are nearly identical, while the second floor fireplaces differ. The second floor's fireplaces are very similar in form but different in detail from those on the other two floors. The second floor fireplace surrounds utilize the unique trim found only on that floor of the mansion (Figure 26).

Figure 26. Fireplace in gallery (room 216).

Finishes.

The interior finishes used are consistent throughout the building. All of the original interior walls and ceilings are clad with wooden tongue-and-groove beadboard. This material was removed from the walls of the gallery rooms during the 1980s renovation and replaced with carpet, but beadboard was left on the ceilings. The beadboard remains undisturbed on the first and third floors of the mansion. All the beadboard in the building was painted a creamy white color during the 1980s renovation. Prior to then, the beadboard was painted in shades of pink and green (A. Houchins, personal communication, March 27, 2017). It remains unclear, however, what the original paint colors were. A wide assortment of trim styles are used at the beadboard transitions. Most exterior corners are boxed out with inch-thick square boards, but in some places molding was used instead. The interior corners utilized a mix of several styles of molded, squared, and half-round pieces. These transition pieces on the second and third floors are painted to match the walls and ceiling color, but the majority of the transition pieces on the first floor are wood grained.

As discussed above, each room has wood moldings that were painted with a dark wood grain. The two front rooms on the first floor have vertical board wainscoting possessing original wood graining. The first and second floors have exposed hardwood flooring, Board width varies from room to room between two to four inches, but board width is consistent within each room. All finishes were cataloged by room; this information can be found in Appendix C.

Condition Assessment

Moisture Survey

One hundred and forty instances were recorded in the moisture survey of the interior rooms of the Lucas Mansion. Once the areas of deterioration were identified, they were considered within the context of the building's maintenance records to attempt to identify whether the moisture damage was ongoing or from a one-time extreme event; whether the problem had been resolved; or whether the deterioration was unrelated to moisture.

Third floor.

The third floor was difficult to evaluate because there are many large doll cases that obstruct the view of many of the exterior walls (Figure 27). Because of this, the data collected on this floor may be incomplete. The third floor has the least visible moisture damage of the three stories. There are minor problems with peeling paint on the walls and ceilings in all the

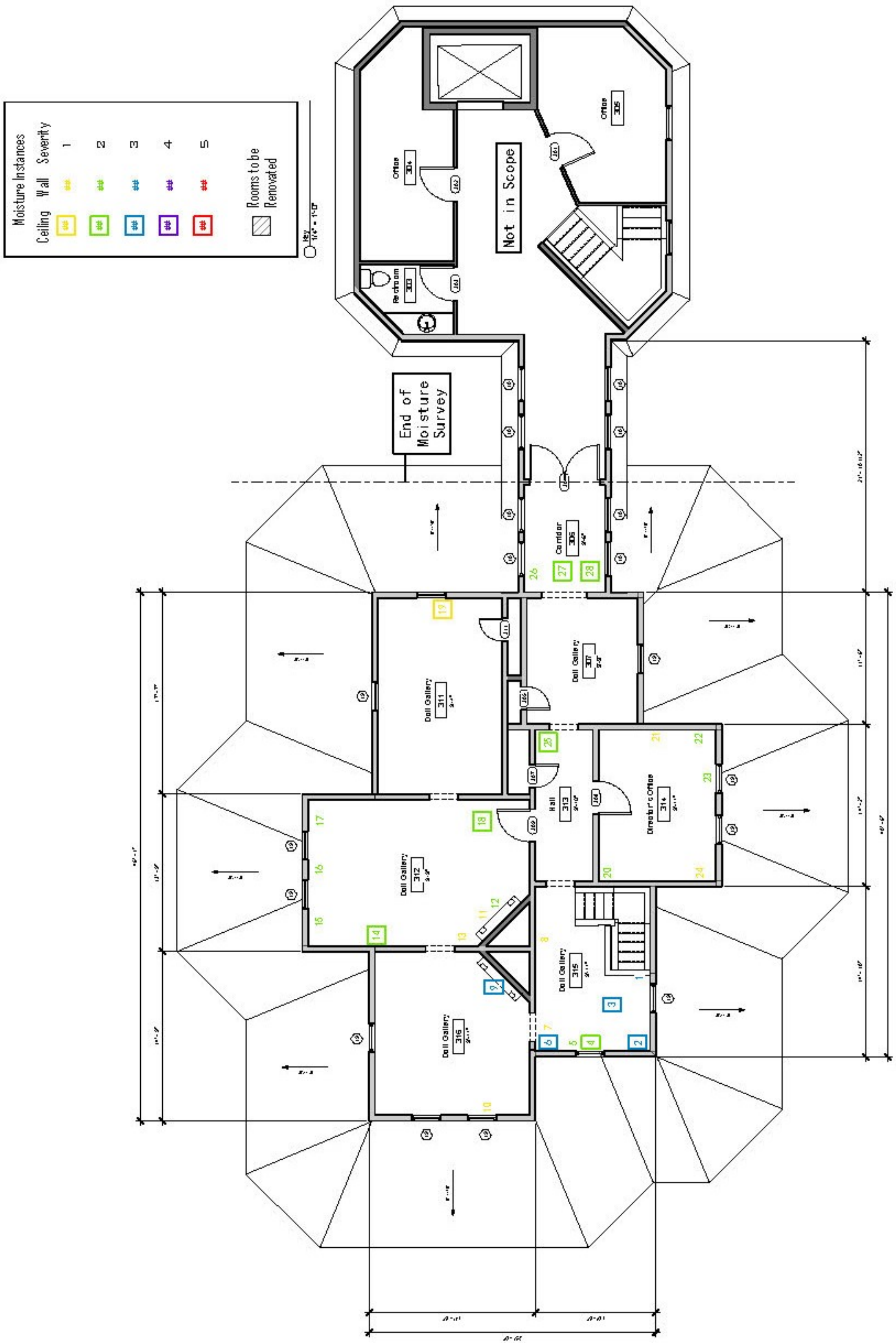

Figure 27. Floor plan showing all moisture instances on the third floor.

rooms on this floor, but little evidence of warped wood. These instances do not appear to have been caused by bulk moisture. The majority of the damage documented on this floor was concentrated in the southwest corner of the building (room 315). This corner is adjacent to a gutter problem and roof leak on the second story roof attached to the exterior wall on this side of the house. The Hiddenite Center staff has noticed that storms with driving rain from the west can cause the damaged areas on the ceiling of room 315 to become damp to the touch. Since the roof was repaired in 2013, the problem of flaking paint has been slowed. At one time there was a significant water leak that affected all three floors of the mansion around a chimney that is set in the valley between the two east gables. As mentioned earlier, this leak occurred for several years with some short-lived repairs before finally being fixed with the installation of membrane flashing that appears to have resolved the problem. This leak entered the third floor inside the closet adjacent to one of the doll galleries (room 307). The damaged material inside the closet was replaced after the membrane was installed.

Second floor.

Water damage on the second floor is largely concentrated in the rooms that are under the porch roof, with the exception of the damage on the east side of the main gallery (room 215; Figure 28). This damage has been attributed to the roof valley leak and sprinkler system malfunctions, neither of which remain a threat to the building. The east side of the main gallery room was flooded multiple times by the old sprinkler system, which caused most of the moisture damage that can been seen on the ceiling of the room. The roof valley leak came down the south wall. Most of the damage done by the leak on the ceiling was repaired. Since the roof valley repair and replacement of the sprinkler system the problems in this area have been resolved (A. Houchins, personal communication, March 26, 2017).

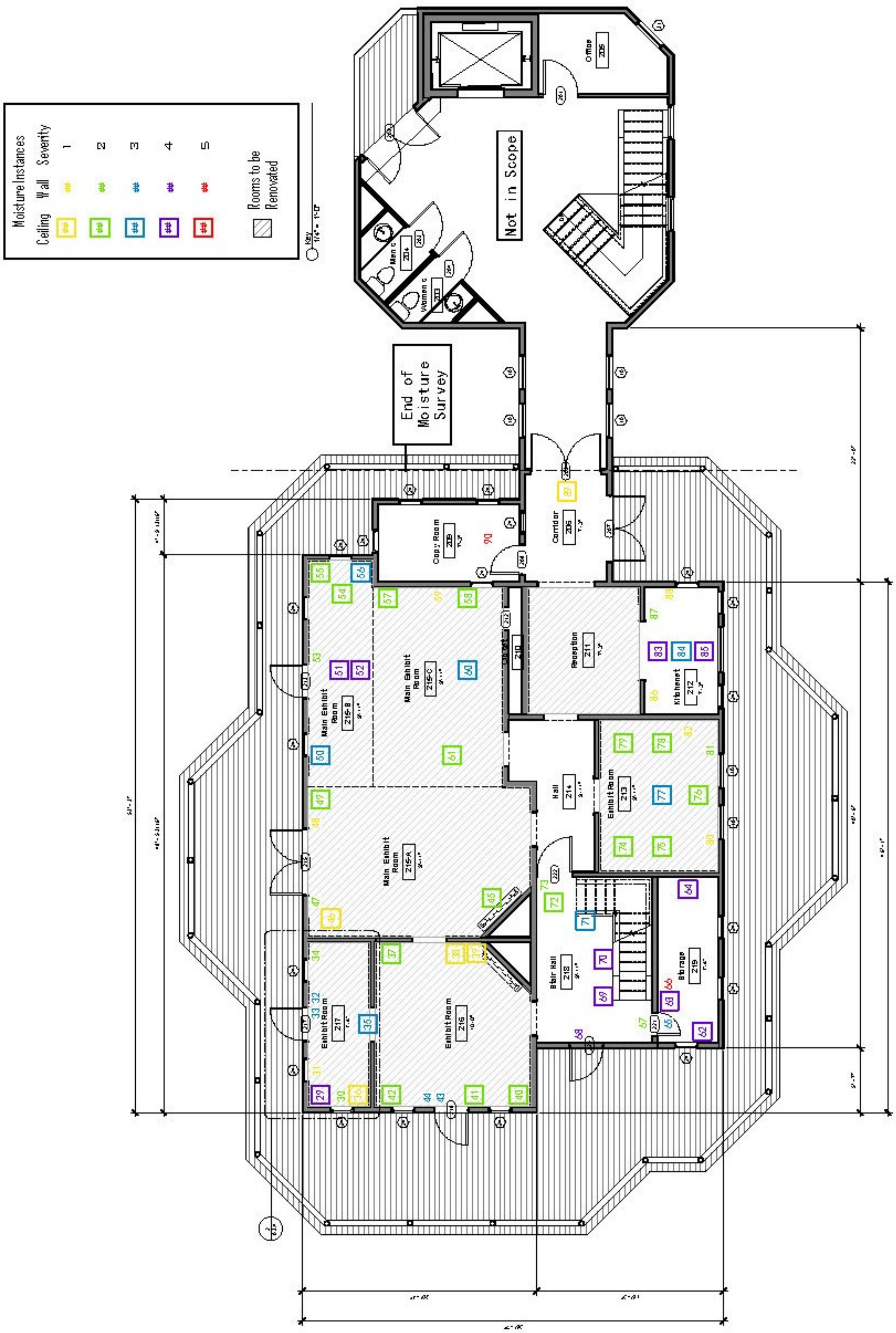

Figure 28. Floor plan showing all Moisture instances on the second floor.

The remainder of notable moisture problems found on this floor are under or adjacent to the second floor porch roof. The first example of this is the damage in the corner of room 217, which has peeling paint and warped wood. The staff at the Hiddenite Center have noticed that this area becomes wet to the touch when they have storms with driving wind from the west.

Figure 29. Moisture damage in room 219, instance 66.

There is an extreme amount of peeling paint and warped wood in room 219, an unconditioned storage room (Figure 29). The damage is concentrated on the north wall of the room, which is directly below where the second floor roof connects to the third-story wall. It can be seen from cracks in the walls and the slope of the floor that this room has undergone quite a bit of settling, pulling the room down and away from the main house. This is likely creating stress on the flashing joint directly above the damaged area. According to the Hiddenite Center staff, damage in this room has been progressing slowly but steadily. It was pointed out that, unlike the other rooms in the house, this room has not been repainted at all since the first round of renovations in 1981 (A. Houchins, personal communication, March 26, 2017).

Just outside of room 219 moisture damage on the ceiling of the stair hall (room 218) appears to be radiating out from the exterior wall, which is below the porch roof's connection to the wall (Figure 30). This area is adjacent to the area on the west porch with a large roof leak; water could be wicking in from this location. The leak in the porch roof pours water during heavy rains, and significant damage can be seen on the ceiling of the porch. This is also a section of roof that regularly experiences gutter overflow.

Figure 30. Moisture damage on the ceiling of room 219, instance 69.

Another leak that seems to be coming from the porch wall connection is in the kitchenette (room 212). This roof has had a chronic leak that comes down its south wall, which is directly under the transition between the second floor roof and the third floor wall above. This area was re-flashed a few years ago. This repair helped, but water sill comes in at this location when driving rains come from the south. At times enough water comes through this area that the staff has to put out buckets to capture the water (A. Houchins, personal communications, March 27, 2017).

Finally, there was a major leak into the copy room (room 209), which caused a large mold spot to form that has since be repaired. This room is completely under the porch roof. This part of the porch roof is also where the water from the large valley of the upper roof is funneled onto the lower roof, putting extra stress on this part of the roof. This section of roof underwent a major repair in 2016. This repair appears to have addressed the leak adequately. When the roof was opened up for the repair it was noted that the wood framing was in remarkably good shape. Even though the wood was blackened with water stains, none of it was rotten or required replacement (A. Houchins, personal communications, March 27, 2017). The material was clearly drying out quickly enough that the water was not causing rot problems.

Minor moisture problems are visible around seams at covered window and door locations, as well as at the edges of the carpet on exterior walls. These moisture issues appear to be caused by moisture brought in by air infiltration.

First floor.

Almost all problems noted on the first floor originated from either sprinkler malfunctions, the roof valley leak, or settling (Figure 31). The majority of instances recorded on the south side of this floor were cracks in the walls. After interviews with the Hiddenite Center staff it was determined that these cracks were actually caused by settling and foundation repair (A. Houchins, personal communication, March 26, 2017). The sag in the ceiling on the north side of the kitchen and the water staining on the opposite side of the wall in the bedroom came from the roof leak in the valley (Figure 32). The damage in the bedroom has stabilized but the sag in the kitchen ceiling continues to slowly get worse. This could point to rotten wood that has

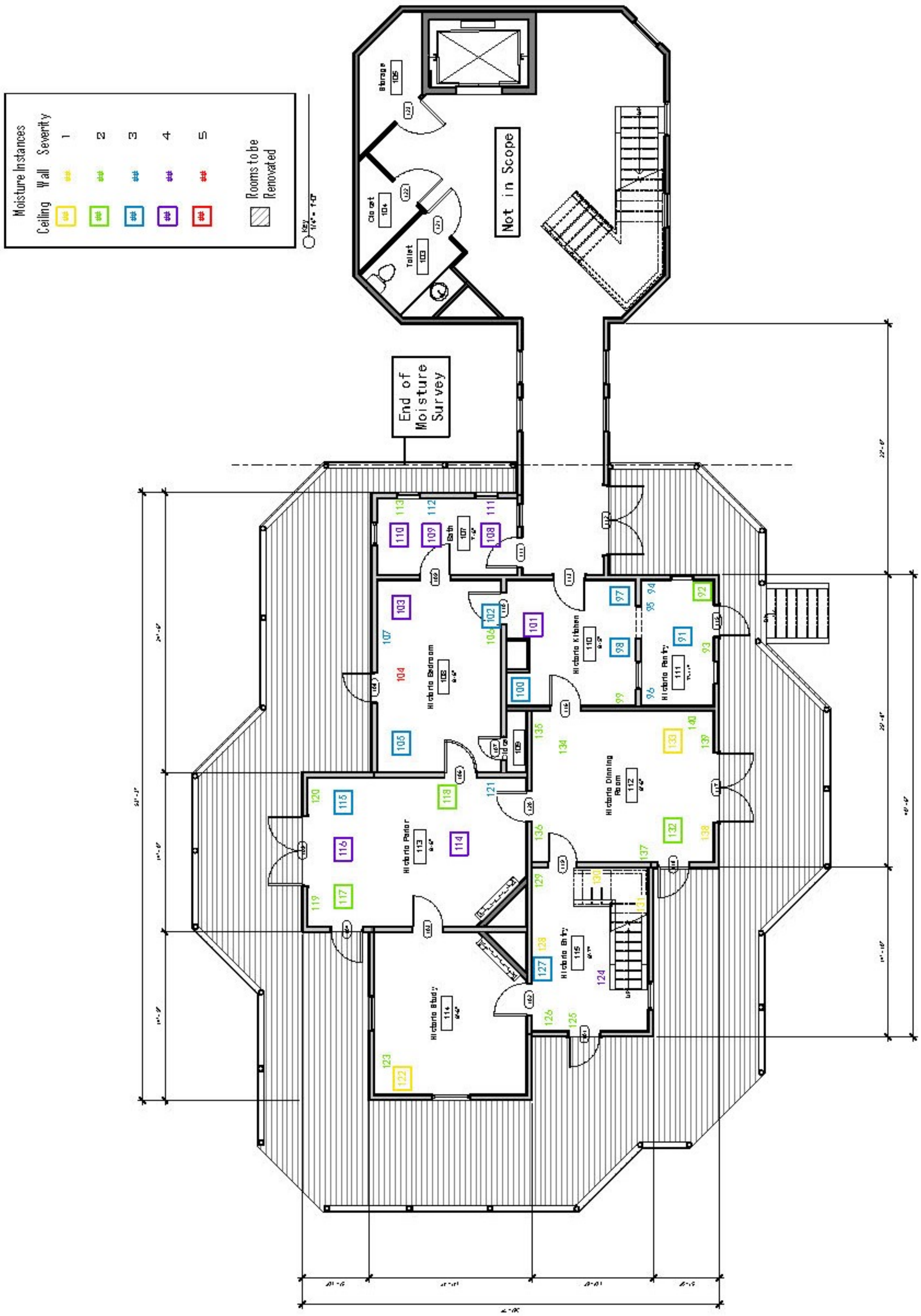

Figure 31. Floor plan showing all moisture instances on the first floor.

not been addressed. The substantial damage on the ceiling of the bedroom and the ceiling and walls of the bathroom came from the sprinkler malfunctions in the main gallery room directly above. The 1985 sprinkler leak was primarily concentrated in the historic parlor (room 113). They had to remove a large section of the ceiling in this room to repair the broken pipe, then the same boards were put back up. These areas have looked the same for years (A. Houchins, personal communications, March 27, 2017).

Figure 32. Sag in the ceiling of the historic kitchen (room 111) that continues to progress; instance 101.

Images of each instance of moisture on the interior of the building, along with data collected about each instance in the survey, are included in Appendix D.

Roof.

The upper roof has many areas were light can be seen through the flashing in the attic. There are water stains on the framing members radiating out from these faulty flashings, but no rot was found. The water that is getting in appears to be drying quickly enough to avoid mold and rot. The second floor porch roof has more significant problems on the north side of the building, where it is in desperate need of repainting. Paint has been peeling off in large chunks for years (Houchins, 2014, December).

There is no guttering or drip edge on the upper roof, and the fascia boards are very close to the edge of the roofing Figure 33). This causes water to run back and down the side of the building, leading to damage of the soffit and the body of the building. This may have caused severe water damage to several of the windows on the third floor (Figure 34). The drop from the upper roof to the lower roof could be causing splash-back that has led to damage to the siding just above the lower roof, and has exacerbated peeling paint (Figure 35). The lack of guttering on the upper roof also puts significantly more demand on the original half-round gutters on the porch roof. Gutters on the west side of the building cannot handle the watershed load and regularly overflow. When the gutters overflow the water runs down the west side of the building, which has in part caused chronic rot problems on the west porch.

Additionally, several of the downspouts are compromised in a way that constricts flow, including both downspouts on the west side of the building. The end of the northwest gutter has been crushed (Figure 36). This buckled condition appears to constrict the flow enough that water backs up several feet and leaks out the side. The southwest gutter termination is buried in leaves and dirt, which could be severely constricting its flow as well. This could be contributing to the overflowing gutters on this side of the building.

Figure 33. The upper roof has no gutter or drip edge.

Figure 34. Third floor window with considerable moisture damage.

Figure 35. Moisture damage on the lower siding boards above the second floor roof.

Figure 36. Peeling paint and moisture damaged siding on the second floor roof.

Figure 37. Compromised downspouts on the west side of the building.

The gutters have been problematic for quite some time. In a letter sent to Mrs. Sharpe shortly after she bought the property in 1981, a preservation expert who had done an assessment of the property suggested the replacement of all of the building's gutters. He cited that the failure of the historic half-round gutters had led to damage to the cornices and the body of the house (Swaim, 1981). This work was never done. The original gutters are still in place on the second story roof (A. Houchins, personal communication, March 27, 2017).

Foundation.

Lucas Mansion sits on a foundation of brick piers. Several of the piers in the crawlspace demonstrate efflorescence, some have been repointed, and others, particularly around the perimeter, need to be repointed. Nearly all of the gutter downspouts are draining directly onto these piers (Figure 37). Splash-back appears to have caused moisture damage on the wood porch next to these areas. The downspout on the south side of the building appears to have systems that are meant to move the water away from the building but that are not working effectively because of being clogged with leaves and dirt, corroded metal pipes, and broken clay pipes (Figure 38). The excess moisture around these piers could be contributing to the settling of the foundation, particularly along the porch footprint. South and west porch settling away from the building may be putting pressure on flashing joints, contributing to the failings at the second story roof.

Figure 38. Compromised water drainage from down spouts.

Physical Investigation of the Gallery's Exterior Wall

The west and north walls of gallery room 217 were disassembled from the inside to gain an understanding of the assemblies and interior wall conditions (Figure 39). From exterior to interior the wall is comprised of: painted wood clapboard siding, asphalt paper, diagonal board sheeting, approximately 4-inch deep wood framed cavities filled with R-11 paper backed fiberglass batts, ¾-inch plywood, and ¼-inch hardboard covered in carpet.

Figure 39. Before and after the disassembling of the walls in gallery room 217.

This is notably different than what was expected, in two ways. First, a photograph of the third floor during the 1980s renovation shows a wall with no exterior sheathing (Figure 40). The wall shown in that photograph has the clapboard siding applied directly to the studs. It is likely that when the second floor was added the builder used an assembly different from that used when the building was originally constructed. The presence of diagonal boards on the second floor likely makes a considerable contribution to the building's resistance to shear stress. Second, tarpaper or a similar material was found between the diagonal board sheathing and the siding. Based on photographs and descriptions by individuals who were involved in the building renovation it was not expected to find any moisture control layers in the wall. The tarpaper was likely installed when James Lucas added the second floor. None of the building's siding has been removed since Mrs. Sharpe bought the building.

Figure 40. Photograph of 3rd floor wall striped down to the stud (Joines, 1982).

Even though this floor was added retroactively, a modified balloon framing style was used instead of a platform style. The studs extend about two feet below the finished floor before resting on a plate. The floor joists are hung off the studs. The framing, sheathing, and flooring material all appear to be pine. The original wood floors were still in place under the carpet. The floors have a thick layer of carpet adhesive on them but otherwise appear to be in relatively good condition.

Each of the windows that was uncovered had a 1-inch thick plywood insert placed in it. The side facing the exterior was painted black and the side facing the interior was plastered over to create a level surface with the plywood in the wall assembly. The hardboard was then applied over the leveled plywood layers. Neither the windows nor the original doors have any kind of weather stripping; the windows had been painted shut from the inside. There was no evidence of air sealing measures. The windows had fiberglass insulation haphazardly stuffed in the space around them. The windows are shaped such that storm windows could easily be installed. None of the windows in the building currently has storm windows.

Figure 41. Molding and water stained material from northwest corner of room 217

The corner of room 217 has a known bulk water leak in ceiling just above it. Once the material was removed from the walls it was clear that this moisture was finding its way down the inside of wall. Several of the wood members and large sections of the plywood had water-stained wood, but no rot was found. Mold was discovered on the plywood, hardboard, and carpet (Figure 41). The majority of the mold was on the hardboard, which had sections of mold all the way down the wall, with some areas radiating out from the corner more than a foot. The plywood and carpet only had mold right at the top of the wall and just above the baseboard where the hardboard starts. The carpet had to be removed simultaneously with the hardboard because the carpet adhesive was exceptionally sticky, making the layers impossible to separate. This made it difficult to assess how much mold was on the back of the carpet. Two studs in the corner are much lighter in color and smoother in finish. It is likely that these members were installed during the 1980s renovation, possibly to stabilize the wall or to address rot in this corner. This may indicate that this corner has been problematic for quite some time.

Hygrothermal Modeling

WUFI® data output were examined for each modeled wall assembly to determine the hygrothermal performance of the based on several criterion, with the aim of identifying alternative wall assemblies which performed the similar or better than the existing wall.

Analysis of Existing Wall

Water content criterion.

The total water content of this assembly did not stabilize during the three-year simulation. The water content fluctuated wildly, with high spikes for the entire period (Figure 42, left). Once the layers were examined individually it was clear that the siding layer was the cause. All other layers of the assembly reached a dynamic steady state, with relatively minor fluctuations in water content that followed the seasons, and ended with either lower or similar water content to what they started with. The siding, on the other hand, was marked by dramatic spikes in moisture content, likely caused by simulated weather events (Figure 42, right). A second model was run that was identical in all ways except a layer to represent paint was added to the exterior of the assembly. With this change, both the siding layer and the overall moisture content achieved a dynamic steady state (Figure 43).

Similarly, when the max water content of the wood layer of the existing wall modeled without paint was converted to mass percent by dividing the water content by the material's density it was found that all layers stayed under the 20% threshold for the duration of the test, except the siding layer (Table 6). The water content of the siding reached as high as 44.74%. It can be seen in the graph depicting the water content of siding that this high percentage corresponded to large spikes in the moisture content, and was not sustained (Figure 42, right). The hourly data were analyzed to determine whether the siding exceeded the 20% threshold for decay potential 8.7% of the testing period. This would typically indicate rot, but in this case it was most likely the result of choosing to run the worst-case scenario and not accounting for the paint layer that helps protect the siding. The model with a paint layer added had a maximum moisture content of only 10.41% (Table 7). Even if the actual paint does not perform as well as the paint layer in this model, it can be assumed that the existing wall performs better than the model with no paint represented at all. The actual moisture content likely sits between these two values. Further, a visual inspection of the building exterior reveals that the siding is in relatively good shape. There is very little rot on the exterior of the building, with the exception of areas that have bulk water conditions. Additionally, all the siding on the second floor is protected from direct rainfall by the deck's deep overhangs that encircle the building

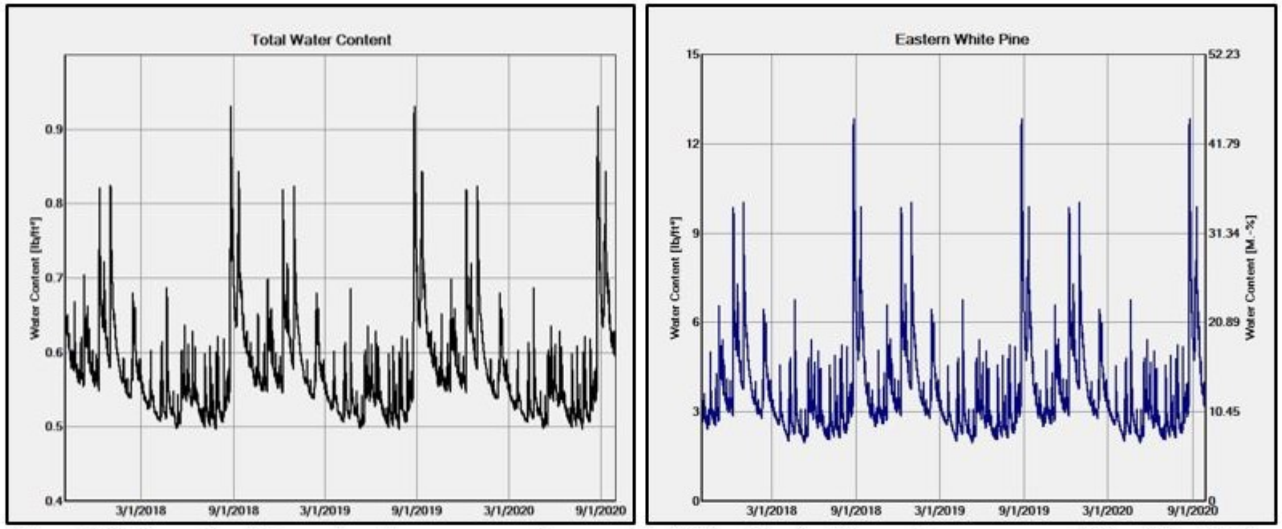

Figure 42. Left: graph of the total moisture content the assembly. Right: Graph of the moisture content of the siding. Both are from the WUFI ® model of the existing wall without a layer representing paint.

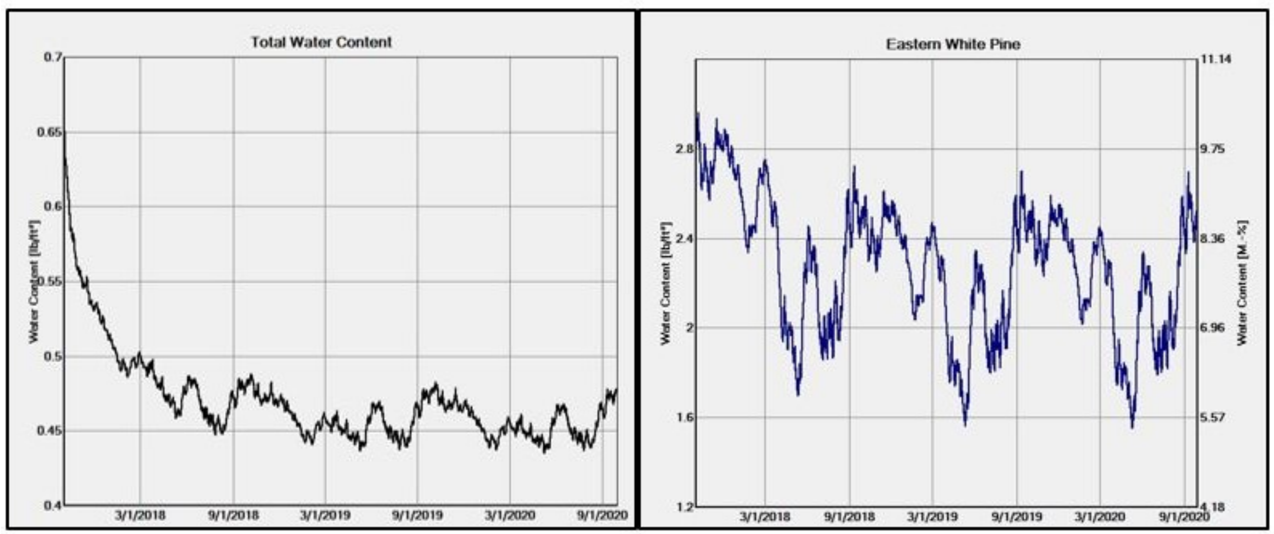

Figure 43. Left: graph of the total moisture content the assembly. Right: Graph of moisture content of the siding. Both from the WUFI ® model of the existing wall with a separate layer representing paint.

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Table 6. *Mass-Percent Water Content of the Wood Components of the Existing Wall*

Material	Max Water Content (lb/ft^3)	Bulk density (lb/ft^3)	Max Mass-Percent Water Content (%)
Siding	12.85	28.72	44.74%
Diagonal Board Sheathing	3.33	28.72	11.59%
Plywood	4.02	29.34	13.70%
Hard Board	2.21	19.98	11.06%

Table 7. *Mass-Percent Water Content of the Wood Components of the Existing Wall with Paint as a Separate Layer*

Material	Max Water Content (lb/ft^3)	Bulk density (lb/ft^3)	Max Mass-Percent Water Content (%)
Siding	2.99	28.72	10.41%
Diagonal Board Sheathing	3.02	28.72	10.52%
Plywood	4.02	29.34	13.70%
Hard Board	2.21	19.98	11.06%

Condensation potential.

Dew point was examined alongside dry bulb temperature at several points in the assembly, including each side of every sheathing layer (i.e., diagonal sheathing boards, plywood, gypsum wall board, hardboard). At each monitoring point the dry bulb temperature remained above dew point at all times. At the monitoring points close to the exterior the temperature and dew point follow each other closely but did not cross (Figure 44). The distance between dew point and dry bulb temperature gradually increased as the monitoring points moved closer to the interior (Figure 45). This shows this assembly, as modeled, has no condensation potential from vapor diffusion. However, it is important to note that these calculations do not account for air infiltration, which could have a significant effect on condensation potential.

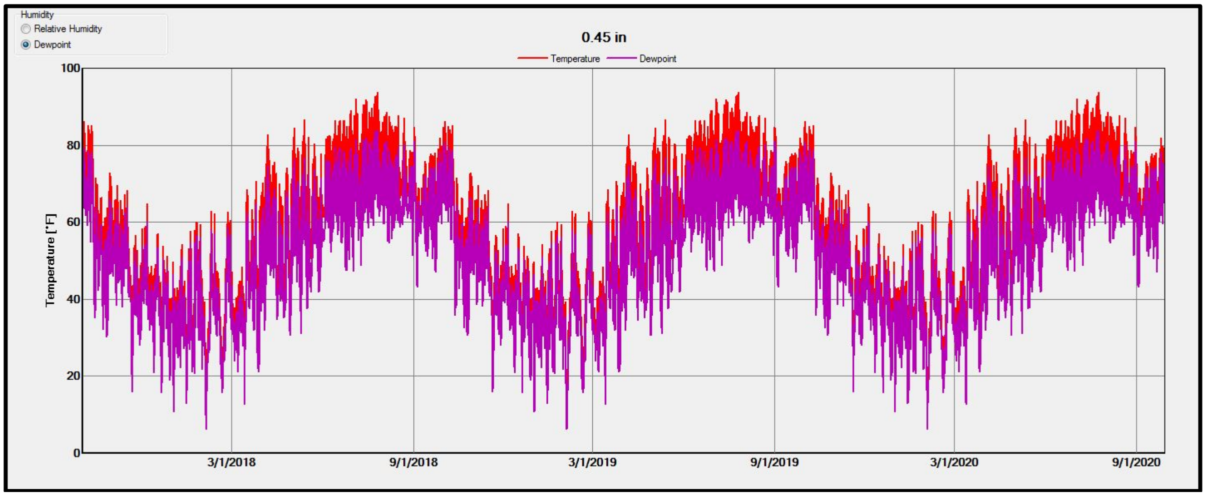

Figure 44. Dry bulb temperature and dew point of the existing wall model at a monitoring point between the siding and tarpaper layers.

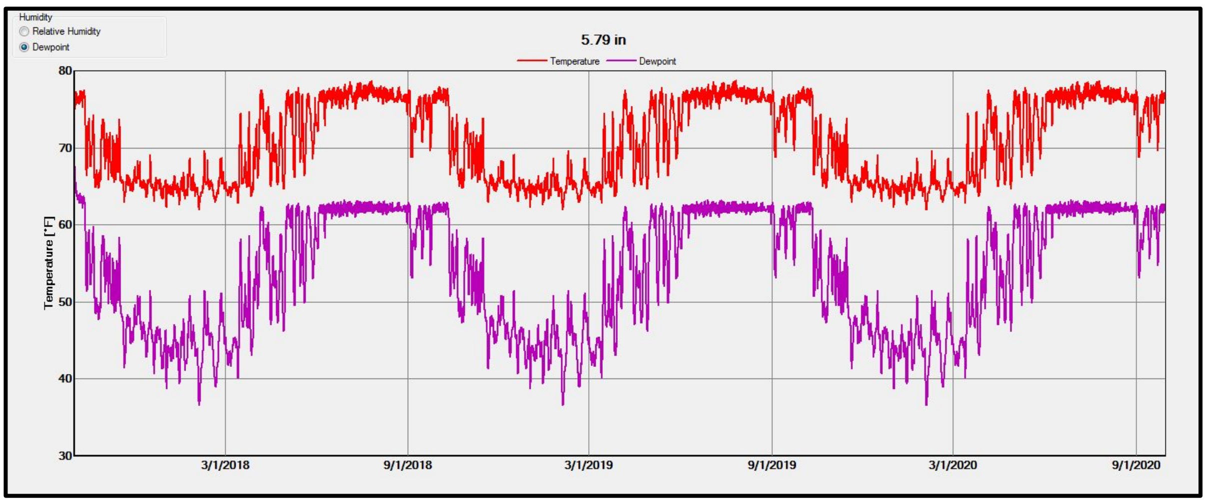

Figure 45. Dry bulb temperature and dew point of the existing wall model at a monitoring point between the plywood and hardboard layers.

Mold growth potential.

The isopleth graph, created by WUFI®, shows that the condition on the interior surface of the wall never exceeds the lowest isopleths for mold for either class of substrate (Figure 46). This alone is not sufficient for a firm assertion that mold will not grow, so the model was also run through WUFI-Bio (Mantha & Arena, 2012). WUFI-Bio indicated that the wall assembly had very low mold growth potential (Figure 47). It gave the assembly a green light; indicating that the total mold growth potential is less than 1.96 inches per year.

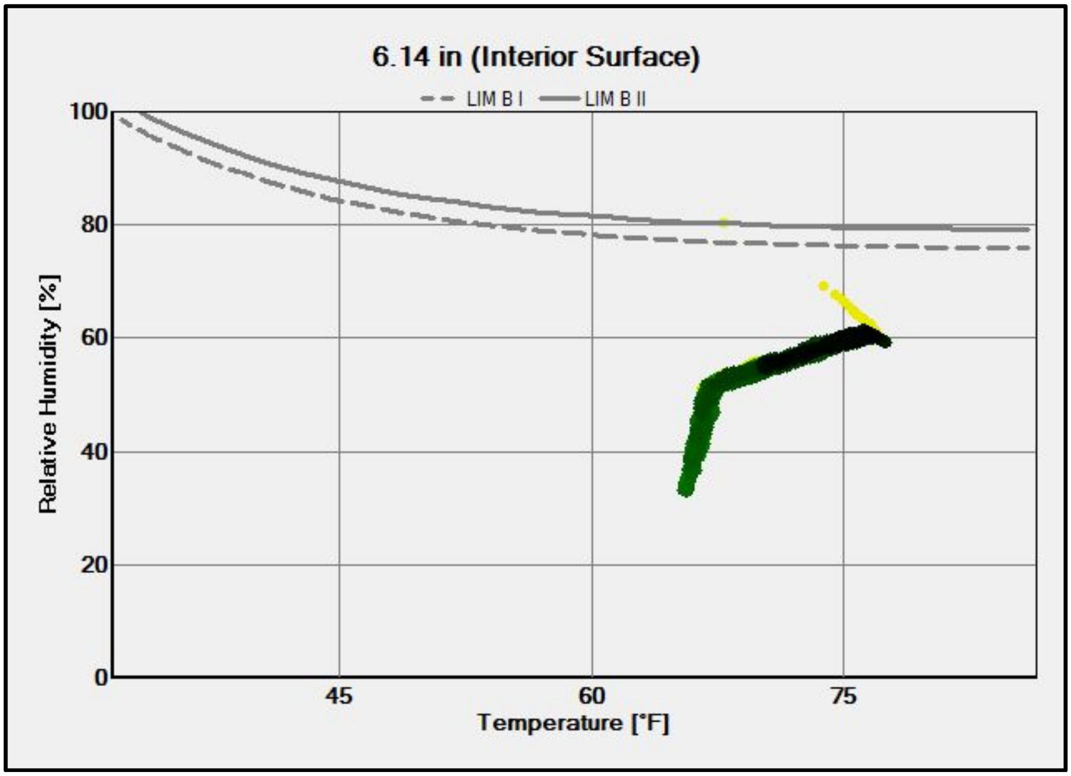

Figure 46. Screenshot of isopleth graph produced by WUFI® showing the modeled condition of the interior surface never exceed the lowest isopleths for mold.

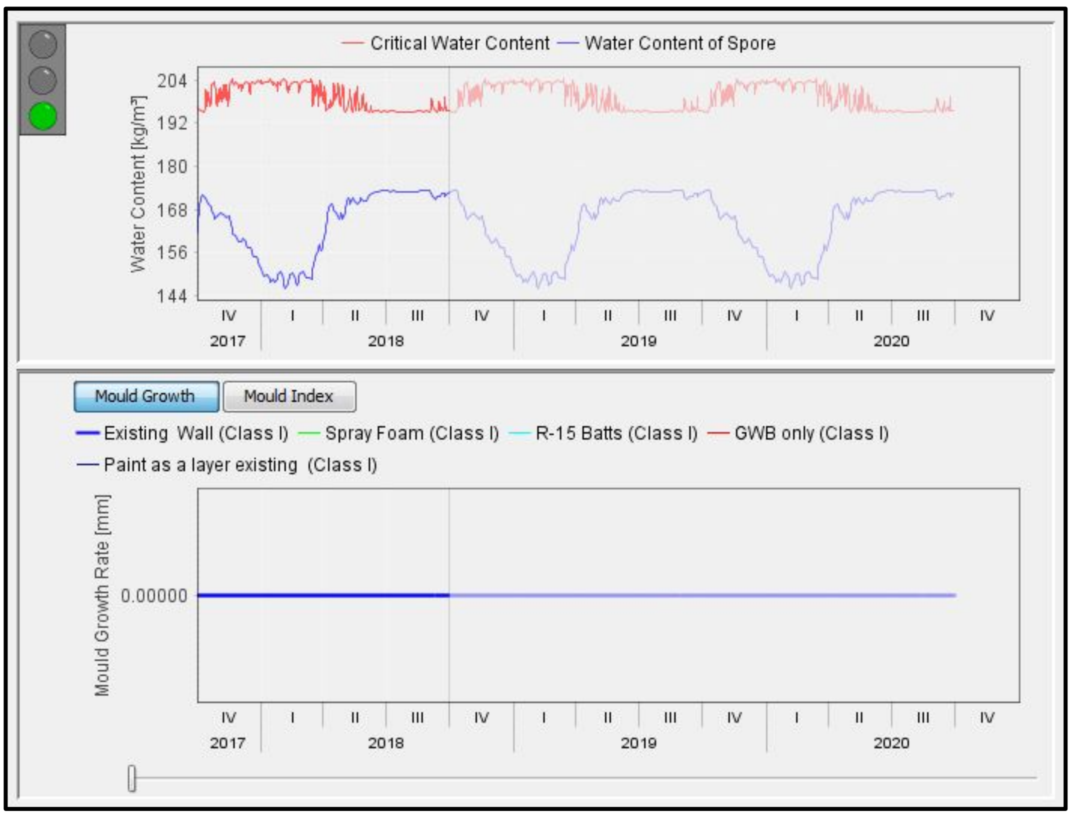

Figure 47. Screenshot of results graph produced by WUFI-Bio showing the modeled condition have little to no mold growth potential.

Analysis of Alternative Assemblies

The results of the three alternative assemblies were remarkably similar to those found in the existing wall model. In each model all layers reached dynamic steady state of moisture content, with the exception of the siding. None of the material layers exceeded 20% moisture content except the siding layer. The maximum mass-percent moisture and the percent of the testing period that the layer exceeded 20% water content did vary between the cases. None of the assemblies' dry bulb temperatures dipped below the dew point on the surface of any of the sheathing layers. All the assemblies passed both tests for mold, with conditions remaining below the lowest isopleth for mold and receiving a green light from WUFI-Bio. Overall, there was extremely little variation in hygrothermal performance of the different assemblies. Like the existing wall, the only criterion any of the alternative assemblies failed was water content of the siding layer. Because they failed this criterion it was decided to illustrate the negligible differences between the various models' results.[16]

It is reasonable that all four of these wall assemblies would preform similarly for two reasons. First Hiddenite has mild climate that might not draw out the hygrothermal difference between the wall assemblies. Second all of the wall assemblies tested effectively had a vapor retarder in on each side of the in insulation limiting the movement of moisture thought the thermally resistant layers. Never the less these similar results led me to run the models again in a more extreme climate to check if my WUFI® models were responsive. I ran the models in Miami, FL and Anchorage, AK. Both climates caused significant changes to the output. The wall assemblies had more variation but , general remained relatively similar to each other within each climate tested. The wall test with a Miami climate continued to have good hygrothermal

[16] Complete reports with result from all WUFI® cases included in appendix G (CD ROM).

performance, but the models run in a Anchorage showed elevated relative humidity at the diagonal sheathing layer of the assemblies. The relative humidity stayed above 80% for most of the year, and well into the warmer seasons, indicating a potential for surface mold. Although relative humidity at the diagonal sheathing layer went above 80% in the walls modeled in Hiddenite, this percentage dropped before the warmer seasons drastically reducing mold potential.

Alternative assembly #1 water content criterion: Rot and decay.

This assembly was nearly identical to the existing wall model (Table 9). The maximum water content of the siding was only 0.04% higher, the diagonal board sheathing was 0.03% higher, and plywood remained the same. The percentage of the testing period that the siding layer was above the 20% threshold was identical at 8.7%.

Table 9. *Mass-Percent Water Content of the Wood Components of Alternative Assembly #1*

Material	Max Water Content (lb/ft^3)	Bulk density (lb/ft^3)	Max Mass-Percent Water Content (%)
Siding	12.86	28.72	44.78%
Diagonal Board Sheathing	3.32	28.72	11.56%
Plywood	4.02	29.34	13.70%

Alternative assembly #2 water content criterion: Rot and decay.

This assembly showed the most variation from the existing wall (Table 10). The maximum water content of the siding was 0.25% higher, the diagonal board sheathing was 0.11% higher, and plywood remained the same. The percentage of the testing period that the siding layer was above the 20% threshold was 1% higher than the existing wall at 9.7%.

Table 10. *Mass-Percent Water Content of the Wood Components of Alternative Assembly #2*

Material	Max Water Content (lb/ft^3)	Bulk density (lb/ft^3)	Max Mass-Percent Water Content (%)
Siding	12.92	28.72	44.99%
Diagonal Board Sheathing	3.36	28.72	11.70%
Plywood	4.02	29.34	13.70%

Alternative assembly #3 water content criterion for rot and decay.

This assembly showed slightly variation (Table 11). The maximum water content of the siding was 0.07% higher, the diagonal board sheathing was 0.04% higher, and plywood remained the same. The percentage of the testing period that the siding layer was above the 20% threshold was less than 1% higher than the existing wall at 9.2%.

Table 11. *Mass-Percent Water Content of the Wood Components of Alternative Assembly #3*

Material	Max Water Content (lb/ft^3)	Bulk density (lb/ft^3)	Max Mass-Percent Water Content (%)
Siding	12.87	28.72	44.81%
Diagonal Board Sheathing	3.34	28.72	11.63%
Plywood	4.02	29.34	13.70%

CHAPTER 5: RECOMMENDATIONS AND DISCUSSION

Treatment Approach

Identifying a treatment approach, as outlined by the Secretary of the Interior, is a vital step that must be done early in the process of planning the renovation of a historic building. It is common for a single historic building to utilize more than one approach in different areas of the building. This is the case at Lucas Mansion. Multiple treatment approaches were utilized in the 1980s renovation. The first floor took a restoration approach and has been made to look as it did during the house's most significant historic period, while the second and third floors took the rehabilitation approach category, altering spaces to fit the needs of a new use while maintaining an effort to retain historic character. For the proposed gallery renovation, the rehabilitation approach is the most appropriate treatment for two primary reasons. First, the character of the spaces was altered heavily in the 1980s to serve the function of a gallery (Morton et al., 1997). Second, since the space will continue to be used as a gallery, there are some concessions of historic character that will have to be made in order to insure that programmatic needs are met.

The rehabilitation treatment approach puts an emphasis on the retention and repair of historic material, but allows for more liberty to be taken to adapt the space to new uses. It is suggested, however, that restoring altered elements to their historic condition will reinstate a measure of the historic character of these spaces. This suggestion must be balanced with the functionality of the space. Although a restoration would mean reinstating more of the space's original character, rehabilitation is more appropriate in this case (Hawkins, 2007). The treatment approach recommended in this report is confined to the gallery rooms that are the primary subject of the study (rooms 211, 213, 215, 216, 217; Figure 48). All recommendations are grounded in compliance with *The Secretary of the Interiors Standard for Rehabilitation, The Secretary of the Interiors Guidelines for Rehabilitation,* and the Preservation Briefs published by the National Park Service.

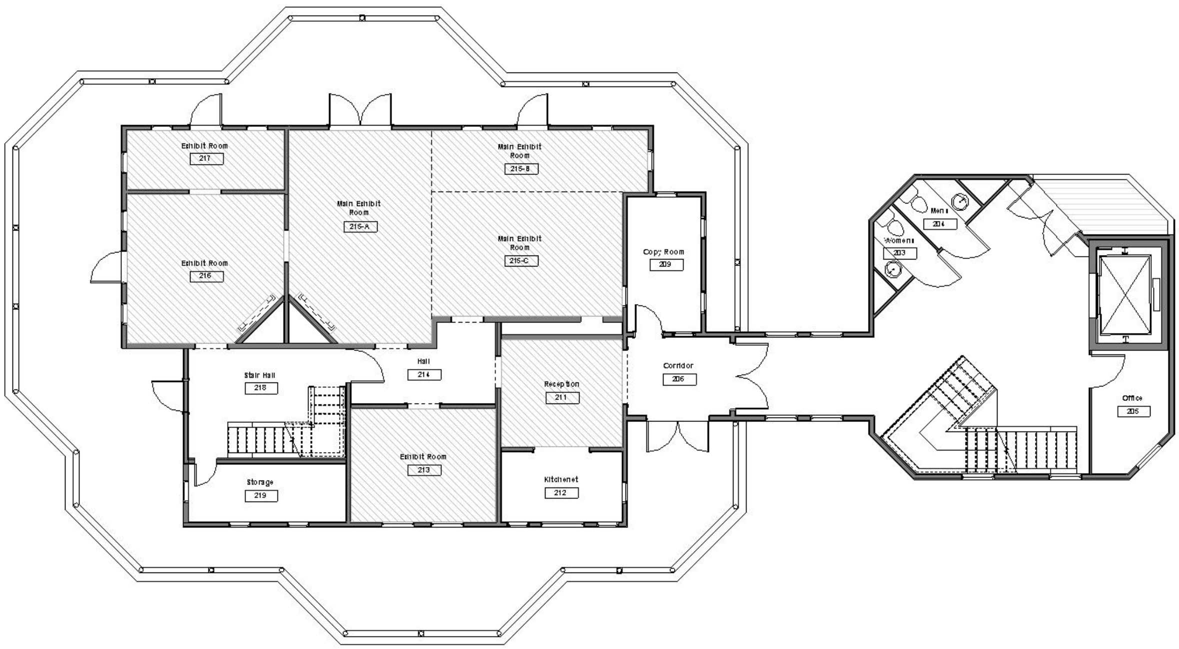

Figure 48. Floor plan of the second floor of Lucas Mansion showing the rooms in which recommended treatment approach is confined with diagonal hatch (gallery rooms).

Historic Character Recommendations

Moldings.

The moldings are particularly significant to the interior character of Lucas Mansion. All of the woodwork in the building was originally wood grained. Although only two rooms in the building still retain their original wood grained finish, this finish has been appropriately restored in all rooms in the building. Wood graining specifically is a called out in *The Secretary of the Interiors Guidelines for Rehabilitation* as important to defining the overall historic character of a building. It was a high style finish rarely found in North Carolina's rural architecture, making it an even more important historic feature of this building. All wood graining in the building, both original and restored, should be retained and a wood grained finish should be applied to any added trim pieces in accordance with *The Secretary of the Interior's Standards* (Morton, Hume, Weeks, & Jandl, 1997).

Molding around the exterior doors and windows of the gallery rooms were removed during the 1980's renovation. Replacing this molding would make a large impact in restoring the historic character in these spaces. *The Secretary of the Interiors Guidelines for Rehabilitation* states that when elements are destroyed by an inappropriate renovation limited replacement in kind is appropriate. The design must base restoration on historical, pictorial, or physical evidence (Morton, Hume, Weeks, & Jandl, 1997). In this case, there are both oral reports of the removal on these trim pieces and physical evidence that may be used to model reproductions (Houchins, personal communication, December 12, 2016). Some of the trim on the second floor was left undisturbed in the 1980's renovation. These surveyed pieces should be used as prototypes to create new pieces to replace those that were removed. In order to maintain compliance with *The Secretary of the Interiors Guidelines for Rehabilitation* it is important that these features not be substituted with a material or form that does not convey the visual appearance of the surviving trim (Morton et al., 1997).

The trim on the second floor is unique from the rest of the building, likely because this part of the building was added later in the unusual addition completed by James Lucas in the early 1900s. The reproduction molding to be installed around windows and doors should match profiles of the other historic trim on the second floor, including bull's-eye corner blocks and plinth blocks (Figure 49).

The shoe molding that once sat on top of the baseboards in these rooms should also be replaced. It can be seen in photographs from the early 1980s that a shoe mold with an angled profile like that in the hallway of the second floor once sat on top of the baseboard. The baseboards themselves are reportedly original and should be retained and protected during the renovation (A. Houchins, personal communication, December 12, 2016).

Figure 49. Surviving original moldings in the second floor gallery spaces.

Windows and Doors

The windows and doors were also altered in the 1980s renovation such that the historic character of the interior was adversely impacted. The windows were completely obstructed by the wall covering and the doors had a second solid door installed over them and cannot be seen when the interior doors are closed. The National Park Service Preservation Brief on the repair of historic windows states that windows and glazed doors have four basic functions that must be considered as part of the character of the space: admitting light to the interior, providing natural ventilation, creating a visual link to the outside, and enhancing the appearance of the building (Myers, 1981). As they are now, the window and doors are not effectively providing any of these functions to the interior. Original windows and doors are considered to be one of the most important features for defining a building's character from the interior and exterior, according to *The Secretary of the Interior's Guidelines for Rehabilitation.* The windows should be uncovered and the second doors removed. This will not only return a principal element of the historic character to these spaces, it will also provide an option for natural ventilation and eliminate a potential area for moisture issues inside the wall assembly. There is evidence that the interior doorways had their doors removed. These can be left as cased openings, because this poses minimal impact on the historic character and helps the spaces serve their function as a gallery (Morton et al., 1997).

Replacement of historic windows is considered a last resort (Morton et al., 1997; Myers,1981). The windows on the second floor of Lucas Mansion are in good or fair shape; all are repairable, and none should be replaced. The windows were not fully accessible in this study because they are covered from the inside. On the exterior, there is only minor repair necessary to a few of the sashes, and one window requires a glazing pane replacement. In the disassembly of the exterior walls in room 217 it was found that the uncovered windows were painted shut. Paint inhibiting window operation should be removed. After this is complete, each window should be inspected for operational soundness (Myers, 1981). The decorative film found on two of the west-facing window is not salvageable and can be removed.

The Secretary of the Interior's Guidelines for Rehabilitation recommends that all serviceable historic hardware (i.e., hinges, handles, and latches) be retained. Accordingly, all existing hinges and bolt latches on windows should be cleaned of paint and reused rather than replaced and, if operational, the hinges and handles on the door should also remain. It may be advantageous to replace the brass dead bolts with less visually intrusive equivalents (Morton et al., 1997).

Fireplaces

The fireplaces and their surrounds are critical to the character of their respective gallery rooms (rooms 215 & 216). Both fireplaces on this floor are in good condition and seem to have undergone minimal changes over the years. They should be left as they are and great care should be taken to adequately protect them during the renovation. It is explicitly recommended in *The Secretary of the Interior's Guidelines for Rehabilitation* that mantels be covered with heavy plastic or canvas while work is being done (Morton et al., 1997). If molding has to be added to conceal new wall finish transitions it should be as visually unobtrusive as possible.

Finishes

Originally, the gallery spaces possessed the distinctive beadboard finish on the walls that is present in other parts of the building; this finish was removed in the 1980s renovation. Although it would be ideal to replace the carpeted walls with reproduction beadboard finish if this was a restoration project, it is not necessary for a rehabilitation project. Further, the installation of beadboard would likely inhibit the function of the gallery space. While the removal of additional beadboard is not advisable, it is appropriate to finish the walls with a different material because they have already been modified from the original in these areas. Carpet should be removed. It is visually distracting and incompatible with historic features. Additionally, the carpet negatively impacts the space's function as a gallery because it does not present a professional image. Its removal would have the added benefit of potentially positively impacting indoor air quality. It would be appropriate to refinish the walls with a visually neutral material that does not distract from the historic elements, such as gypsum wallboard.

The original beadboard is still in place on the ceiling and should be retained. On the east side of the main gallery there is significant moisture damage to the ceiling as a result of multiple sprinkler malfunctions. A case could be made for replacing some of the damaged pieces in this area. Transition trim pieces between wall and ceiling are likely to be necessary. Because the types of transition pieces are somewhat sporadic throughout the building, there are several that could be appropriate. These pieces could either be painted to match ceiling color or be wood grained.

The original wood floors are still under the carpet in the gallery rooms. It would be appropriate to remove this carpet and refinish the floors to match the floors on the first and third floors.

Moisture Assessment Recommendations

The findings of moisture survey of the interior, observation of the exterior conditions, and the maintenance records where considered together to identify and prioritize moisture migration strategies for this building. The following recommendations are discussed roughly in order of importance. Damage caused by bulk moisture is the primary concern. There does appear to be some moisture damage caused by diffusion, mostly peeling paint, but these problems are dramatically overshadowed by bulk moisture problems related to the roof and site drainage. Bulk moisture problems should be address before any other major work is undertaken on the building.

The highest priority is getting the existing historic gutters to function as well as possible. Increasing the rate at which water is drained from the roof could do a great deal to protect the areas of the interior under the second floor, where the vast majority of the building's roof leaks are located. A gutter screen has already been installed to keep leaves from causing clogs. This is a good first step but the gutters should also be evaluated to make sure they have a slope of at least 1/8" per foot (Parks, 1996). Additionally, crushed and clogged downspouts were found in the inspection of the exterior. Both downspouts on west side of the building appear to be compromised. This side of the building is known to have gutter overflows in heavy rain. The National Park Service Preservation Brief on moisture management notes that damaged or clogged downspouts can impede flow and keep water from shedding adequately. This can compromise the roof system, causing moisture problems and leaks to develop (Parks, 1996).

The upper roof's water drainage also needs to be addressed. Unfortunately, sometimes moisture problems can be a result of poorly designed original details (Parks, 1996). In this case the upper roof has neither a gutter nor a drip edge. Currently, the water from the upper roof drains on the second roof whose gutters then handle the water. This is causing several visible problems. Without a drip edge water appears to be running back on the soffit and down the wall, causing some rot and increasing the chance of water getting behind the flashing. Installing a drip edge would help this problem, but there are several other problems related to water dropping six feet from the upper roof to the lower roof. First, the dropping water is likely putting extra stress on the flashing joint, which has failed in several areas. It also appears to be putting extra stress on the roof's paint, which is peeling more rapidly directly under the upper roof's edge. Furthermore, there is evidence that splash-back is a significant problem, causing damage to both the siding and the windows. All of this exterior damage has the potential to exacerbate leaks that damage the interior. Installing gutters on the upper roof would solve several of these problems, while also reducing the load on the historic gutters and therefore reducing the chance of overflow.

Additionally, it was found that the gutters' downspouts do not adequately direct water away from the foundation and deck. The majority of the downspouts drain directly onto foundation piers. Saturated soil around the deck foundation could be contributing to the settling of the deck away from the structure. This settling likely puts stress on the flashing joints of the second floor roof, which could be contributing to or causing leaks (Parks, 1996). Rot on the lower deck appears to be from splash-back from these downspouts. According to the Preservation Brief on moisture management, ground-related and water run-off moisture should always be thoroughly addressed because they can deteriorate the foundation and lead to a variety of other problems. It is recommended that water from downspouts be redirected away from the foundation and deck (Parks, 1996).

Known roof leaks should be repaired, particularly the large leak on the ceiling of the west porch. The primary area of this leak appears to be outside water wicking into the building and causing damage in the stair hall of both the second and third floor (rooms 218 & 315). It is also causing rot on the porch. Leaks in the kitchen and gallery room 217 should also be addressed. Because of their locations, both of these leaks could be from flashing failures or from water blowing under the tin shingles. It is important to repair these leaks even though they are small, not only because they are causing damage to the historic materials but, as seen in physical investigation of room 217, it can and has led to mold growth, which can pose a health concern for occupants. A thorough inspection of the flashing should be conducted all the way around the second floor roof, but particularly on the southwest corner and around those leaks.

To address wind-driven rain getting into the building by blowing under the shingles, use of an underlayment should be considered. This should be considered only after other options because it would require significant disturbance and possible damage to the historic roofing material. Although the whole second floor roof could benefit from the addition of an underlayment from a moisture standpoint, a more limited approach may be appropriate from a historical perspective. This could involve applying this treatment only on the sides that receive the most wind-driven rain. It is possible that these leaks will become less of a problem after the gutters are addressed, which is why that recommendation precedes this one.

The second floor roof is also in need of painting, particularly on the north side of the building. This is a known issue that has been put off due to financial constraints. The deteriorating paint is likely not contributing to moisture problems now, but if left unattended it could become a bigger problem that requires the replacement of roofing material. Trimming back the trees on the north side of the house should also be considered. The north side already has less sun exposure than the other sides of the house, and the trees shade it further. This could be limiting the drying potential of the material on this side of the building, which could explain in part why the roof is in worse condition on this side of the building

Wall Assembly Recommendations

Hygrothermal Modeling Conclusions

In terms of hygrothermal performance, all alternative wall assemblies examined were acceptable in terms of vapor diffusion. They passed every criterion except water content of the exterior siding. The siding on the second floor of the building, where these wall conditions are present, has been physically inspected and is in good condition. From this information it was determined that none of the alternative assembles would have a negative impact on the hygrothermal performance of the building, and the siding would likely remain in the same condition if any of these assemblies was installed in the renovation. Furthermore, high moisture content in the modeled assemblies is likely because they were modeled without an exterior paint layer, in order to observe a worst-case scenario. When a test run was done with a model that contained a layer to represent paint the siding moisture content stayed well below acceptable levels. These assemblies showed resilience in that the other layers of the assemblies were able to reach a moisture content equilibrium with appropriate moisture levels, even with the heightened moisture content of the siding layer.

It is critical to note that these results are primarily in terms of vapor diffusion and some capillary action. These models do account for bulk moisture or air leakage. This building has several known bulk moisture problems, discussed above, that should be addressed with priority.

The building also has very high natural air exchange. The air leakage could heighten the potential for condensation. It would be wise to employ air-sealing measures if the wall is reinsulated.

Weatherization and Efficiency Recommendations

It is likely that the wall cavities of the exterior walls of most of the second floor provide a unique opportunity to retroactively add in air sealing measures. Air sealing will limit moisture infiltration and improve energy efficiency. This building's energy efficiency would benefit more from the addition of air sealing measures than from the addition of higher R-value insulation. Removal of the coverings over the windows and doors is recommend both to restore lost historical character and to eliminate a location where moisture can accumulate. The removal of these coverings has the potential to negatively impact the building's energy efficiency if proper measures are not taken to weatherize the existing windows and doors. Air sealing should therefore be prioritized over upgrading insulation. It is also critical that bulk moisture be addressed prior to any air sealing or insulation measures. These measures can reduce the wall's drying potential and exacerbate moisture related deterioration.

Even if the wall cavities are not opened up, there is some opportunity for air sealing with the addition of gypsum wallboard. New gypsum wallboard installed over the existing wall assembly should be detailed such that the edges are sealed with a continuous bead of caulk. If insulation is removed, it is recommended that a higher R-value insulation be used to replace it. The current insulation is R-11, which is below the requirement of the North Carolina Energy Conservation Code of R-15 for climate zone four (North Carolina Department of the Interior, 2012). The two insulation alternatives that were tested in the hygrothermal modeling are R-15 high-density batts and closed cell spray foam. The R-15 batts offer an affordable option that will increase the R-values. Closed cell spray foam has an R-value of ~6.5 per inch. Since wall cavities vary from 3.5 to 4 inches thick, spray foam would provide an R-value of 22.7 to 24. Spray foam also has the added benefit of providing air sealing. Although the hygrothermal model showed that spray foam would not generate moisture issues regarding vapor diffusion or capillary action, it does have the potential to reduce the drying potential of the wall, which could exacerbate damage done during bulk water intrusions. If spray foam is chosen as an insulation material, existing bulk moisture problems should be dealt with thoroughly first. With either type of insulation, care should be taken to install it correctly and insulation should be added to the band joist area, which currently has no insulation. If batts are used for the insulating material, additional air sealing using low expansion foam around windows and doors would be advisable.

In addition to air sealing, the addition of weather stripping and storm windows would be beneficial to the energy efficiency of the building. This should be done with respect for the historic character of these features. A low profile weather stripping that has a minimal effect on the appearance and operation of the windows and doors should be chosen. Storm windows may be installed to the exterior and should have frames that match the color of the exterior trim and that do not hinder the visibility of the window (Myers, 1981). Storm window would ideally be removable so that the cavity between can be opened to dry out moisture on occasion (Parks, 1996).

Additionally, a removable insulating block should be added to the chimneys to reduce air leakage.

Recommendations for Future Research

This report aimed to lay the groundwork for future research and collaboration between the Department of Sustainable Technology and the Built Environment and the Hiddenite Arts and Heritage Center. The Hiddenite Arts and Heritage Center has a long-established relationship with Appalachian State University thought the Art Department, but this study marks the forging of a new relationship with the Department of Sustainable Technology and the Built Environment (STBE). This is a mutually beneficial relationship that will help the Hiddenite Center develop plans for their building that are rooted in research, and that will give STBE students an opportunity for hands-on learning and real world research. The recommendations for future research were developed with this relationship in mind.

The report was also written with the aspiration that it might be used to as the foundation to build a full historic structure report. This would require an additional depth to the chronology of ownership, construction, alteration, use, and significant events; a complete architectural description of the building's interior and exterior that identifies all significant elements and their condition; a full building code and accessibility review that outlines specific suggestions and their impacts; an evaluation of the existing conditions of structural systems that includes an assessment of their capacity to support the building; and additional recommendations for treatment and use.

Recommendations for Future Research:

- The completion of a full Historic Structure Report of Lucas Mansion, using this report as a starting point
- Structural evaluation of the foundation system to develop long lasting solutions to ongoing settling problems.
- The creation of interior designs and innovative solutions that will assist the Hiddenite Art and Heritage center improve their space to meet programmatic needs while maintaining the historic integrity of Lucas Mansion.
- An indoor air quality evaluation and the development of recommendations to improve the health of occupants.

- A full building system evaluation to expand on the condition assessment of the of the HVAC system completed by Reid Anderson, a graduate student in the STBE department, concurrent to this study.
- Conducting an energy use evaluation and development of whole building weatherization strategy along with other energy saving recommendations.
- A moisture evaluation that specifically considers the roofs and how the can be best address to insure the long-term durability of Lucas Mansion.
- A moisture evaluation that targets the site water management straggles.
- A full condition assessment of Lucas Mansion's exterior in order to update records and identify and prioritize needed maintained.

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APPENDIX A: Data Collection tools

ABBREVIATED HISTORIC STRUCUTURE REPORT
LUCAS MANSTION, HIDDENITE, NC
[Architectural Field Note Checklist]

Questions to guide narrative field note descriptions of a room-by-room investigation of interior architecture:

GENERAL QUESTIONS:

Is there significance in this space's size, height, proportions, configuration, or function? (NPS, 3)

Does this space relate functionally and architecturally to the building's external appearance? How? (NPS, 1)

Is this primary or secondary space? (NPS, 1)

ROOM IN CONTEXT:

Are adjoining rooms visually and physically related? (NPS, 3)

How does this room fit into the overall floor plan? (NPS, 1)
Is there an important sequence of spaces that are related to each other? (NPS, 3)

FEATURES:

Are there interior features that help define the character of the building? (NPS, 3) If so, how do these features relate to the building's style and period of construction? (NPS, 1)

In what condition are identified features? (NPS, 1)
Do any features appear to be recycled or reproduced? (NPS, 2)

Is there evidence of repair, patches, or shadow outlines of missing features? (NPS, 2)

Is there evidence indicating former attachments such as hardware, scars or holes? (NPS, 2)

MATERIALS AND FINISHES:

What are the surface finishes; the material, color. and texture? (NPS, 3)

Are there notable finishes or fixtures that demonstrate craft practices that contribute to the historic character? (NPS, 3)

How do the finishes in the space contribute to the room's historic character? (NPS, 3)

Do any materials appear to be recycled or a reproduced? (NPS, 2)

Is their evidence of repairs or patches? (NPS, 2)

All questions are based on recommendations for architectural investigations in the National Park Service's Preservation Briefs.

REFFERENCES:

(NPS, 1) Jandl, H. W. (1988). *Preservation brief 18 rehabilitating interiors in historic buildings.* Retrieved from: https://www.nps.gov/tps/how-to-preserve/briefs/18-rehabilitating-interiors.htm

(NPS, 2) McDonald, T. C., Jr. (1994). *Preservation brief 35: understanding old buildings: the process of architectural investigation.* Retrieved from: https://www.nps.gov/tps/how-to-preserve/briefs/35-architectural-investigation.htm

(NPS, 3) Nelson, L. H. (1982). *Preservation brief 17: architectural character: Identifying the visual aspects of historic buildings as an aid to preserving their character.* Retrieved from: https://www.nps.gov/tps/how-to-preserve/briefs/17-architectural-character.htm

Moisture Survey Worksheet

ABBREVIATED HISTORICAL STRUCTURE REPORT ON THE HIDDENITE ARTS AND HERITAGE CENTER IN HIDDENITE, NC

* Required

1. **Instant Number** *

   ____

2. **Room Number** *

   ____

3. **Location of moisture problem :** *

   Check all that apply.

   - [ ] Wall
   - [ ] Ceiling
   - [ ] Floor
   - [ ] Other: ______________________________

If problem is not on a wall skip the next 5 questions

4. **Wall**

   Mark only one oval.

   - ( ) North
   - ( ) South
   - ( ) East
   - ( ) West

5. **Location on Wall**

   Mark only one oval per row.

	Left	Middle	Right
Top	( )	( )	( )
Middle	( )	( )	( )
Bottom	( )	( )	( )

6. **Does the wall contain an exterior window or door?**
Mark only one oval.

- ⬭ Window
- ⬭ Door
- ⬭ Both
- ⬭ Neither

7. **Is the door or window covered?**
Mark only one oval.

- ⬭ Yes
- ⬭ No

8. **Is the moisture problem adjacent to the window or door?**
Mark only one oval.

- ⬭ Yes
- ⬭ No

If problem is not on ceiling or floor skip the next question

9. **Location on Floor and Ceiling**
Mark only one oval per row.

	West	Center	East
North	⬭	⬭	⬭
Center	⬭	⬭	⬭
South	⬭	⬭	⬭

10. **Is the moisture problem proximal to a penetration or building material transition on the exterior of the building?**
Mark only one oval.

- ⬭ Yes
- ⬭ No
- ⬭ Unclear

11. **If yes to the above question, describe the type of penetration or transition:**
Mark only one oval.

- ⬭ Roof to wall
- ⬭ Porch to wall
- ⬭ Roof Valley
- ⬭ Old building to new building
- ⬭ Fenestration
- ⬭ Other: ____________________

12. **Type of finish?** *
Check all that apply.

- [ ] Bead Board
- [ ] Dry wall
- [ ] Carpet
- [ ] Wood
- [ ] Other: ______________________

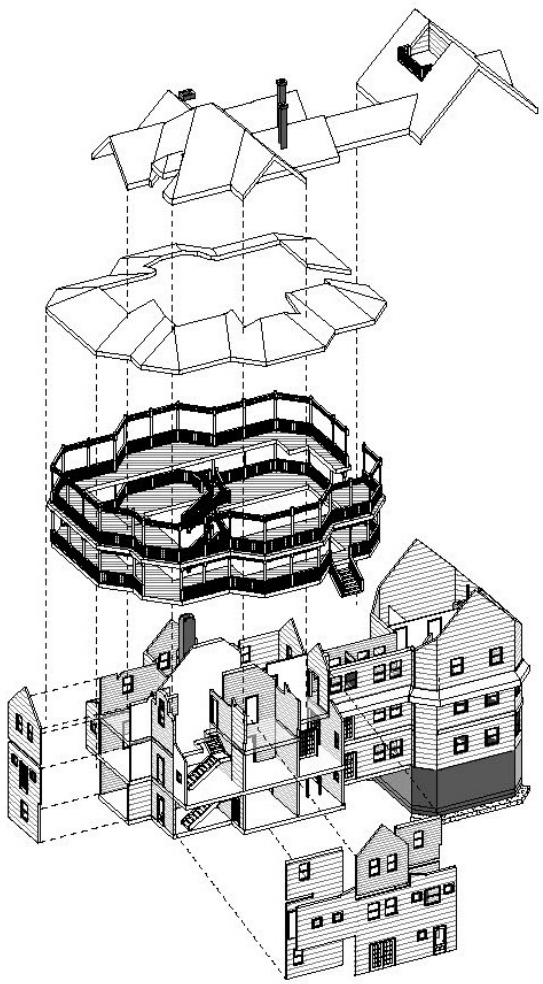
13. **Type of Moisture Problem**
Check all that apply.

- [ ] Biological growth (mold, mildew, etc)
- [ ] Water Stain
- [ ] Eroding Surface
- [ ] Efflorescence
- [ ] Flaking Finish
- [ ] Blistering Finish
- [ ] Musty Smells
- [ ] Condensation
- [ ] Rust
- [ ] Corrosion Stain
- [ ] Cupped Wood
- [ ] Warped Wood
- [ ] Rotting
- [ ] Sagging
- [ ] Hole
- [ ] Crack
- [ ] Peeling Paint
- [ ] Other: ______________________

14. **Rate Severity:**
Mark only one oval.

	1	2	3	4	5	
Easily repairable	◯	◯	◯	◯	◯	Needs Replacement

APPENDIX B: As-Built Revit Drawings



LUCAS MANSION

HIDDENITE ART AND HERITAGE CENTER

LEAH SIMMERMAN

Hiddenite Arts & Heritage Center

HIDDENITE ARTS & HERITAGE CENTER

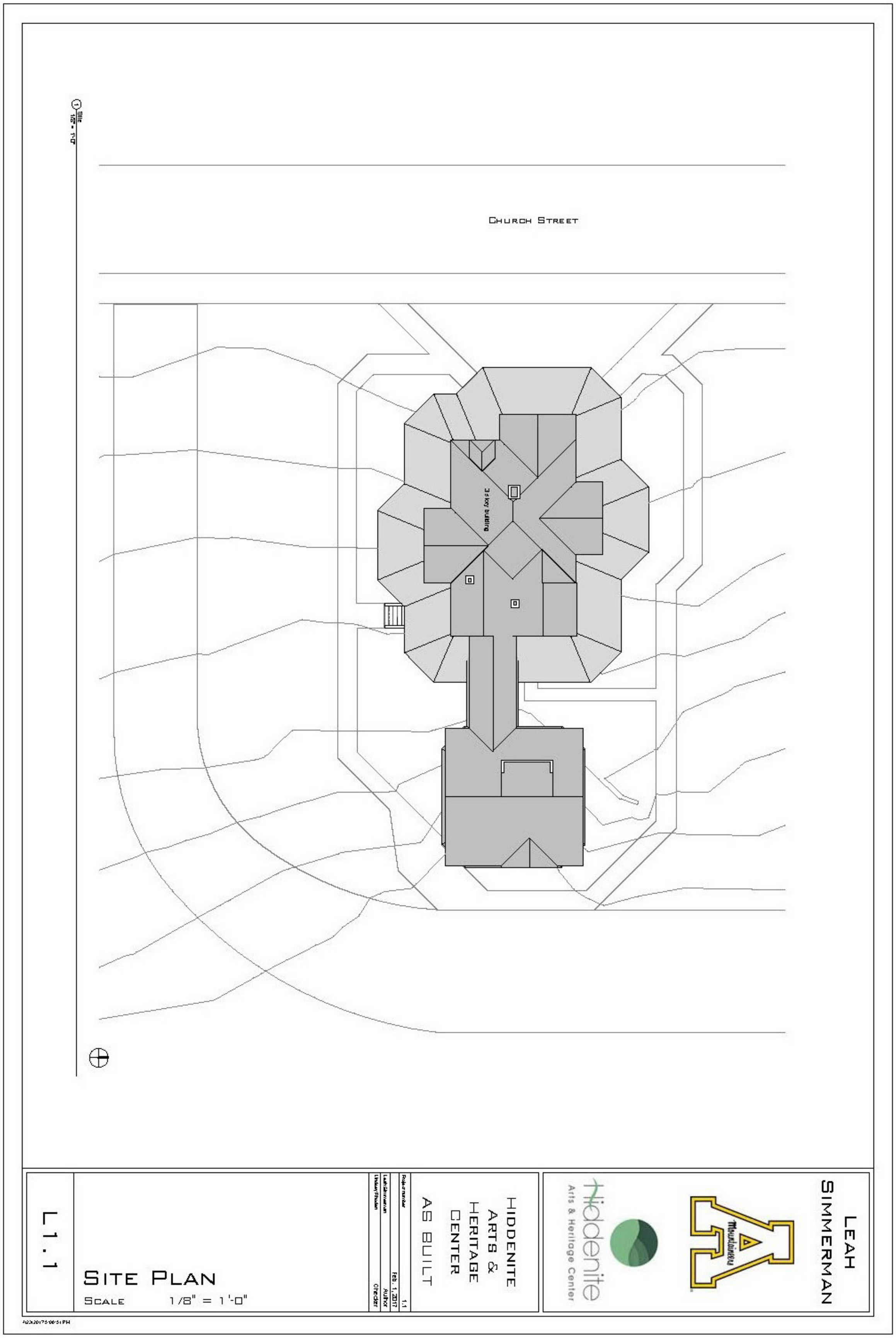
AS BUILT

Project number	1.1
	Feb. 1, 2017
Leah Simmerman	Author
Lindsay Rhoden	Checker

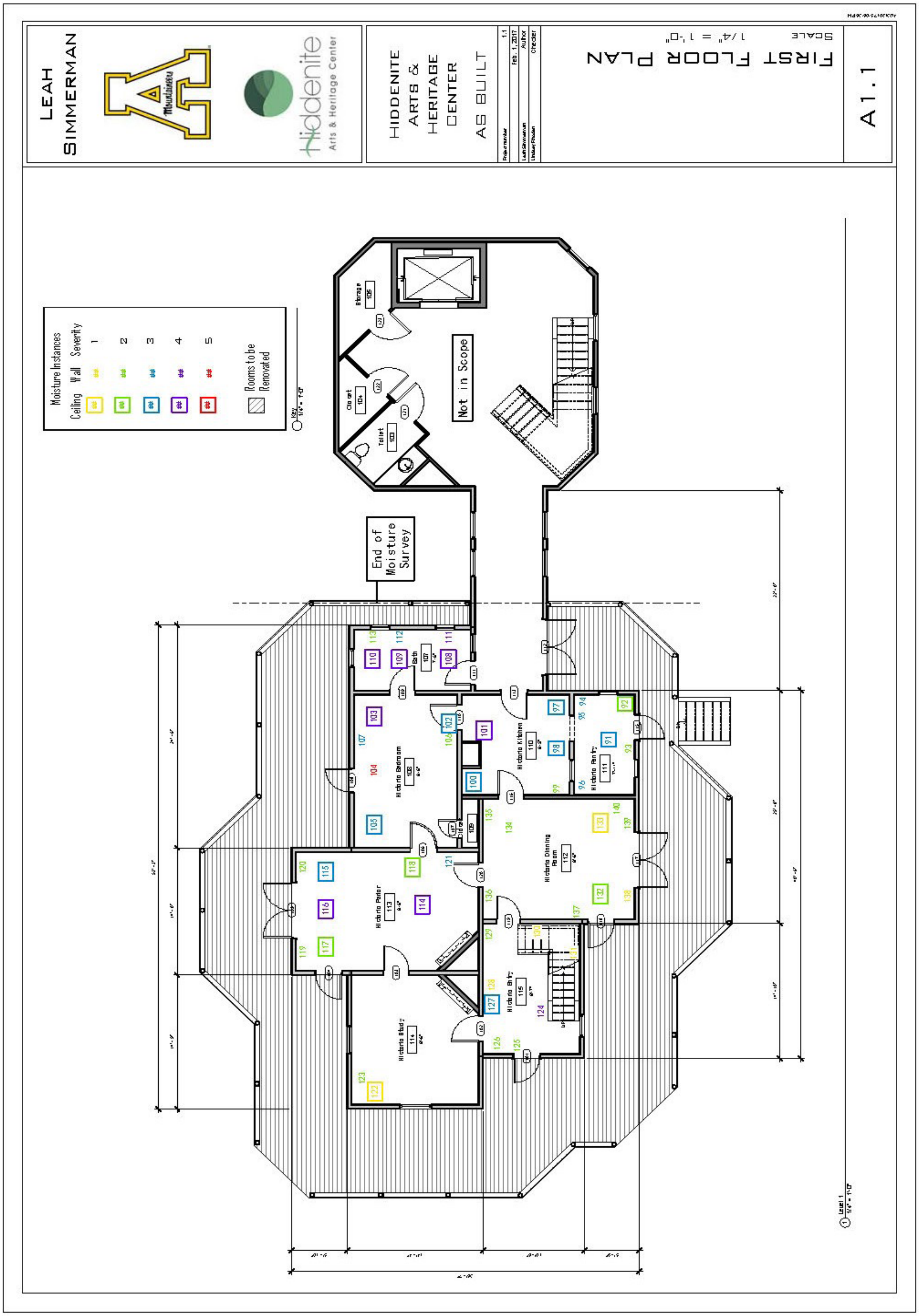
COVER SHEET

SCALE

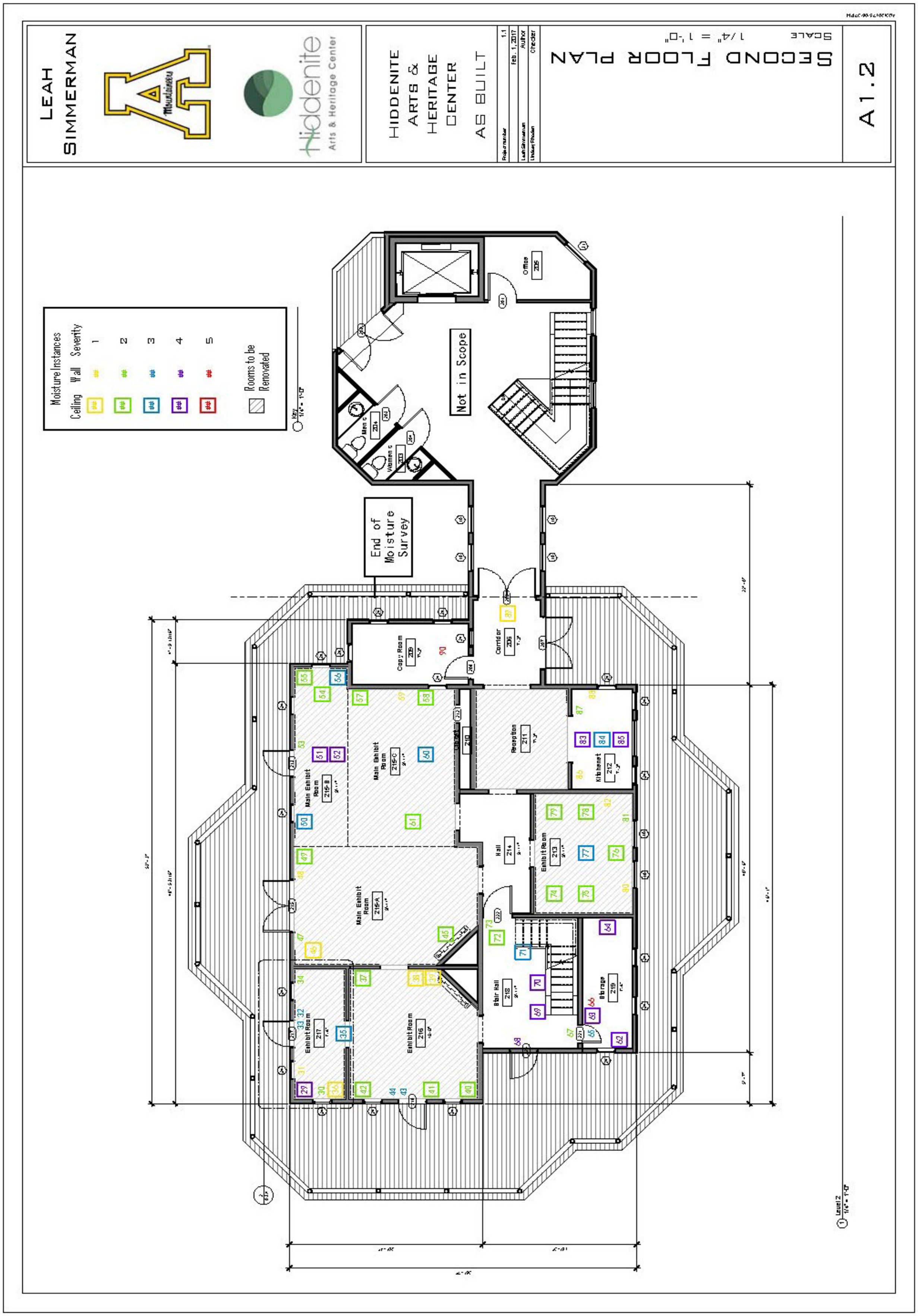
A0.0

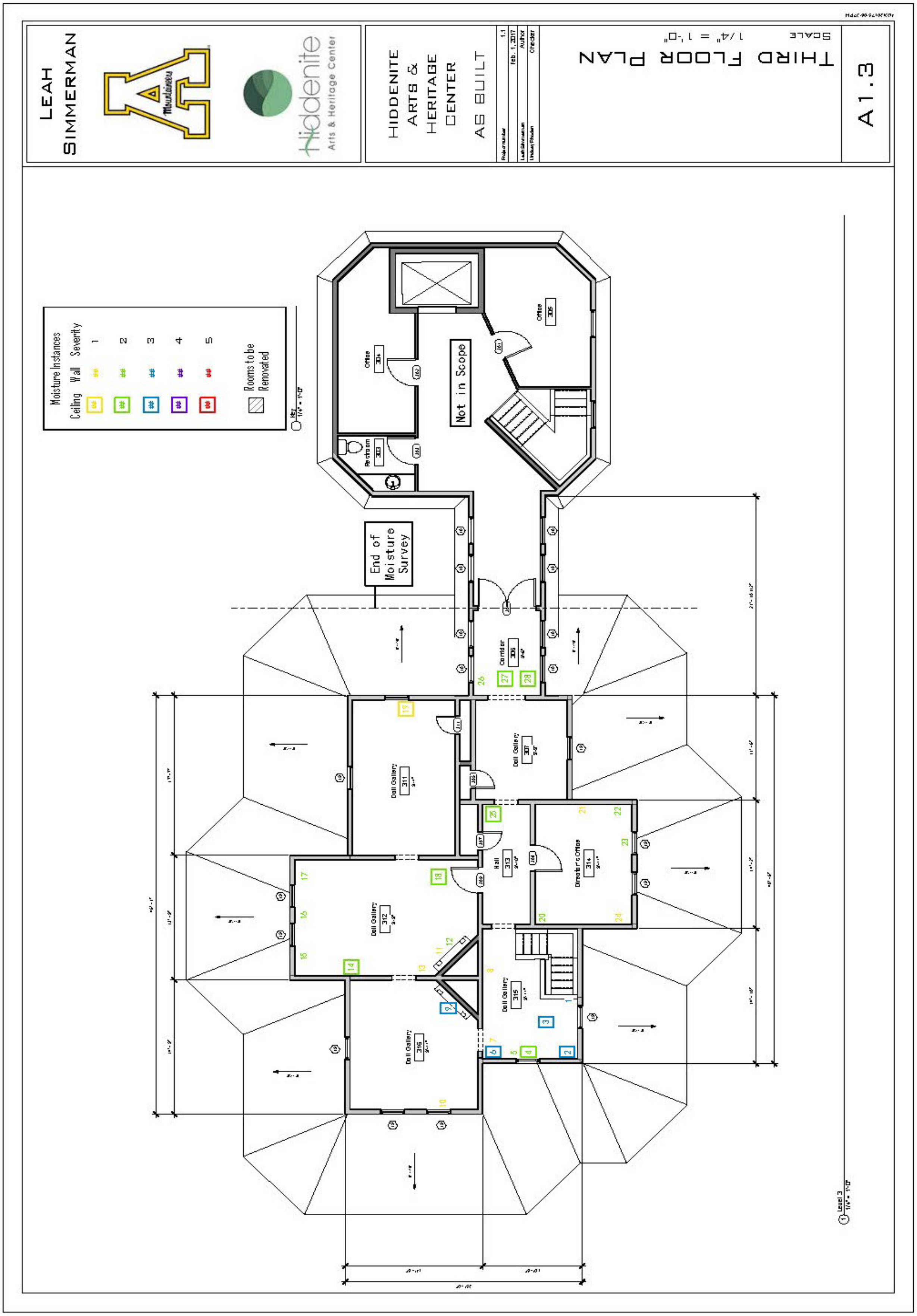


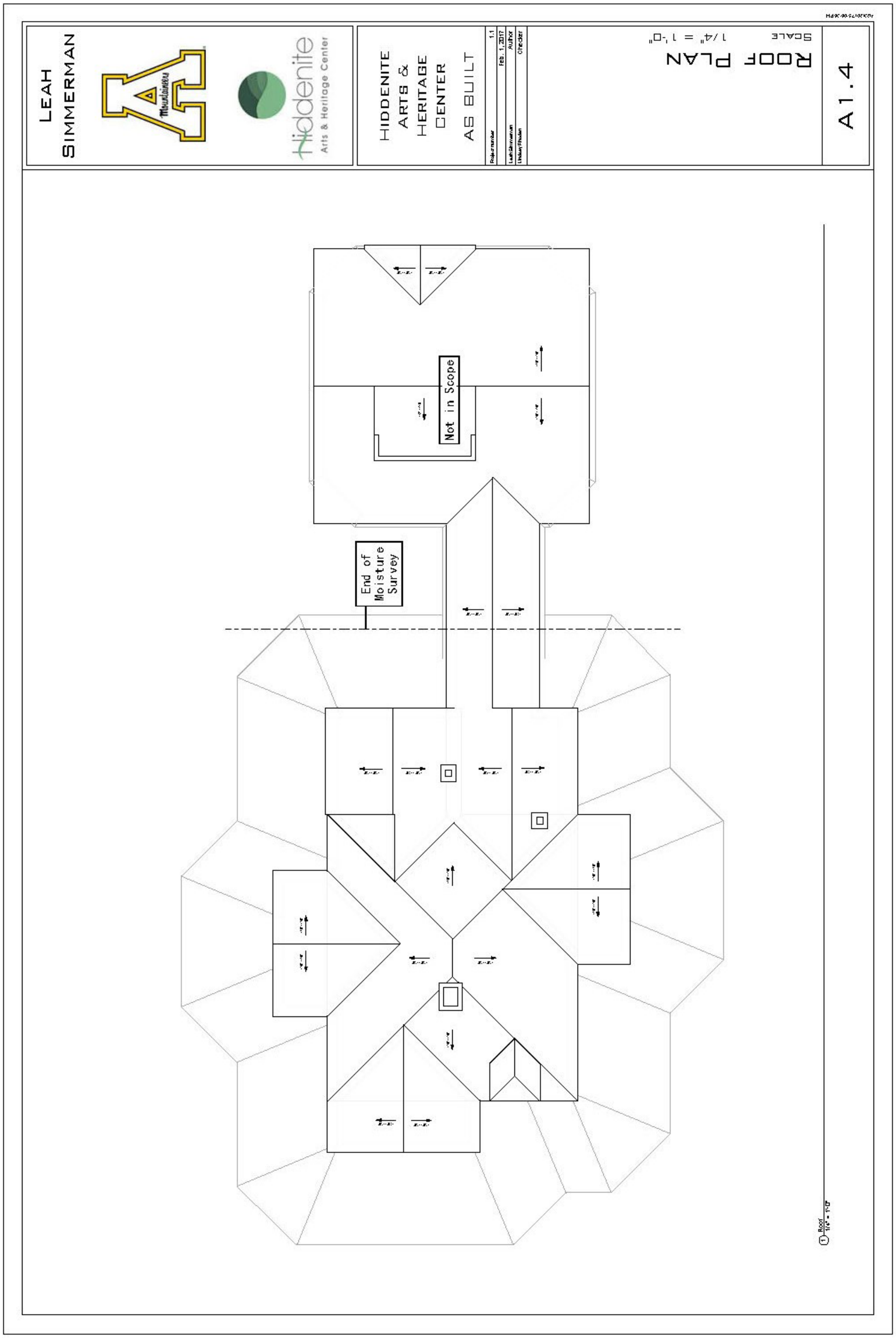
Church Street
Leah Simmerman
hiddenite
Arts & Heritage Center
Hiddenite Arts & Heritage Center
As Built
Site Plan
Scale 1/8" = 1'-0"
L1.1

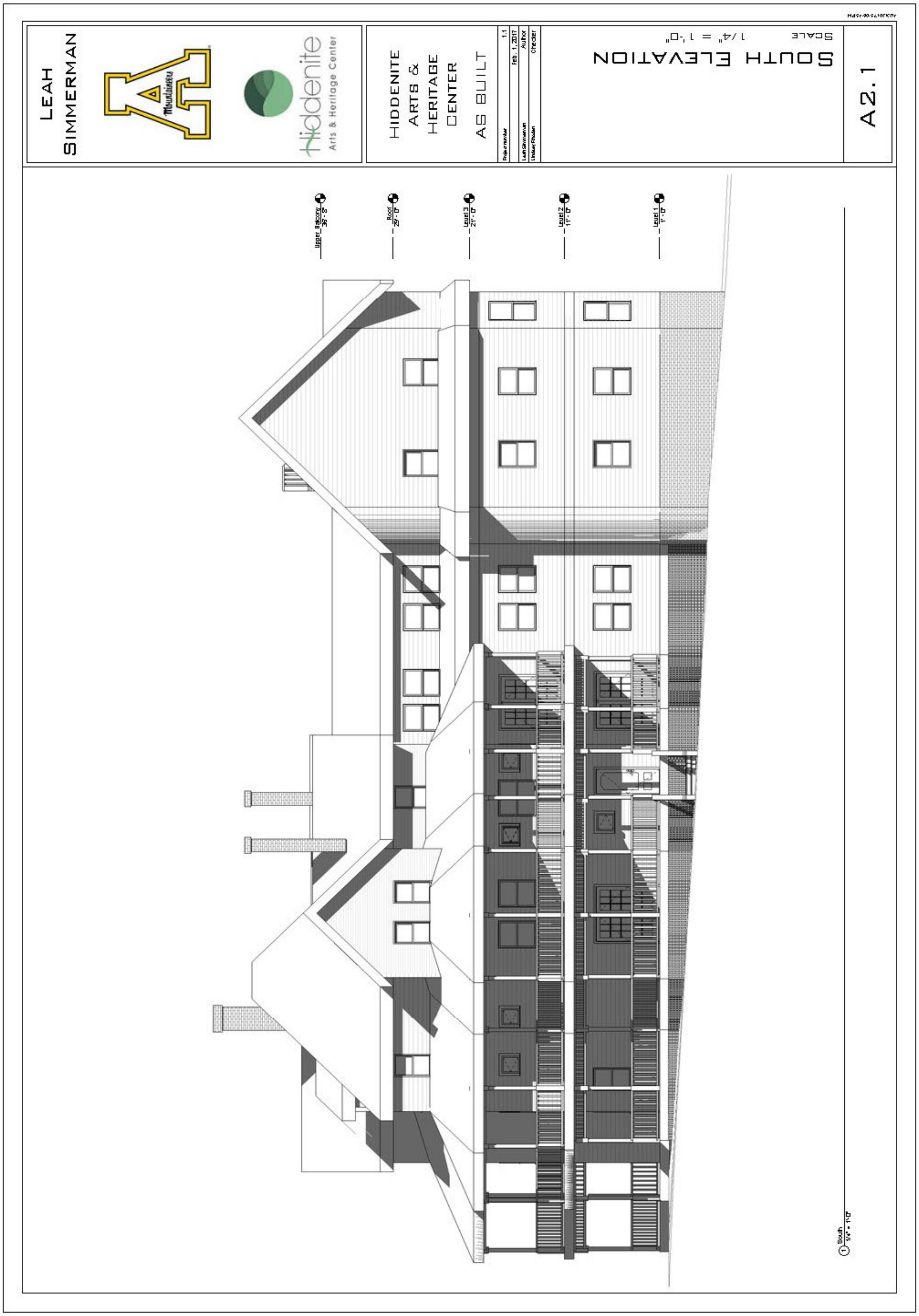


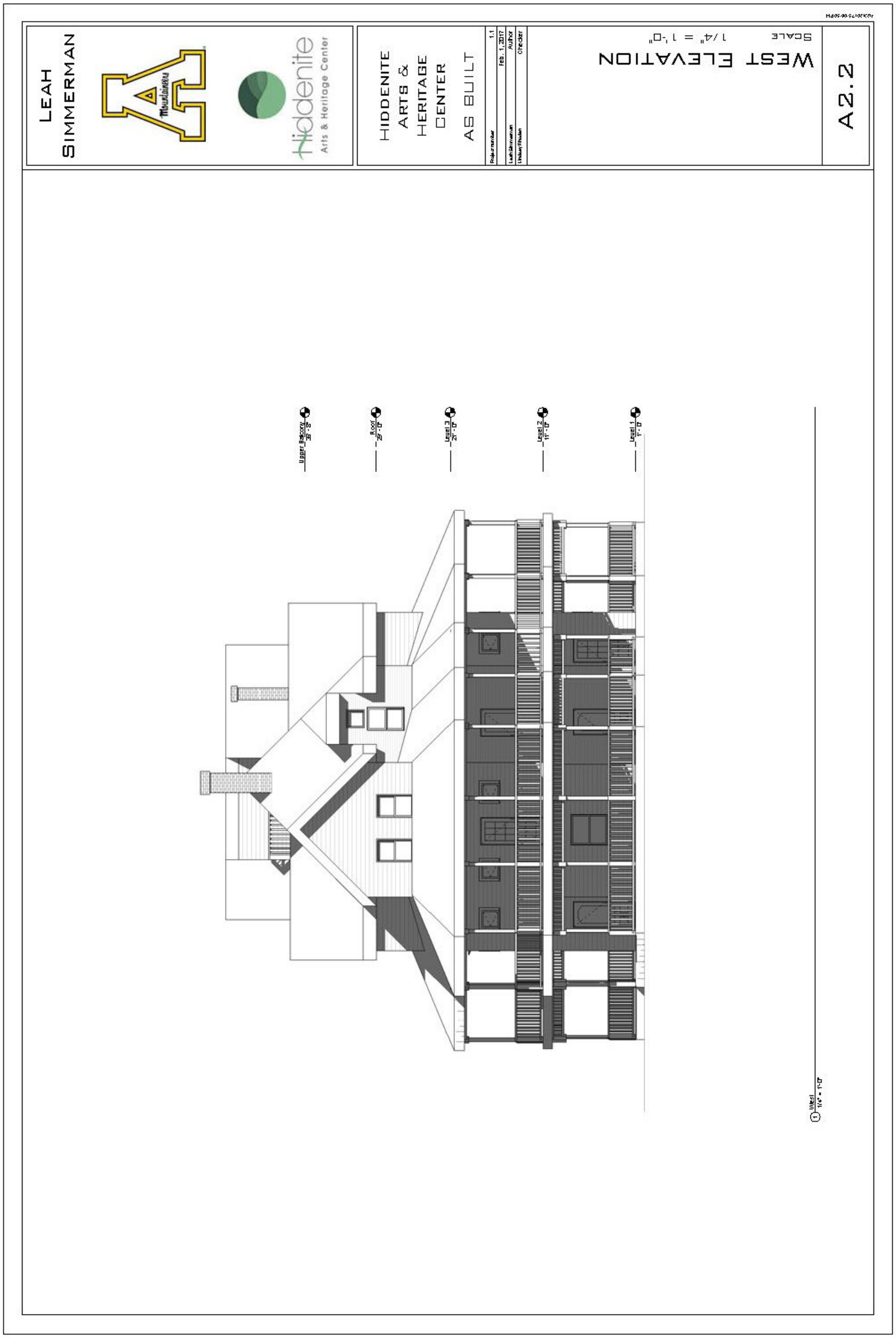
LEAH SIMMERMAN
Hiddenite Arts & Heritage Center
HIDDENITE ARTS & HERITAGE CENTER
AS BUILT
FIRST FLOOR PLAN
SCALE 1/4" = 1'-0"
A1.1
Moisture Instances
Ceiling Wall Severity
1
2
3
4
5
Rooms to be Renovated
Not in Scope
End of Moisture Survey
Storage
Closet
Toilet
Bath
Historic Bedroom
Historic Kitchen
Historic Pantry
Historic Dinning Room
Historic Parlor
Historic Entry
Historic Study


LEAH SIMMERMAN
Hiddenite
Arts & Heritage Center
HIDDENITE ARTS & HERITAGE CENTER
AS BUILT
SECOND FLOOR PLAN
SCALE 1/4" = 1'-0"
A1.2
Moisture Instances
Ceiling Wall Severity
Rooms to be Renovated
Not in Scope
End of Moisture Survey

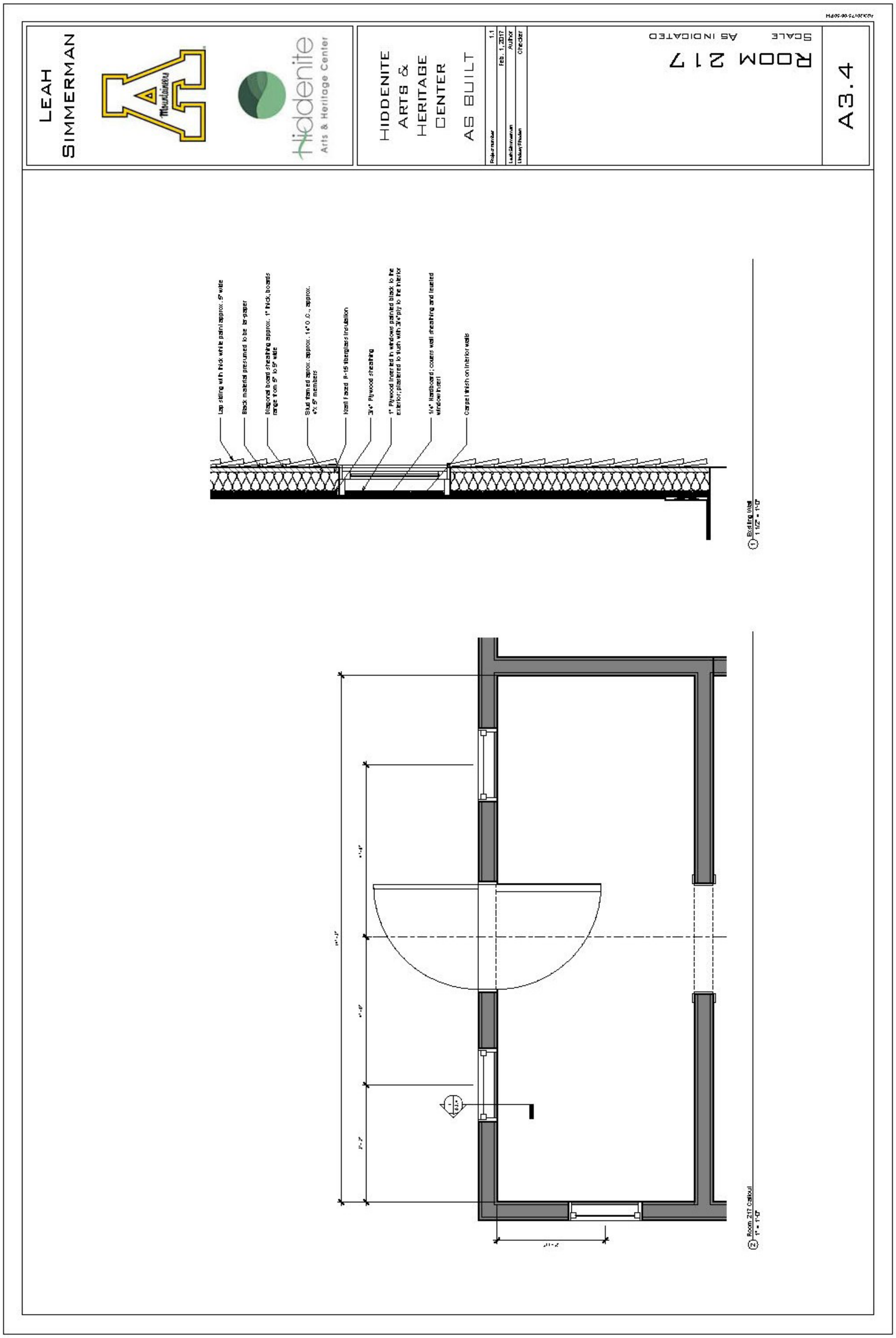

LEAH SIMMERMAN
Hiddenite
Arts & Heritage Center
HIDDENITE ARTS & HERITAGE CENTER
AS BUILT
THIRD FLOOR PLAN
SCALE 1/4" = 1'-0"
A1.3
Moisture Instances
Ceiling
Wall
Severity
1
2
3
4
5
Rooms to be Renovated
Not in Scope
End of Moisture Survey
Office
Office
Restroom
Corridor
Doll Gallery
Hall
Director's Office


LEAH SIMMERMAN
Hiddenite Arts & Heritage Center
HIDDENITE ARTS & HERITAGE CENTER
AS BUILT
Project number 1.1
Feb. 1, 2017
Author
Checker
ROOF PLAN
SCALE 1/4" = 1'-0"
A1.4
Not in Scope
End of Moisture Survey
1 Roof 1/4" = 1'-0"


LEAH SIMMERMAN
Hiddenite
Arts & Heritage Center
HIDDENITE ARTS & HERITAGE CENTER
AS BUILT
SOUTH ELEVATION
SCALE 1/4" = 1'-0"
A2.1

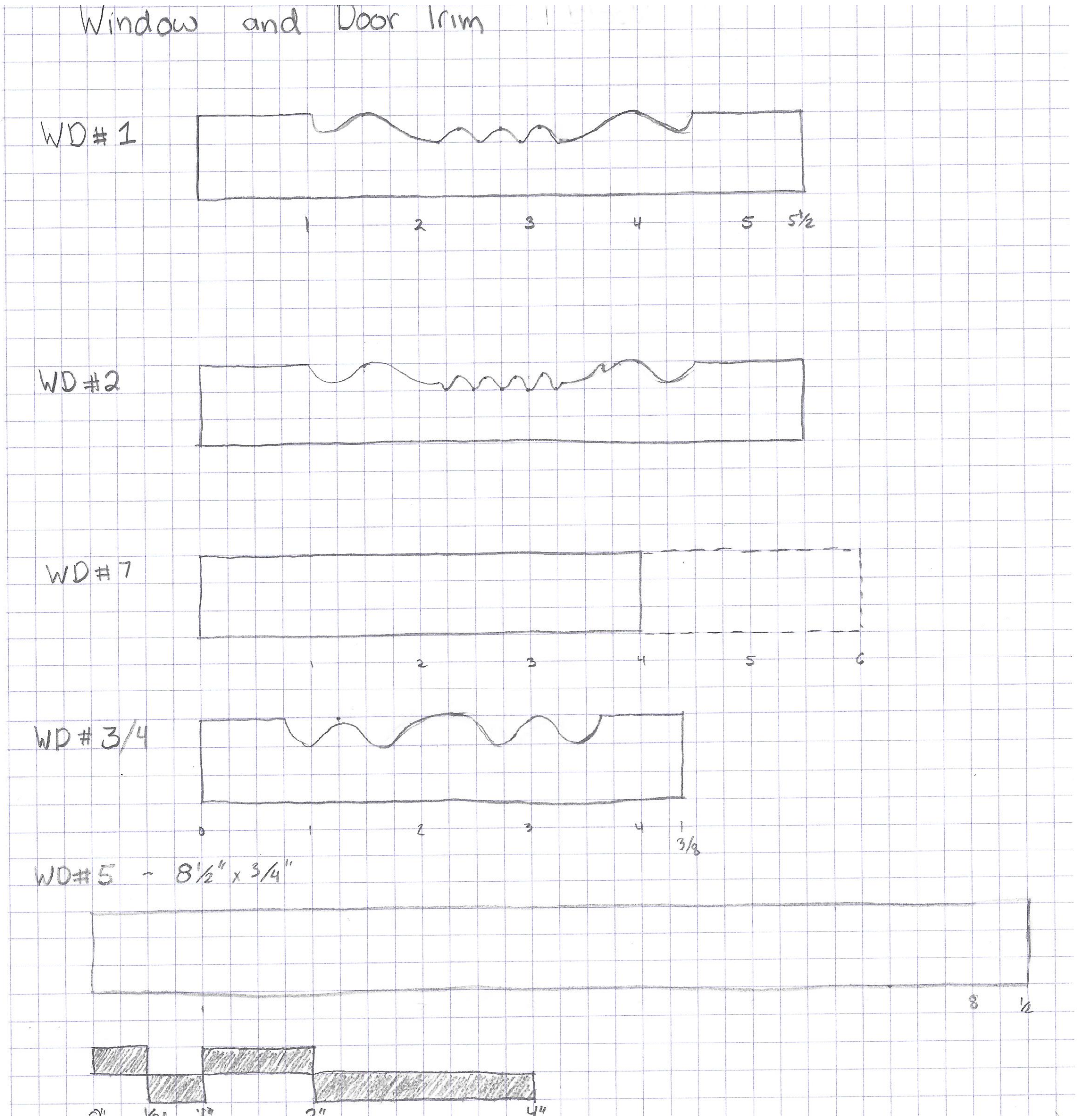


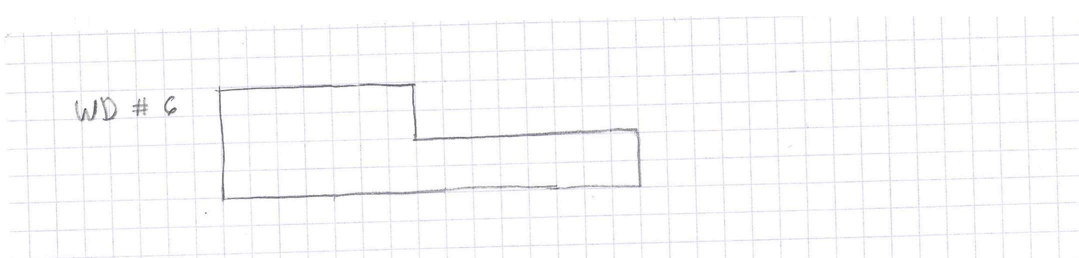
LEAH SIMMERMAN
Hiddenite
Arts & Heritage Center
HIDDENITE ARTS & HERITAGE CENTER AS BUILT
Project number 1.1
Feb. 1, 2017
Author
Checker
WEST ELEVATION
SCALE 1/4" = 1'-0"
A2.2
Upper Balcony
Roof
Level 3
21' - 0"
Level 2
11' - 0"
Level 1
1' - 0"
West
1/4" = 1'-0"


Leah Simmerman
Hiddenite
Arts & Heritage Center
Hiddenite Arts & Heritage Center
As Built
Project number 1.1
Feb. 1, 2017
Leah Simmerman Author
Lindsey Rhoden Checker
Room 217
Scale As indicated
A3.4
Lap siding with thick white paint approx. 5" wide
Black material presumed to be tar-paper
Diagonal board sheathing approx. 1" thick, boards range from 5" to 9" wide
Stud framed aprox. approx. 14" O.C., approx. 4"x 5" members
Kraft Faced R-15 fiberglass insulation
3/4" Plywood sheathing
1" Plywood inserted in windows painted black to the exterior; plastered to flush with 3/4" ply to the interior
1/4" Hardboard; covers wall sheathing and leveled window insert
Carpet finish on interior walls
1 Existing Wall
1 1/2" = 1'-0"
2 Room 217 Callout
1" = 1'-0"

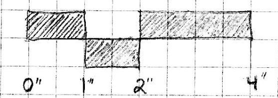
APPENDIX C: Finishes Data

Room			Ceiling		Moulding Type			Finshes			Windows	Notes:
Number	Use	Pre/post 80's	~ height	Flat of irregular	Baseboard	Window/Door	Corner Block	Wall	Floor	Ceiling	Covered	notes
316	Doll Gallery	Old	9'-11"	irregular	BB-2	T-1,2	CB-1	Beadboard	Wood	Beadboard	Covered - BB	Mostly T-2 with some T-1. One door mostly T-2 with short section of a T-1 spliced in
315	Doll Gallery	Old	9'-11"	irregular	BB-1	T-1,2	CB-1,2	Beadboard	Wood	Beadboard	Open	Window have T-1 and doors have T-2
314	Directors Office	Old	9'-11"	irregular	BB-2	T-1,2	CB-1	Beadboard	Red Carpet	Beadboard	Open	doors T-2. a mix of T-1 and T-2 in single window
313	Hall	Old	9'-10"	irregular	BB-1	T-1,2	CB-1	Beadboard	Wood	Beadboard	None	Mostly T-2 with some T-1
312	Doll Gallery	Old	9'-9"	irregular	BB-2	T-1,2	CB-1	Beadboard	Wood	Beadboard	Covered - BB	Mostly T-2 with some T-1 on windows/transom
311	Doll Gallery	Old	9'-4"	irregular	BB-3	T-1,2	CB-1	Beadboard	Wood	Beadboard	Covered - BB	Mostly T-2 with some T-1 on window
307	Doll Gallery	Old	9'-3"	irregular	BB-2	T-1,2	CB-1,2	Beadboard	Wood	Beadboard	Open	amost alll T-2 with one piece of T-1 on one door
306	Corridor	New	9'-6"	irregular	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	Open	
305	Office	New	9'-6"	Flat	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	Open	
304	Office	New	9'-6"	Flat	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	None	
303	Restroom	New	9'-6"	Flat	BB-4	T-2	CB-2	Drywall	Laminate	Drywall	None	
302	Lobby	New	9'-6"	Flat	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	Open	
202	Lobby	New	7'-11"	Flat	BB-4	T-2	CB-2	Drywall	Laminate	Drywall	Open	
203	Restroom	New	7'-11"	Flat	BB-4	T-2	CB-2	Drywall	Laminate	Drywall	None	
204	Restroom	New	7'-11"	Flat	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	None	
205	Office	New	7'-11"	Flat	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	Open	
206	Corridor	New	7'-3"	Flat	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	Open	
209	Copy Room	Old	7'-3"	Flat	BB-4	T-2	CB-2	Drywall	Laminate	Drywall	Open	
211	Reception	Old	7'-3"	Flat	BB-6	T-3	CB-3	White Carpet	Red Carpet	Beadboard	None	
212	Kitchenet	Old	?	Flat	BB-5	T-4	none	Beadboard	Laminate	Beadboard	Open	
213	Exibit Room	Old	?	Flat	BB-6	T-3	CB-3	White Carpet	Green Carpet	Beadboard	Covered - carp	
214	Hall	Old	9'-11"	Flat	BB-7	T-3	CB-3	Beadboard	Wood	Beadboard	None	
215 A	Main Exibit Room	Old	9'-11"	Flat	BB-6	T-3	CB-3	White Carpet	Green Carpet	Beadboard	Covered- carp	Door trim only on interior doors. No trim in exterior doors. No visable window
215 B	Main Exibit Room	Old	9'-11"	Flat	BB-6	T-3	CB-3	White Carpet	Green Carpet	Beadboard	Covered- carp	Door trim only on interior doors. No trim in exterior doors. No visable window
215 C	Main Exibit Room	Old	9'-11"	irregular	BB-6	T-3	CB-3	White Carpet	Green Carpet	Beadboard	none	Door trim only on interior doors. No trim in exterior doors. No visable window
216	Exibit Room	Old	10'-0"	Flat	BB-6	T-3	CB-3	White Carpet	Green Carpet	Beadboard	Covered- carp	Door trim only on interior doors. No trim in exterior doors. No visable window
217	Exibit Room	Old	7'-4"	Flat	BB-6	T-3	CB-3	White Carpet	Green Carpet	Beadboard	Covered- carp	Door trim only on interior doors. No trim in exterior doors. No visable window
218	Stair Hall	Old	9'-11"	Flat	BB-7	T-3	CB-3	Beadboard	Red Carpet	Beadboard	Open	
219	Storage	Old	7'-4"	Flat	BB-8	T-4	none	Beadboard	Red Carpet	Beadboard	Open	
102	Lobby	New	7'-11"	Flat	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	Open	
103	Restroom	New	7'-11"	Flat	BB-4	T-2	CB-2	Drywall	Laminate	Drywall	None	
104	Restroom	New	7'-11"	Flat	BB-4	T-2	CB-2	Drywall	Laminate	Drywall	None	
105	Storage	New	7'-11"	Flat	BB-4	T-2	CB-2	Drywall	Red Carpet	Drywall	None	
107	Historic Bath	Old	7'-6"	Flat	BB-2	T-4	none	Beadboard	Wood	Beadboard	Open	
108	Historic Bedroom	Old	8'-6"	Flat	BB-2	T-2,4	CB-2, none	Beadboard	Wood	Beadboard	Open	Two doors with T-2 and CB-2 and Three doors with T-4 and no CB
110	Historic Kitchen	Old	8'-5"	Flat	BB-2	T-4	none	Beadboard	Painted Wood	Beadboard	None	
111	Historic Pantry	Old	7'-11"	Flat	none	T-4,6	none	Beadboard	Painted Wood	Beadboard	Open	T-4 on outside wall and T-6 on inside wall
112	Historic Dinningroom	Old	8'-6"	Flat	BB-2	T-2,5	none	Beadboard	Wood	Beadboard	Open	All T-2 except for around exterior french doors
113	Historic Parlor	Old	8'-6"	Flat	BB-2	T-2,5	CB-2	Beadboard	Wood	Beadboard	Open	All T-2 except for around exterior french doors
114	Historic Study	Old	8'-6"	Flat	BB-9	T-2	CB-2	Beadboard	Wood	Beadboard	Open	Original Wood Gaining, chair rail and wainscoting
115	Historic Entry	Old	8'-7"	Flat	BB-10	T-3	CB-3	Beadboard	Wood	Beadboard	Open	Original Wood Gaining, chair rail and wainscoting

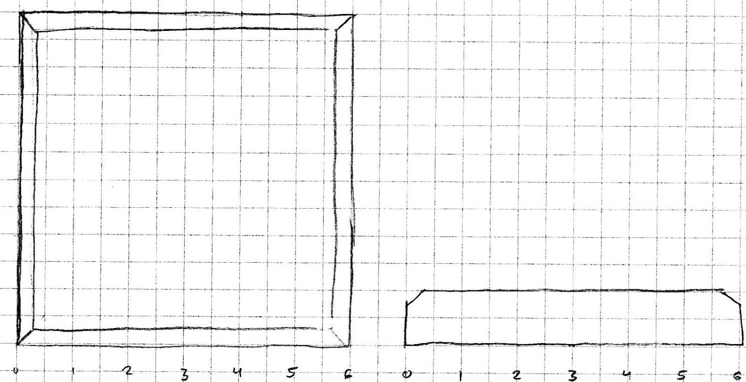

Window and Door Trim
WD#1
1 2 3 4 5 5½
WD#2
WD#7
1 2 3 4 5 6
WD#3/4
0 1 2 3 4 1 3/8
WD#5 - 8½" x 3/4"
8 ½


WD # 6

Clorner Blocks

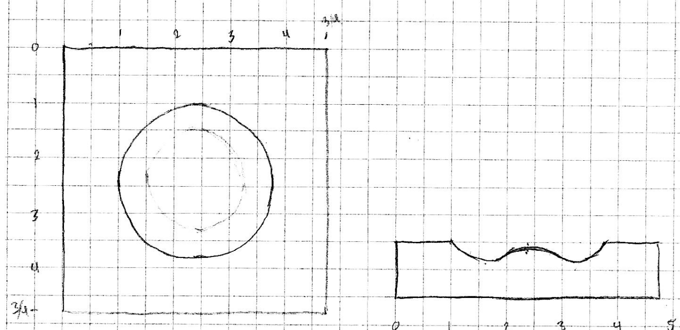


CB#1/#2



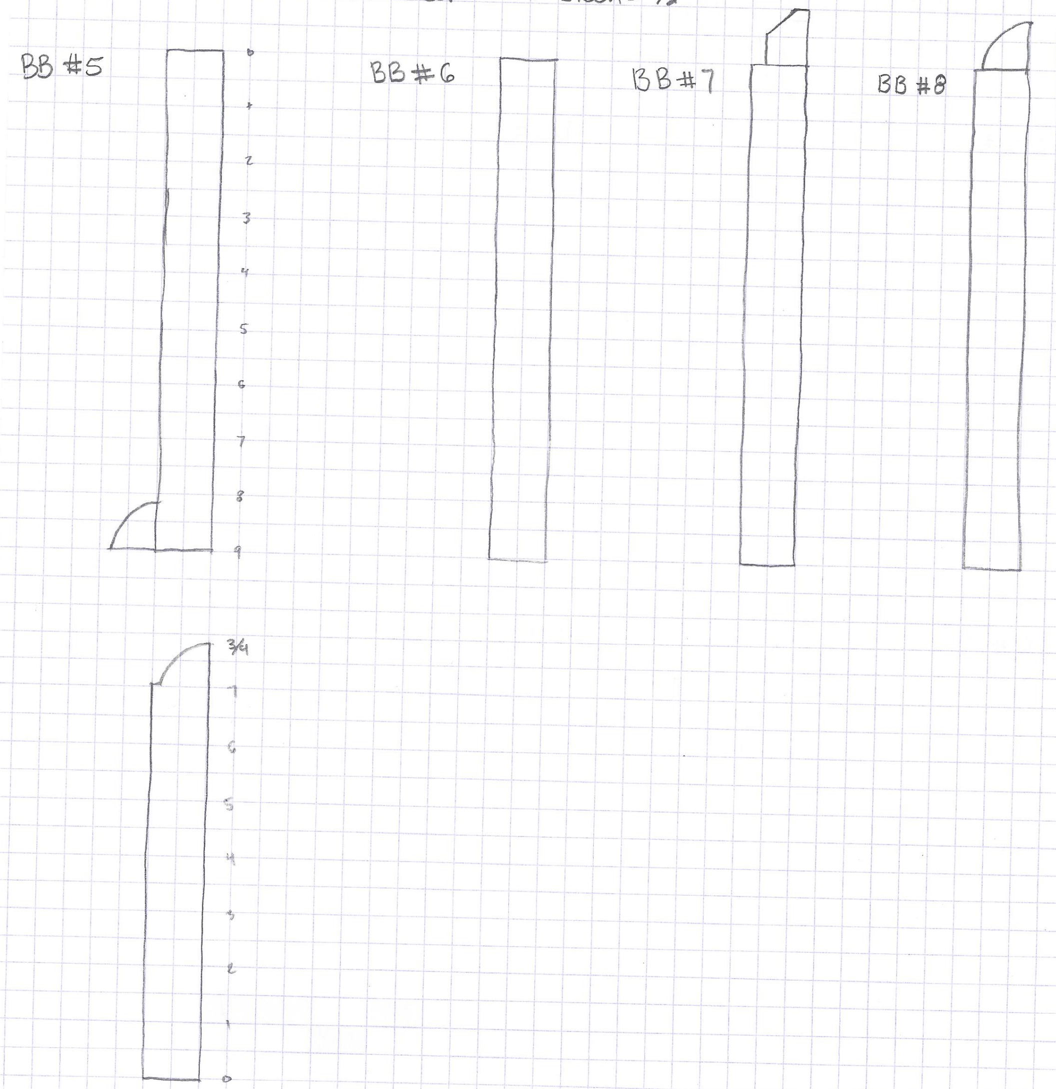
CB#2 1½ x 5½ square block

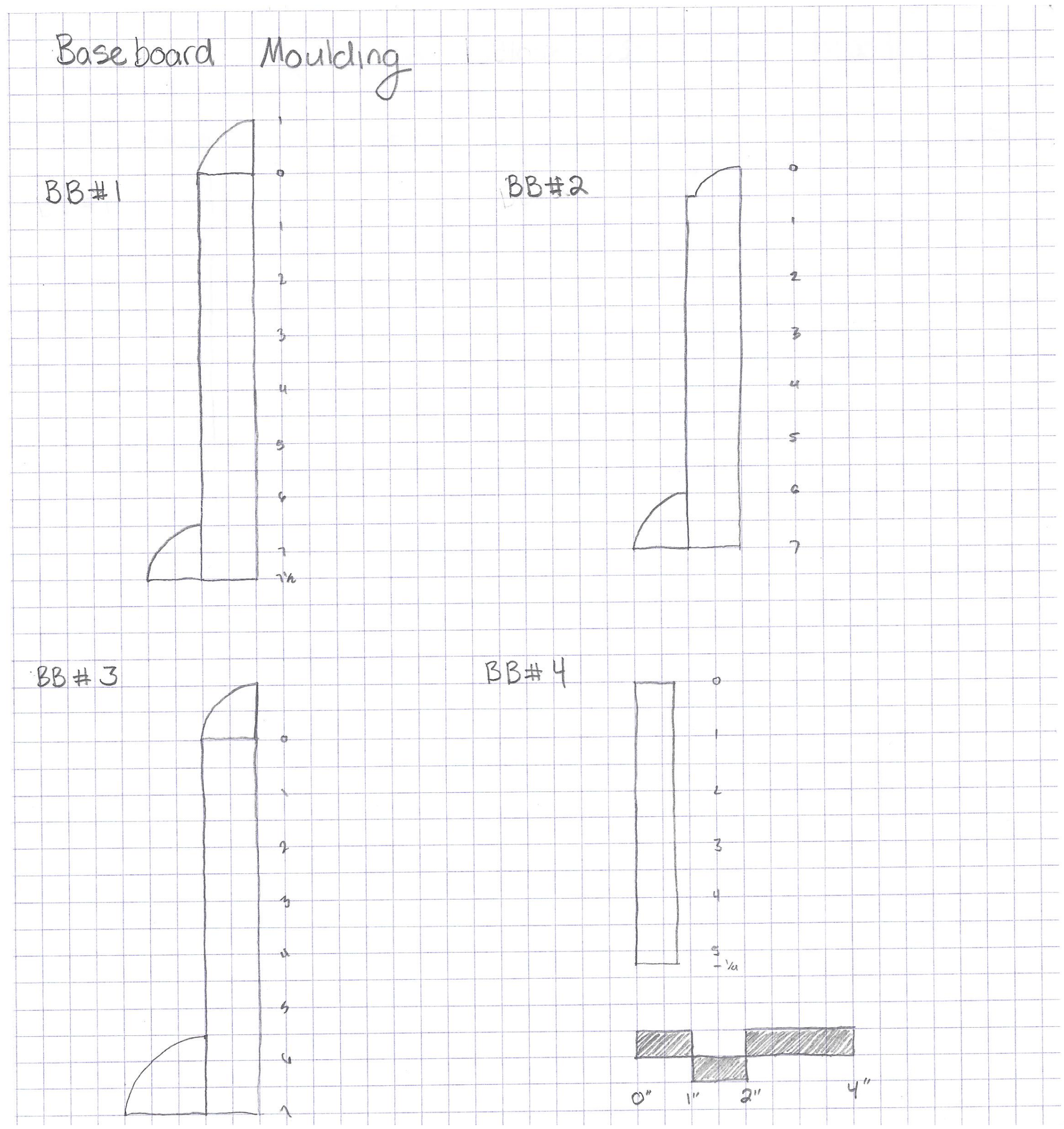
CB#3

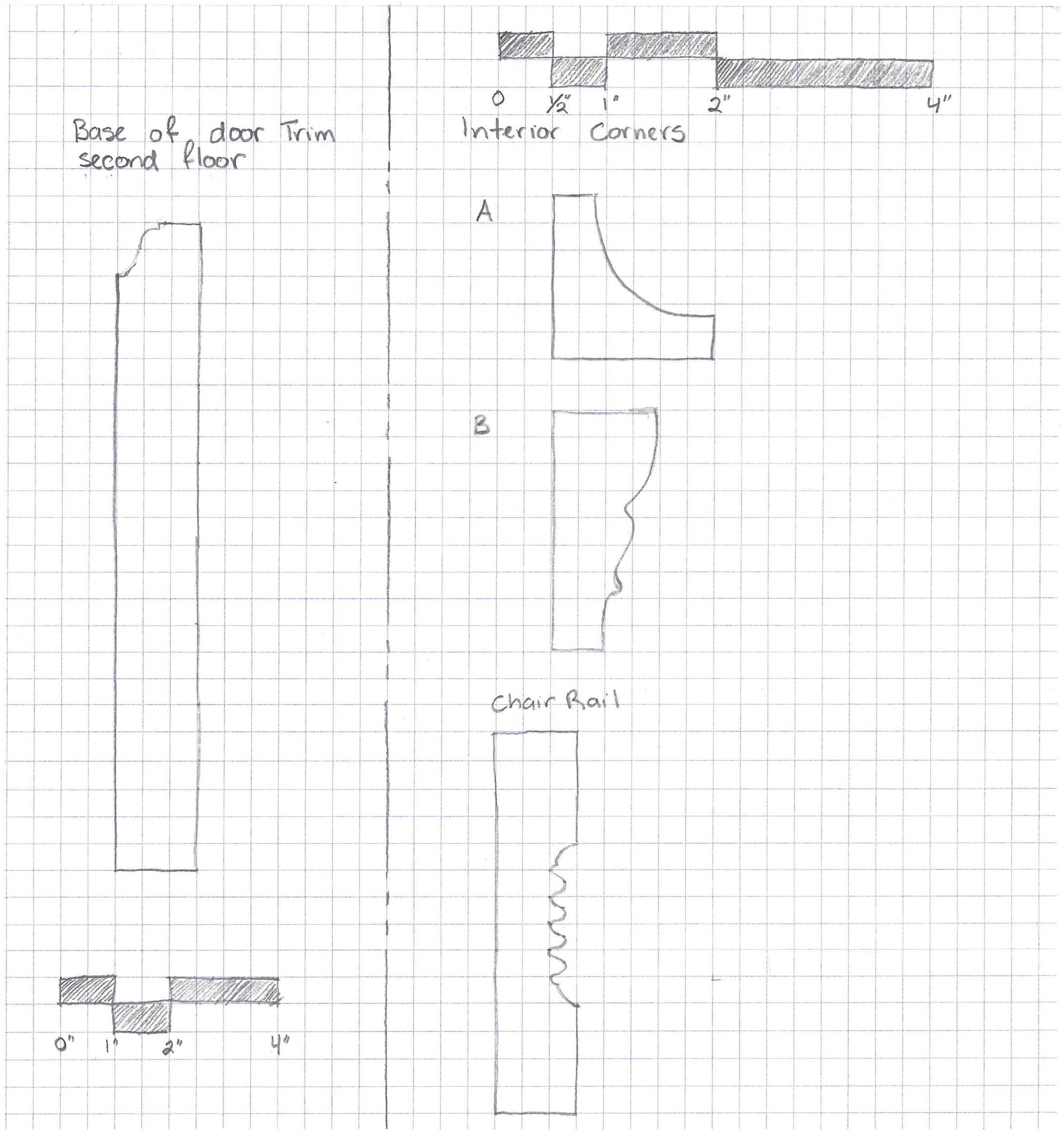


Baseboard Continued

1 Block = 1/2"




Baseboard Moulding
BB#1
BB#2
BB#3
BB#4
0"
1"
2"
4"


Base of door Trim
second floor
0" 1" 2" 4"
0 ½" 1" 2" 4"
Interior Corners
A
B
Chair Rail

APPENDIX D: Moisture Survey Data

Instant Number	Room Number	wall or ceiling	Wall	Location	Exterior wall	exterior window or door	MP adjacent to window/door	door/window covered	MP proximal to a penetration/transition	type of penetration/transition	Type of finish	Type of MP	Severity Rating
1	315	Wall	South	Top Middle	yes	Window	Yes	No	Yes	Window	Bead Board	Peeling Paint, Cupped Wood, Crack	3
2	315	Ceiling		South West					Yes	Roof Peak	Bead Board	Peeling Paint, Cupped Wood, Warped Wood	3
3	315	Ceiling		South West					Unclear		Bead Board	Water Stain, Flaking Finish, Cupped Wood, Sagging	3
4	315	Ceiling		West					Yes	HVAC vent	Bead Board	Peeling paint	2
5	315	Wall	West	Bottom Middle	yes	Window	Yes	No	Yes	Window	Wood	Flaking Finish, Blistering Finish	2
6	315	Ceiling		North West					No		Bead Board	Peeling Paint, Warped Wood	3
7	315	Wall	North	Middle left	no						Wood	Warped Wood, Crack	1
8	315	Wall	North	Middle Right	no						Bead Board	Peeling paint	1
9	316	Ceiling		South East					Yes	Chimney to roof	Bead Board	Peeling paint, Crack, Warped Wood	3
10	316	Wall	West	Center	yes	Window	Yes	Yes	Yes	Window	Bead Board	Peeling paint	1
11	312	Wall	South	Middle Right	no				Yes	Chimney behind wall	Bead Board	Peeling Paint, Crack	1
12	312	Wall	South	Top Right	no				Yes	Chimney behind wall	Bead Board	Peeling paint, Crack	2
13	312	Wall	West	Middle left	yes	Neither					Bead Board	Peeling paint	1
14	312	Ceiling		North West					No		Bead Board	Peeling paint	2
15	312	Wall	North	Top Middle	yes	Window	No	Yes	No		Bead Board	Peeling paint	2
16	312	Wall	North	Top Middle	yes	Window	No	Yes	No		Bead Board	Peeling paint	2
17	312	Wall	North	Top Middle	yes	Window	No	Yes	No		Bead Board	Peeling paint	2
19	311	Ceiling		East					Yes	Roof gable and HVAC vent	Bead Board	Peeling paint	1
18	312	Ceiling		South East					Yes	Attic Hatch	Wood	Peeling paint	2
20	314	Wall	West	Middle Right	no				Unclear	Roof Valley	Bead Board	Water Stain, Peeling Paint	2
21	314	Wall	East	Center	yes	Neither			No		Bead Board	Peeling paint	1
22	314	Wall	East	Middle Right	yes	Neither			No		Bead Board	Peeling Paint, Crack	2
23	314	Wall	South	Middle left	yes	Window	Yes	No	No		Bead Board, Wood	Peeling Paint, Blistering Finish, Warped Wood	2
24	314	Wall	West	Middle left	yes	Neither			No		Bead Board	Peeling paint	1
25	313	Ceiling		North East					Unclear	Roof Valley	Bead Board	Peeling Paint, Water Stain, Blistering Finish, Crack	2
26	306	Wall	North	Top Left	yes	Window	No	No	Yes	Old building to new building	Dry wall	Blistering Finish,Peeling drywall tape	2
27	306	Ceiling		North West					Yes	Old building to new building	Dry wall	Water Stain, Crack, Peeking drywall tape	2
28	306	Ceiling		South West					Yes	Old building to new building	Dry wall	Crack, Peeling drywall tape	2
29	217	Ceiling		North West					Yes	Roof to wall	Bead Board, Carpet	Biological growth (mold, mildew, etc), Water Stain, peeling paint, Cupped Wood, Crack	4
30	217	Wall	West	Center	yes	Window	Yes	Yes	Unclear	under porch roof. Prox. covered window	Carpet	Biological growth (mold, mildew, etc), Musty Smells	2
31	217	Wall	North	Middle left	yes	Both	No	Yes	Unclear	Under porch roof	Carpet	Biological growth (mold, mildew, etc), Musty Smells	1
32	217	Wall	North	Top Middle	yes	Both	Yes	Yes	Unclear	Under porch roof, Door	Carpet	Biological growth (mold, mildew, etc), Water Stain, Musty Smells, Peeling carpet	3
33	217	Wall	North	Center	yes	Both	Yes	Yes	Unclear	Under porch roof, Door	Carpet	Biological growth (mold, mildew, etc), Water Stain, Musty Smells, Peeling carpet	3
34	217	Wall	North	Top Right	yes	Both	No	Yes	Unclear	Under porch roof	Carpet	Biological growth (mold, mildew, etc), Water Stain, Musty Smells	2
35	217	Ceiling		South					Yes	Roof to wall	Bead Board	Water Stain, Peeling Paint, Cupped Wood, Warped Wood	3
36	217	Wall	South	Top Right	no	Neither			Yes	Roof to wall	Carpet	Biological growth (mold, mildew, etc), Water Stain, Musty Smells	1
37	216	Ceiling		North East					Yes	Roof to wall	Bead Board, Carpet	Biological growth (mold, mildew, etc), Water Stain, Peeling paint, Crack	2
38	216	Ceiling		East					No		Bead Board	Peeling paint	1
39	216	Ceiling		South East					No		Bead Board	Water Stain, Peeling paint	1
40	216	Ceiling		North West					Yes	Roof to wall	Bead Board	Cupped Wood, Warped Wood, Peeling paint	2
41	216	Ceiling		West					Yes	Roof to wall	Bead Board	Cupped Wood, Warped Wood, Peeling paint	2
42	216	Ceiling		South West					Yes	Roof to wall	Bead Board	Cupped Wood, Warped Wood, Peeling paint	2

43	216	Wall	West	Center	yes	Both	Yes	Yes	Yes	Door	Carpet	Biological growth (mold, mildew, etc), Water Stain, Musty Smells	3
44	216	Wall	West	Middle bottom	yes	Both	Yes	Yes	Yes	Door	Carpet	Biological growth (mold, mildew, etc), Water Stain, Musty Smells	3
45	215A	Ceiling		South West					Unclear		Bead Board	Water Stain, Crack, Peeling Paint	2
46	215A	Ceiling		North West					Yes	Roof to wall	Bead Board	Blistering Finish, Crack, Peeling Paint	1
47	215A	Wall	North	Middle left	yes	Both	Yes	Yes	Yes	Door	Carpet	Biological growth (mold, mildew, etc), Water Stain	2
48	215A	Wall	North	Center	yes	Both	Yes	Yes	Yes	Door	Carpet	Biological growth (mold, mildew, etc), Water Stain	1
49	215A	Ceiling		North East					Yes	Roof to wall	Bead Board	Water Stain, Crack, Peeling Paint	2
50	215 B	Ceiling		North West					Yes	Roof to wall	Bead Board, Carpet	Water Stain, Corrosion Stain, Warped Wood, Peeling Paint	3
52	215 B	Ceiling		Center					Yes	Roof to wall	Bead Board	Water Stain, Blistering Finish, Cupped Wood, Warped Wood, Rotting, Sagging, Crack	4
51	215 B	Ceiling		South					Yes	Roof to wall	Bead Board	Water Stain, Blistering Finish, Cupped Wood, Warped Wood, Rotting, Sagging, Crack	4
53	215 B	Wall	North	Center	yes	Door	Yes	Yes	Yes	Door	Carpet	Biological growth (mold, mildew, etc), Water Stain	2
54	215 B	Ceiling		East					Yes	Face plate over hole	Bead Board	Peeling Paint	2
55	215 B	Ceiling		North East					Yes	Roof to wall	Bead Board	Biological growth (mold, mildew, etc), Water Stain, Crack, Peeling Paint	2
56	215 B	Ceiling		South East					Yes	Roof to wall	Bead Board	Water Stain, Corrosion Stain, Cupped Wood, Sagging, Crack, Peeling Paint	3
57	215 C	Ceiling		North East					Yes	Roof to wall	Bead Board	Water Stain, Peeling Paint, Crack	2
58	215 C	Ceiling		South East					Yes	Roof to wall	Bead Board	Water Stain, Cupped Wood, Crack, Peeling Paint	2
59	215 C	Wall	East	Top Middle	no	Neither			Yes	Roof to wall	Carpet	Rust	1
60	215 C	Ceiling		South					No		Bead Board	Blistering Finish, Cupped Wood, Crack, Peeling Paint	3
61	215 C	Ceiling		West					No		Bead Board	Water Stain, Blistering Finish, Peeling Paint	2
62	219	Ceiling		West					Yes	Roof to wall	Bead Board	Warped Wood, Crack, Peeling Paint	4
63	219	Ceiling		North					Yes	Roof to wall	Bead Board	Crack, Peeling Paint	4
64	219	Ceiling		East					Yes	Roof to wall	Bead Board	Biological growth (mold, mildew, etc), Water Stain, Sagging, Crack, Peeling Paint	4
65	219	Wall	North	Top Left	no	Neither			Yes	Roof to wall	Bead Board, Wood	Blistering Finish, Crack, Peeling Paint	3
66	219	Wall	North	Top Middle	no	Neither			Yes	Roof to wall	Bead Board	Water Stain, Cupped Wood, Warped Wood, Hole, Crack, Peeling Paint	5
67	218	Door	South	Bottom Right		Neither			Yes	Roof to wall	Wood	Flaking Finish	2
68	218	Wall	West	Top Middle	yes	Door	No	No	Yes	Roof to wall	Bead Board	Blistering Finish, Cupped Wood, Warped Wood, Crack	4
69	218	Ceiling		West					Yes	Roof to wall	Bead Board	Flaking Finish, Blistering Finish, Cupped Wood, Warped Wood, Sagging, Crack, Peeling Paint	4
70	218	Ceiling		Center					Yes	Roof to wall	Bead Board	Flaking Finish, Blistering Finish, Cupped Wood, Sagging, Crack, Peeling Paint	4
71	218	Ceiling		East					Yes	Roof to wall	Bead Board	Flaking Finish, Blistering Finish, Cupped Wood, Sagging, Crack, Peeling Paint	3
72	218	Ceiling		North East					No		Bead Board	Peeling Paint	2
73	218	Wall	East	Top Left	no	Neither			No		Bead Board	Crack	2
74	213	Ceiling		North West					No		Bead Board	Crack, Peeling Paint	2
75	213	Ceiling		West					Unclear		Bead Board	Crack, Peeling Paint	2
76	213	Ceiling		South					Yes	Roof to wall	Bead Board	Cupped Wood, Crack, Peeling Paint	2
77	213	Ceiling		Center					No		Bead Board	Warped Wood, Peeling Paint	3
78	213	Ceiling		East					Unclear		Bead Board	Cupped Wood, Crack, Peeling Paint	2
79	213	Ceiling		North East					Unclear		Bead Board	Crack, Peeling Paint	2
80	213	Wall	South	Top Right	yes	Window	Yes	Yes	Yes	Roof to wall	Carpet	Biological growth (mold, mildew, etc), Water Stain	1
81	213	Wall	South	Middle Left	yes	Window	Yes	Yes	Yes	Roof to wall	Carpet	Biological growth (mold, mildew, etc), Water Stain	2
82	213	Wall	East	Center	no	Window	No	Yes	Unclear		Carpet	Biological growth (mold, mildew, etc), Water Stain	1
83	212	Ceiling		South					Yes	Roof to wall	Bead Board	Water Stain, Cupped Wood, Warped Wood, Crack, Peeling Paint	4
84	212	Ceiling		Center					Yes	Under porch roof	Bead Board	Rust, Crack, Peeling Paint	3
85	212	Ceiling		South					Yes	Under porch roof	Bead Board	Biological growth (mold, mildew, etc), Water Stain, Warped Wood, Sagging, Crack, Peeling Paint	4
86	212	Wall	North	Top Left	no	Neither			Yes	Roof to wall	Bead Board	Peeling Paint	1
87	212	Wall	North	Middle Right	no	Neither			Yes	Roof to wall	Bead Board	Crack, Peeling Paint	2
88	212	Wall	East	Top Left	yes	Window	Yes	No	Yes	Roof to wall	Bead Board	Crack	1
89	206	Ceiling		East					Yes	Old building to new building	Dry wall, Metal vent cover	Rust	1
90	209	Ceiling		South East					Yes	Roof to wall	Dry wall	Biological growth (mold, mildew, etc), Water Stain, Sagging, Crack	5
91	111	Ceiling		Center					Yes	Porch to wall	Bead Board	Water Stain, Flaking Finish, Blistering Finish, Warped Wood, Crack, Peeling Paint	3
92	111	Ceiling		South East					Yes	Porch to wall	Bead Board	Flaking Finish, Blistering Finish, Crack	2
93	111	Wall	South	Center	yes	Both	Yes	No	Yes	Porch to wall	Bead Board	Crack, Peeling Paint	2
94	111	Wall	North	Bottom Right	no	Neither			Yes	Porch to wall	Bead Board	Blistering Finish, Peeling Paint	3
95	111	Wall	North	Top Middle	no	Neither			Yes	Porch to wall	Bead Board, Wood	Flaking Finish, Warped Wood, Crack	3
96	111	Wall	West	Top Right	no	Neither			Yes	Porch to wall	Bead Board	Crack, Peeling Paint	3
97	110	Ceiling		South East					Yes	Porch to wall	Bead Board	Blistering Finish, Sagging, Peeling Paint	3
98	110	Ceiling		South					Yes	Porch to wall	Bead Board	Blistering Finish, Crack, Peeling Paint	3
99	110	Wall	West	Top Left	no	Neither			Yes	Porch to wall	Bead Board	Crack	2
100	110	Ceiling		North West					No		Bead Board	Blistering Finish, Cupped Wood, Warped Wood, Sagging, Crack, Peeling Paint	3

101	110	Ceiling		North East					No		Bead Board	Water Stain, Cupped Wood, Warped Wood, Sagging, Peeling Paint	4
102	108	Ceiling		South East					No		Bead Board	Blistering Finish, Warped Wood, Water Stains, Peeling Paint	3
103	108	Ceiling		North East					Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Cupped Wood, Warped Wood, Sagging, Crack, Peeling Paint	4
104	108	Ceiling		North					Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Cupped Wood, Warped Wood, Sagging, Crack, Peeling Paint	5
105	108	Ceiling		North West					Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Sagging, Crack, Peeling Paint	3
106	108	Wall	South	Top Left	no	Neither			No		Bead Board	Water Stain, Crack	2
107	108	Wall	North	Top Middle	yes	Door	Yes	No	Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Crack, Peeling Paint	3
108	107	Ceiling		South					Yes	Porch to wall	Bead Board	Blistering Finish, Sagging, Crack, Peeling Paint	4
109	107	Ceiling		Center					Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Sagging	4
110	107	Ceiling		North					Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Rust, Sagging, Crack	4
111	107	Wall	East	Top Right	yes	Window	Yes	No	Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Warped Wood, Cupped Wood, Crack	4
112	107	Wall	East	Top Middle	yes	Window	Yes	no	Yes	Porch to wall	Bead Board	Blistering Finish, Warped Wood, Cupped Wood, Crack	3
113	107	Wall	East	Top Left	yes	Window	Yes	No	Yes	Porch to wall	Bead Board, Wood	Pealing Finish, Blistering Finish, Warped Wood, Cupped Wood, Crack	2
114	113	Ceiling		Center					No		Bead Board	Blistering Finish, Warped Wood, Crack, Peeling Paint	4
115	113	Ceiling		North East					Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Crack, Peeling Paint	3
116	113	Ceiling		North					Yes	Porch to wall	Bead Board	Water Stain, Blistering Finish, Cupped Wood, Warped Wood, Sagging, Crack, Peeling Paint	4
117	113	Ceiling		North West					Yes	Porch to wall	Bead Board	Crack, Peeling Paint	2
118	113	Ceiling		South East					No		Bead Board	Crack, Peeling Paint	2
119	113	Wall	North	Top Left	yes	Door	yes	No	Yes	Porch to wall	Bead Board	Crack	2
120	113	Wall	North	Top Right	yes	Door	No	No	Yes	Porch to wall	Bead Board	Crack	2
121	113	Wall	East	Top Right	no	Neither			No		Bead Board	Blistering Finish, Warped Wood, Crack	3
122	114	Ceiling		North West					Yes	Porch to wall	Bead Board	Flaking Finish, Crack, Peeling Paint	1
123	114	Wall	North	Top Left	yes	Window	No	No	Yes	Porch to wall	Bead Board	Crack, Peeling Paint	2
124	115	Ceiling		Center					No		Bead Board	Water Stain, Warped Wood, Crack, Peeling Paint	3
125	115	Wall	West	Top Middle	yes	Door	No	No	Yes	Porch to wall	Bead Board, Wood	Flaking Finish, Crack	2
126	115	Wall	West	Middle Right	yes	Door	No	No	No		Bead Board	Flaking Finish, Blistering Finish, Peeling Paint, Crack	2
127	115	Wall	North	Top Left	no	Neither			No		Bead Board	Crack, Peeling Paint	2
128	115	Wall	North	Middle Left	no	Neither			No		Bead Board	Crack, Peeling Paint	1
129	115	Wall	North	Middle Right	no	Neither			No		Bead Board	Flaking Finish, Blistering Finish, Crack, Peeling Paint	2
130	115	Wall	East	Middle Right	no	Neither			No		Bead Board	Crack, Peeling Paint	1
131	115	Wall	South	Middle Left	yes	Neither			No		Bead Board	Blistering Finish, Crack, Peeling Paint	1
132	112	Ceiling		South West					Yes	Porch to wall	Bead Board	Crack, Peeling Paint	2
133	112	Ceiling		South East					No		Bead Board	Crack, Peeling Paint	1
134	112	Ceiling		North East					No		Bead Board	Peeling Paint	1
135	112	Wall	East	Middle left	no	Neither			No		Bead Board	Blistering Finish, Crack, Peeling Paint	2
136	112	Wall	North	Top Left	no	Neither			No		Bead Board	Blistering Finish, Crack, Peeling Paint	2
137	112	Wall	West	Top Middle	yes	Door	No	No	Yes	Porch to wall	Bead Board	Blistering Finish, Crack	2
138	112	Wall	South	Top Right	yes	Door	No	No	Yes	Porch to wall	Bead Board	Crack	1
139	112	Wall	South	Middle Left	yes	Door	No	No	Yes	Porch to wall	Bead Board	Crack	2
140	112	Wall	East	Middle Right	yes	Neither			Yes	Porch to wall	Bead Board	Blistering Finish, Crack	2

APPENDIX E: Example Summary Report from WUFI Model

(Note: full reports of each case and WUFI® on CD-ROM)

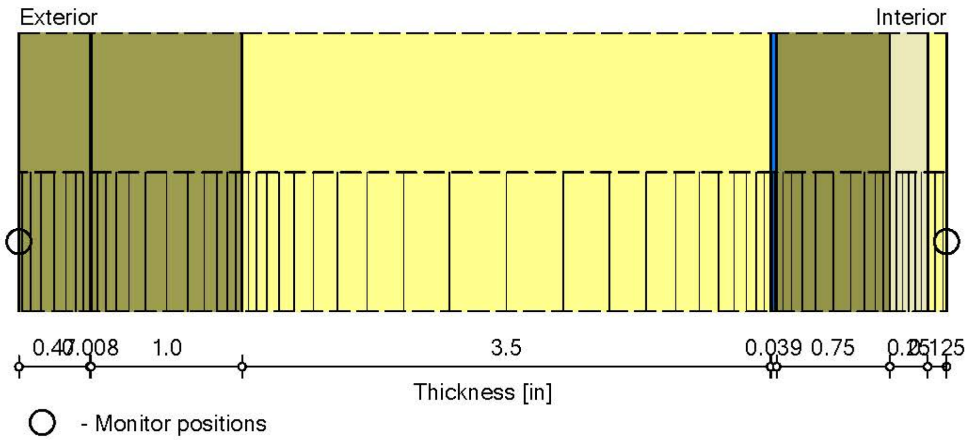
WUFI® Pro 5.3

Project Data

Project Name	Lucas Mansion Exterior Gallery Wall
Project Number	1
Client	Hiddenite Arts and Heritage Center
Contact Person	Pete Wood
City/Zip	28636
Street	316 Hiddenite Church Rd
Phone	828-632-6966
Fax	
e-mail	
Responsible	
Remarks	
Date	3/16/2017 8:20:27 AM

Component Assembly

Case: Existing Wall



Materials:

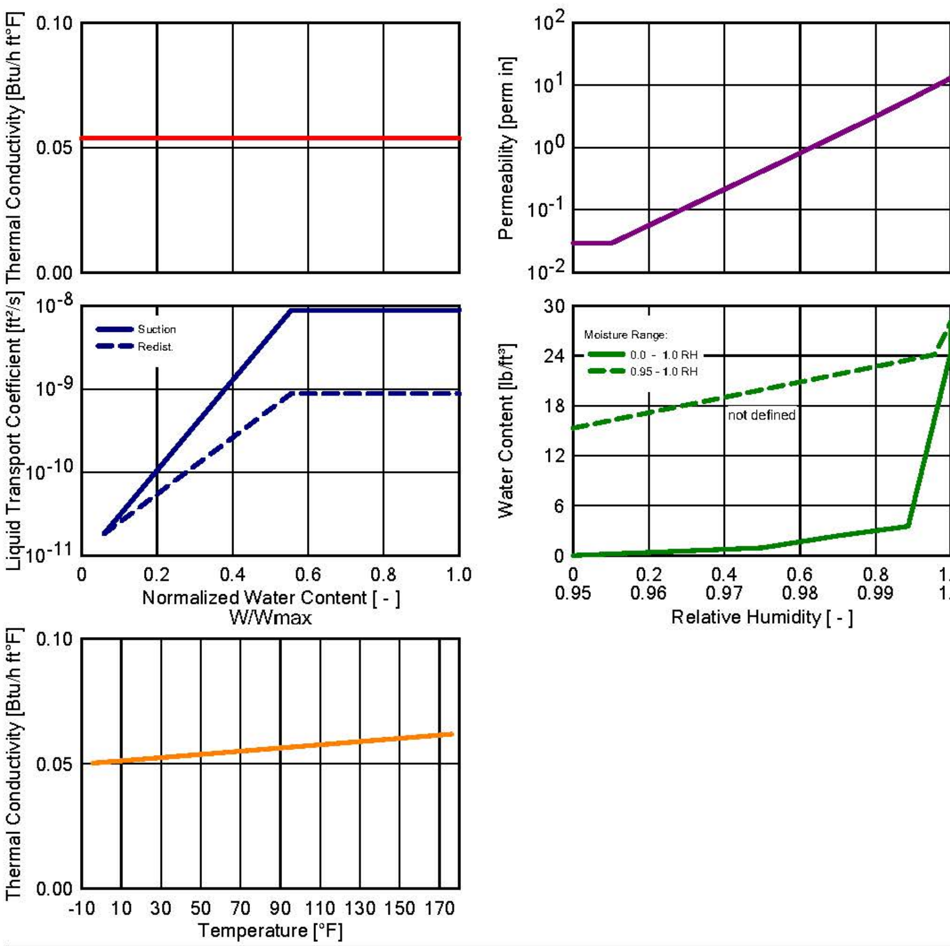
- Eastern White Pine	0.47 in
- Asphalt Impregnated Paper (30 min Paper)	0.008 in
- Eastern White Pine	1.0 in
- Low Density Glass Fibre Batt Insulation	3.5 in
- Kraft Paper	0.039 in
- Plywood (USA)	0.75 in
- Woodfibre Board	0.25 in
- Low Density Glass Fibre Batt Insulation	0.125 in

Total Thickness: 6.14 in
R-Value: 16.45 h ft² °F/Btu
U-Value: 0.057 Btu/h ft²°F

Material: Eastern White Pine

Checking Input Data

Property	Unit	Value
Bulk density	[lb/ft³]	28.7169
Porosity	[ft³/ft³]	0.81
Specific Heat Capacity, Dry	[Btu/lb°F]	0.449
Thermal Conductivity, Dry, 50°F	[Btu/h ft°F]	0.0537
Permeability	[perm in]	0.0291
Reference Water Content	[lb/ft³]	2.9778
Free Water Saturation	[lb/ft³]	28.0926
Water Absorption Coefficient	[lb/in²s^0.5]	0.0000094
Temp-dep. Thermal Cond. Supplement	[Btu/h ft°F²]	0.0000642

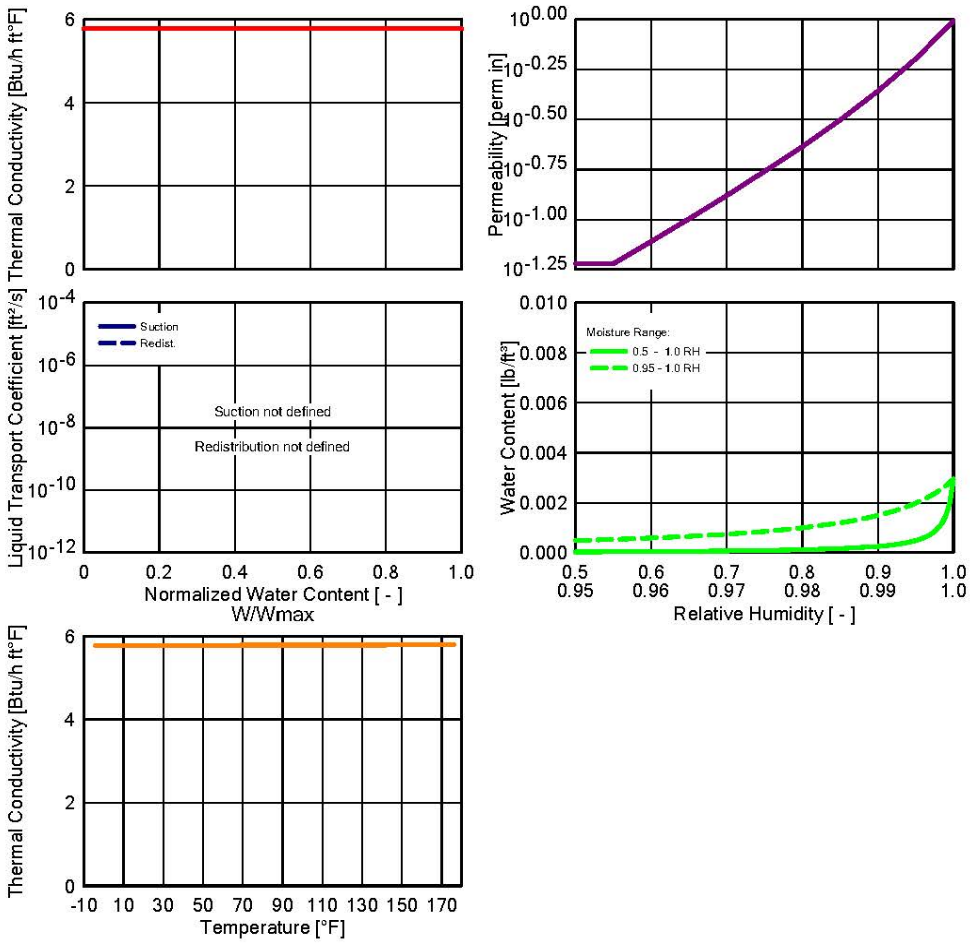


WUFI® Pro 5.3

Material: Asphalt Impregnated Paper (30 min Paper)

Checking Input Data

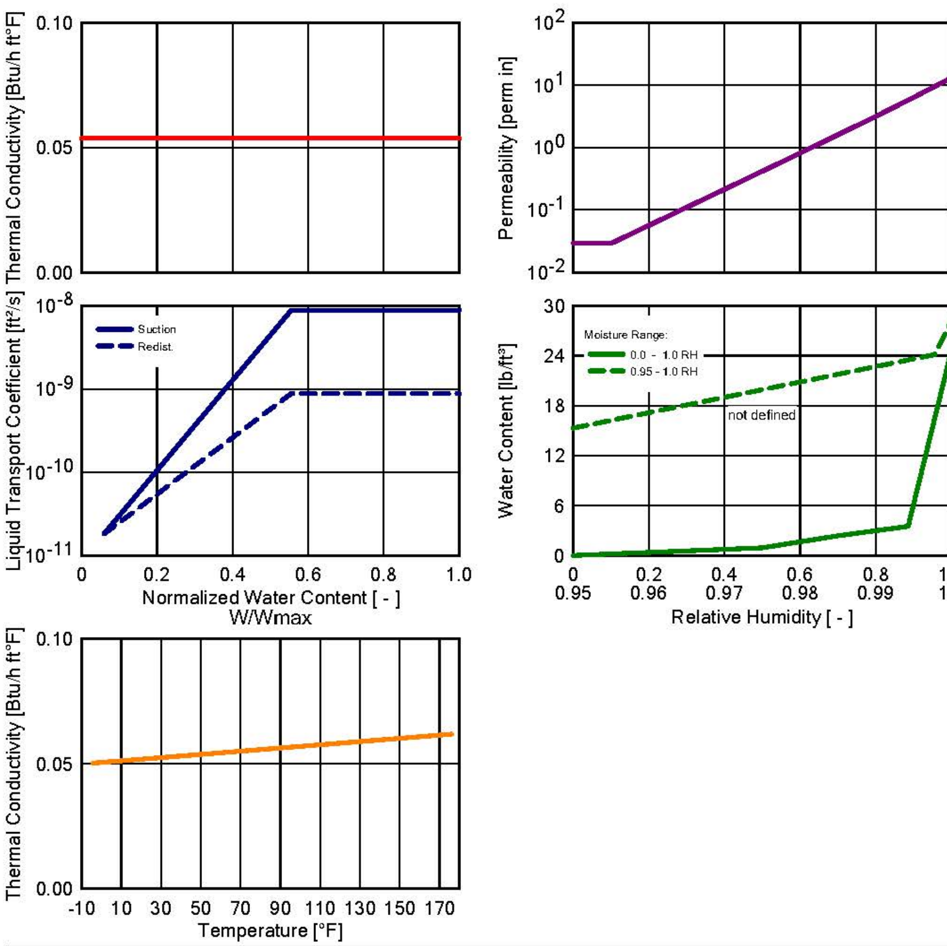
Property	Unit	Value
Bulk density	[lb/ft³]	56.747
Porosity	[ft³/ft³]	0.001
Specific Heat Capacity, Dry	[Btu/lb°F]	0.3583
Thermal Conductivity, Dry, 50°F	[Btu/h ft°F]	5.7779
Permeability	[perm in]	0.0601
Temp-dep. Thermal Cond. Supplement	[Btu/h ft°F²]	0.0000642



Material: Eastern White Pine

Checking Input Data

Property	Unit	Value
Bulk density	[lb/ft³]	28.7169
Porosity	[ft³/ft³]	0.81
Specific Heat Capacity, Dry	[Btu/lb°F]	0.449
Thermal Conductivity, Dry, 50°F	[Btu/h ft°F]	0.0537
Permeability	[perm in]	0.0291
Reference Water Content	[lb/ft³]	2.9778
Free Water Saturation	[lb/ft³]	28.0926
Water Absorption Coefficient	[lb/in²s^0.5]	0.0000094
Temp-dep. Thermal Cond. Supplement	[Btu/h ft°F²]	0.0000642

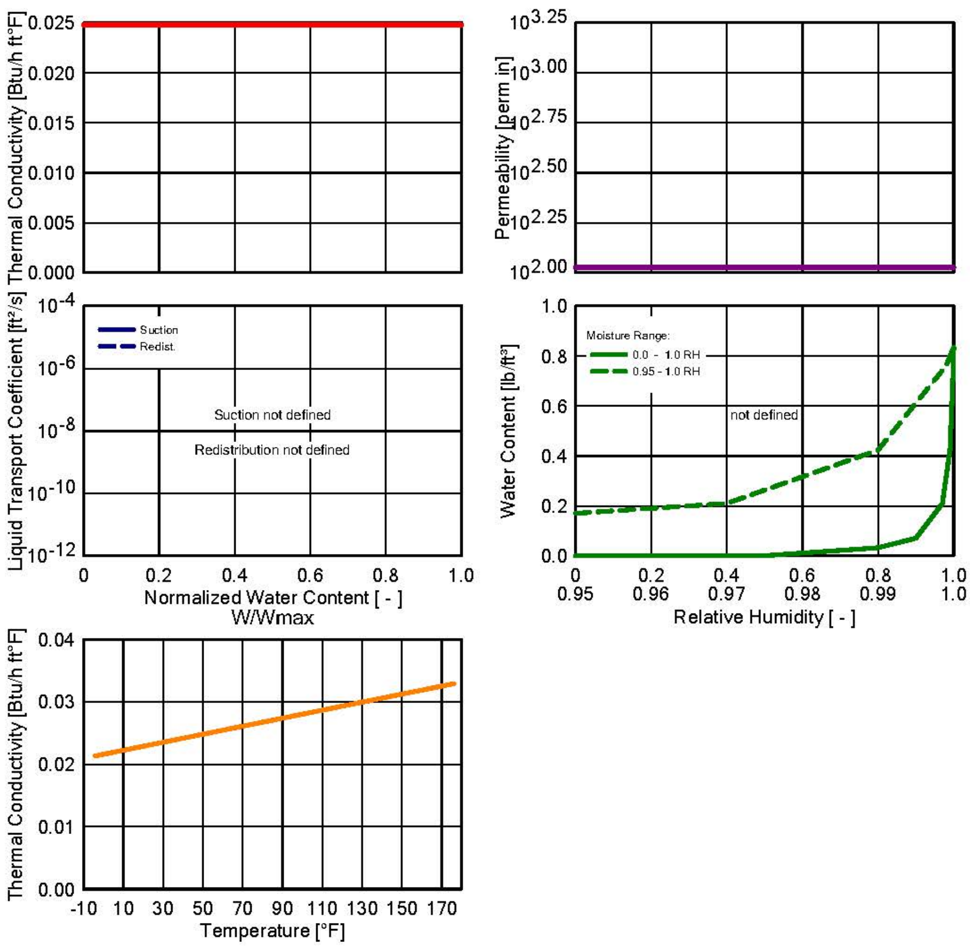


WUFI® Pro 5.3

Material: Low Density Glass Fibre Batt Insulation

Checking Input Data

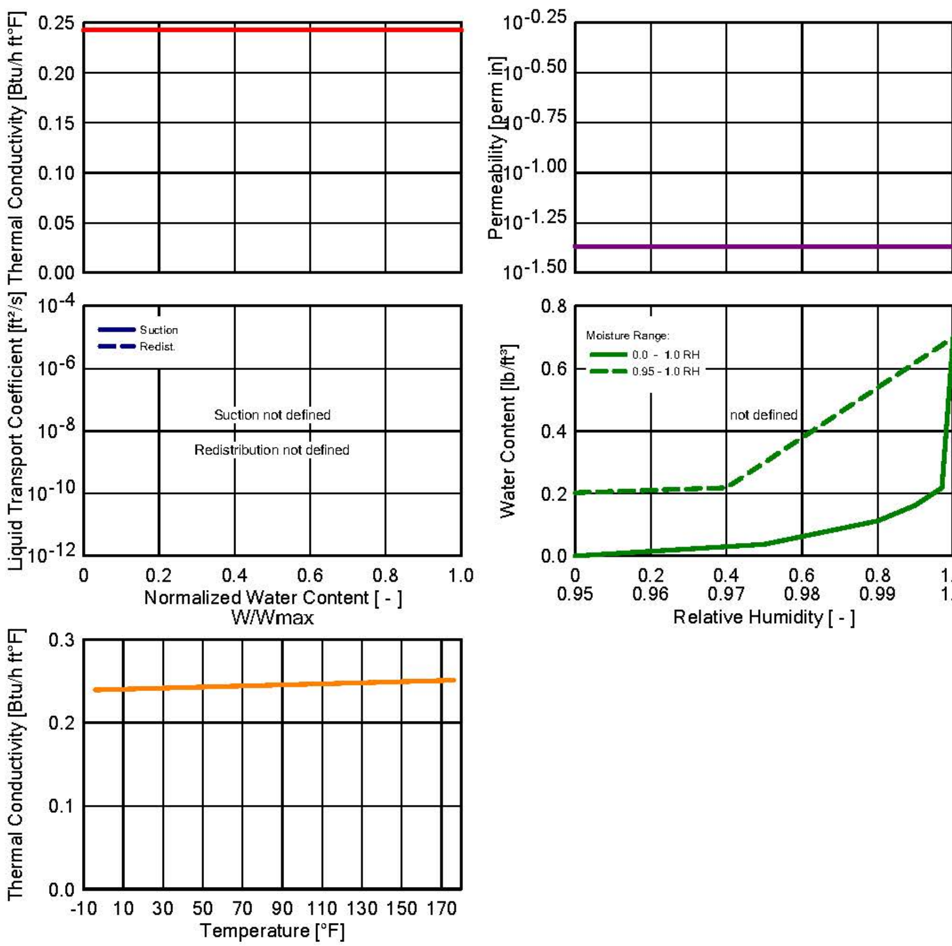
Property	Unit	Value
Bulk density	[lb/ft³]	0.5494
Porosity	[ft³/ft³]	0.999
Specific Heat Capacity, Dry	[Btu/lb°F]	0.2006
Thermal Conductivity, Dry, 50°F	[Btu/h ft°F]	0.0248
Permeability	[perm in]	106.4463
Temp-dep. Thermal Cond. Supplement	[Btu/h ft°F²]	0.0000642



Material: Kraft Paper

Checking Input Data

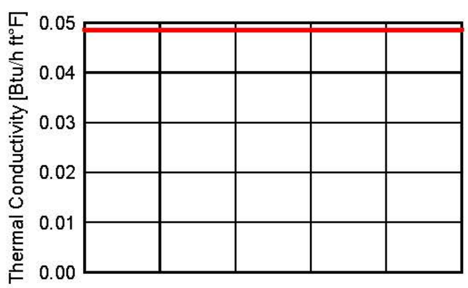
Property	Unit	Value
Bulk density	[lb/ft³]	7.4914
Porosity	[ft³/ft³]	0.6
Specific Heat Capacity, Dry	[Btu/lb°F]	0.3583
Thermal Conductivity, Dry, 50°F	[Btu/h ft°F]	0.2427
Permeability	[perm in]	0.0429
Temp-dep. Thermal Cond. Supplement	[Btu/h ft°F²]	0.0000642

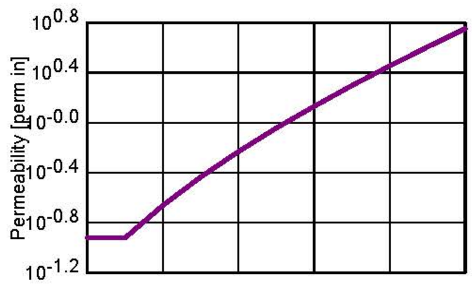


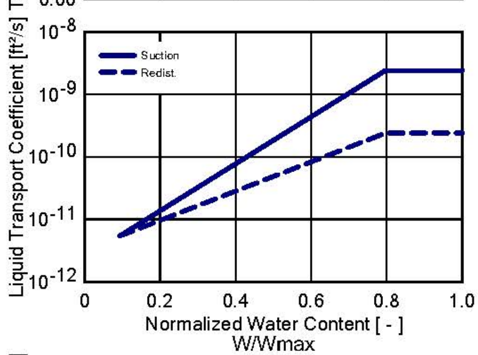
Material: Plywood (USA)

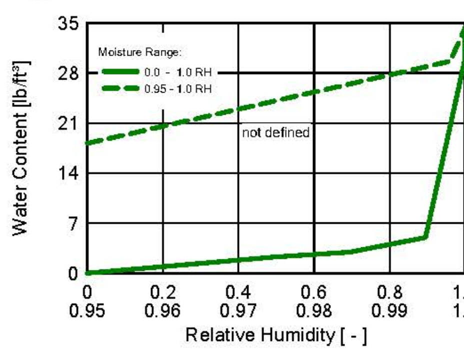
Checking Input Data

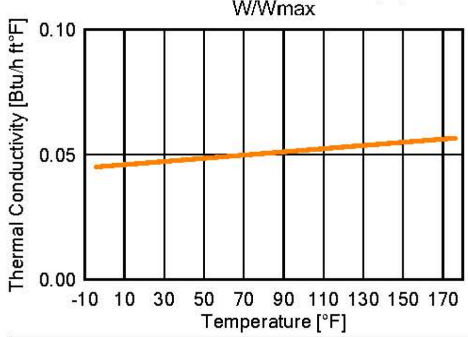
Property	Unit	Value
Bulk density	[lb/ft³]	29.3411
Porosity	[ft³/ft³]	0.69
Specific Heat Capacity, Dry	[Btu/lb°F]	0.449
Thermal Conductivity, Dry, 50°F	[Btu/h ft°F]	0.0485
Permeability	[perm in]	0.1195
Reference Water Content	[lb/ft³]	4.0204
Free Water Saturation	[lb/ft³]	34.3354
Water Absorption Coefficient	[lb/in²s^0.5]	0.0000060
Temp-dep. Thermal Cond. Supplement	[Btu/h ft°F²]	0.0000642







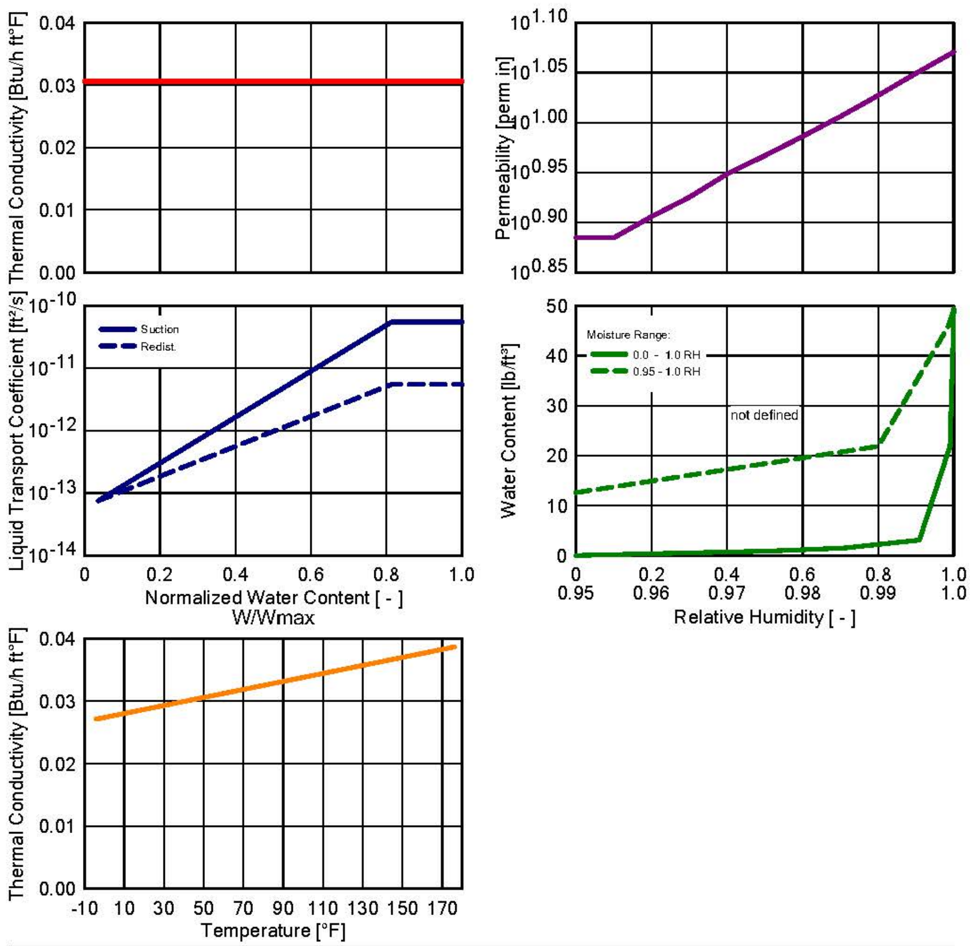




Material: Woodfibre Board

Checking Input Data

Property	Unit	Value
Bulk density	[lb/ft³]	19.977
Porosity	[ft³/ft³]	0.97
Specific Heat Capacity, Dry	[Btu/lb°F]	0.449
Thermal Conductivity, Dry, 50°F	[Btu/h ft°F]	0.0306
Permeability	[perm in]	7.6667
Reference Water Content	[lb/ft³]	2.21
Free Water Saturation	[lb/ft³]	49.3181
Water Absorption Coefficient	[lb/in²s^0.5]	0.0000013
Temp-dep. Thermal Cond. Supplement	[Btu/h ft°F²]	0.0000642

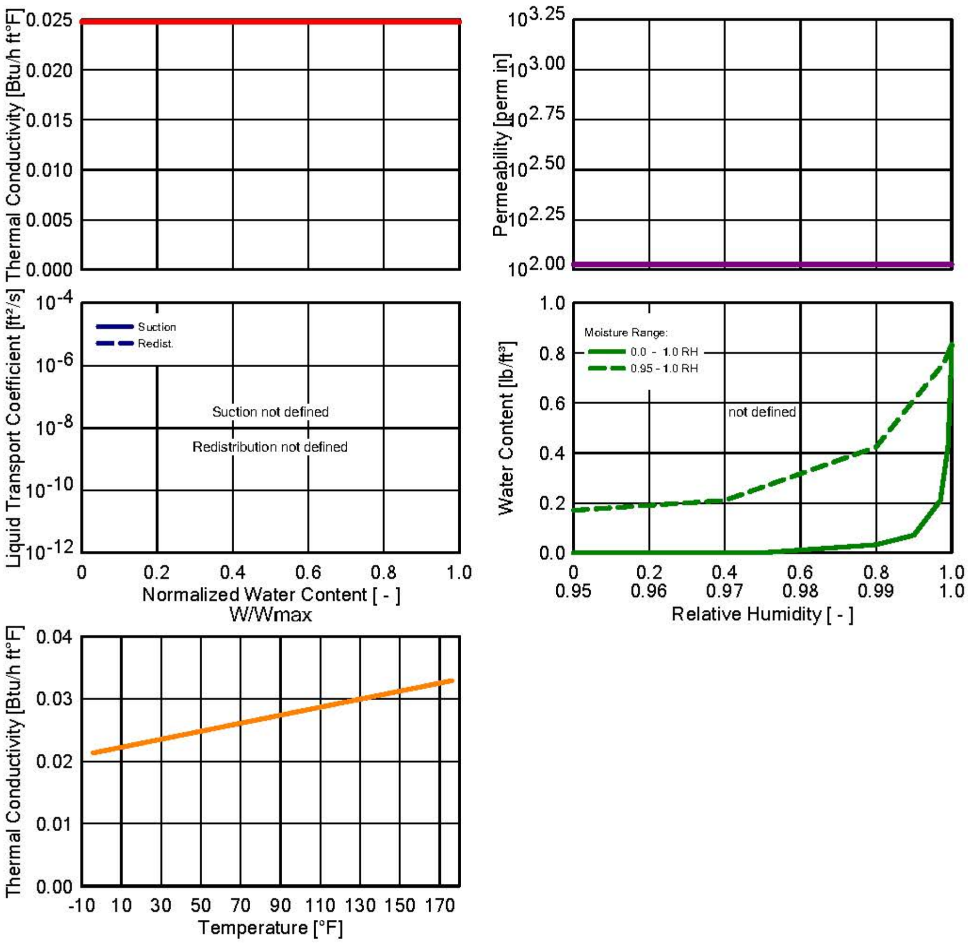


WUFI® Pro 5.3

Material: Low Density Glass Fibre Batt Insulation

Checking Input Data

Property	Unit	Value
Bulk density	[lb/ft³]	0.5494
Porosity	[ft³/ft³]	0.999
Specific Heat Capacity, Dry	[Btu/lb°F]	0.2006
Thermal Conductivity, Dry, 50°F	[Btu/h ft°F]	0.0248
Permeability	[perm in]	106.4463
Temp-dep. Thermal Cond. Supplement	[Btu/h ft°F²]	0.0000642



Boundary Conditions

Exterior (Left Side)
Location: Roanoke, VA; warm year
Orientation / Inclination: North / 90 °

Interior (Right Side)
Indoor Climate: EN 15026
Normal Moisture Load

Surface Transfer Coefficients

Exterior (Left Side)

Name	Description	Unit	Value
Heat Resistance - includes long-wave radiation	External Wall	[h ft² °F/Btu]	0.334 yes
Permeance	No coating	[perm]	----
Short-Wave Radiation Absorptivity	No absorption/emission	[-]	----
Long-Wave Radiation Emissivity	No absorption/emission	[-]	----
Adhering Fraction of Rain	Depending on inclination c	[-]	0.7
Explicit Radiation Balance			no

Interior (Right Side)

Name	Description	Unit	Value
Heat Resistance	External Wall	[h ft² °F/Btu]	0.71
Permeance	No coating	[perm]	----

WUFI® Pro 5.3

Results from Last Calculation

Status of Calculation

Calculation: Time and Date	4/4/2017 7:31:46 PM
Computing Time	1 min,0 sec.
Begin / End of calculation	10/1/2017 / 10/1/2020
No. of Convergence Failures	73

Check for numerical quality

Integral of fluxes, left side (kl,dl)	[lb/ft²]	5.72 -5.68
Integral of fluxes, right side (kr,dr)	[lb/ft²]	0.0 0.12
Balance 1	[lb/ft²]	-0.08
Balance 2	[lb/ft²]	-0.07

Water Content [lb/ft²]

	Start	End	Min.	Max.
Total Water Content	0.67	0.6	0.5	0.93

Water Content [lb/ft³]

Layer/Material	Start	End	Min.	Max.
Eastern White Pine	2.98	3.16	1.96	12.85
Asphalt Impregnated Paper (30 min F	0.00	0.00	0.00	0.00
Eastern White Pine	2.98	3.23	2.54	3.33
Low Density Glass Fibre Batt Insulati	0.03	0.03	0.01	0.04
Kraft Paper	0.11	0.09	0.02	0.13
Plywood (USA)	4.02	2.70	2.10	4.02
Woodfibre Board	2.21	1.16	0.62	2.21
Low Density Glass Fibre Batt Insulati	0.03	0.01	0.00	0.03

Time Integral of fluxes

Heat Flux, left side	[Btu/ft²]	-24156.44
Heat Flux, right side	[Btu/ft²]	-24191.15
Moisture Fluxes, left side	[lb/ft²]	0.04
Moisture Fluxes, right side	[lb/ft²]	0.12

Hygrothermal Sources

Heat Sources	[Btu/ft²]	0.0
Moisture Sources	[lb/ft²]	0.0

APPENDIX F: National Registry of Historic Places Nomination Form (1981)

FHR-8-300 (11-78)

OMB 1024-0018
EXP 12-31-84

United States Department of the Interior
Heritage Conservation and Recreation Service

For HCRS use only
received
date entered

National Register of Historic Places Inventory—Nomination Form

See instructions in *How to Complete National Register Forms*
Type all entries—complete applicable sections

1. Name

historic The Lucas Mansion

and/or common

2. Location

street & number East side SR 1503 (Church Street) 0.3 mile North of jct. with NC 90 ___ not for publication

city, town Hiddenite ___ vicinity of congressional district Tenth

state North Carolina code 037 county Alexander code 003

3. Classification

Category	Ownership	Status	Present Use	
___ district	___ public	___ occupied	___ agriculture	___ museum
x building(s)	x private	___ unoccupied	___ commercial	___ park
___ structure	___ both	x work in progress	___ educational	___ private residence
___ site	**Public Acquisition**	**Accessible**	___ entertainment	___ religious
___ object	___ in process	x yes: restricted	___ government	___ scientific
	___ being considered	___ yes: unrestricted	___ industrial	___ transportation
	N/A	___ no	___ military	x other: planned museum

4. Owner of Property

name Mrs. Eileen L. Sharpe

street & number P.O. Box 615

city, town Winston-Salem ___ vicinity of state North Carolina 27102

5. Location of Legal Description

courthouse, registry of deeds, etc. Alexander County Courthouse

street & number

city, town Taylorsville state North Carolina

6. Representation in Existing Surveys

title N/A has this property been determined elegible? ___ yes x no

date ___ federal ___ state ___ county ___ local

depository for survey records N/A

city, town state

7. Description

Condition		Check one	Check one
x excellent	___ deteriorated	x unaltered	x original site
___ good	___ ruins	___ altered	___ moved date ______
___ fair	___ unexposed		

Describe the present and original (if known) physical appearance

The Lucas Mansion, a three-story frame house of irregular plan with an impressive two-story wraparound porch, is the chief architectural landmark of the small community of Hiddenite in Alexander County. Located on a lot of slightly less than one acre, the unusual early twentieth century structure, of Queen Anne derivation in plan and detail, dwarfs the small early-to-mid twentieth century neighboring houses that front along Church Street.

The house is believed to have reached its present form through two or perhaps three stages of construction. An early twentieth century photograph shows the house as a one-and-one-half story dwelling of roughly the same plan and roof configuration that it has today, consisting of a complex system of projecting gables intersecting a central hip roof. Local tradition recounts that the house was enlarged twice by the strange method of raising the existing stage and building a new floor beneath or between the existing floors. According to the story, the top floor is the oldest section, the bottom floor second oldest, and the second floor most recent. How this was accomplished is not altogether clear, but certain features of the structure give support to the story that it was enlarged at least once in some unusual fashion. The interior finish of the first and third floors are identical, with the second floor woodwork of a different character, and two sets of floor joists were discovered beneath the second floor during restoration.

The house roughly follows a cruciform plan, though the plan varies from floor to floor, and overall the house is characterized by irregularity of form, plan, and detail. It rests on a system of brick piers, with latticework connecting the piers along the perimeter of the porch. It is covered with plain weatherboards, with narrow corner posts framing the elevations. The complexity of the plan is enhanced by the two-story porch which completely envelopes the structure on all sides. The porch is supported by turned posts with scrollwork brackets, with a balustrade featuring turned balusters and molded handrail connecting the posts on both levels. The first story porch includes a spindle frieze above the brackets. The second level features hinged gates at points along the balustrade, which reportedly served as access points for furniture and art objects too large for the narrow interior stair, and which were hoisted to the second level through the porch.

Windows vary in size, configuration, and location. Major first floor windows and all third floor windows are of one-over-one sash, in simple frames, and all with shutters with moveable louvers. Second floor windows and secondary first floor windows are small square casement windows, set high in the wall, also shuttered. Exterior doors are distributed irregularly on both levels, and all are glazed. Double French doors provide entry to the first level centered on the north and south elevations with an identical door directly above the first on the north side opening out to the second floor porch. Secondary doors open at various points elsewhere on the two levels.

The roof is clad in standing seam tin, with tin shingles covering the porch roof. A tall interior chimney with corbeled cap pierces the west slope of the main hip of the roof. A smaller kitchen flu protrudes from the east slope opposite.

The interior plan is highly irregular, with little relation between room arrangements from one room to the next. The first floor plan contains no central hall, and consists of several rooms of varying size adjoining each other in a seemingly haphazard fashion. The second and third floors contain irregular central east-west hallways, with private access to rooms of irregular shapes and sizes off the halls.

Interior walls are finished with horizontal tongue and groove sheathing. Some rooms contain vertical board wainscoting. Door and window frames of the first and third floor levels are symmetrically molded, with identical profiles and plain corner blocks. Second floor door and window frames,also symmetrically molded but with a different profile, have oversized corner blocks with rondels. Interior doors on all levels are of the five panel milled type, with pairs of vertical panels above and below a central horizontal one. Mantels vary in form, with reeded pilasters and wide friezes adorned with reeding, diamond center plates, and other devices. The open stair rises through the southwest rooms on all three levels; this features molded handrail, turned balusters that resemble those of the porch, and turned newels. One of the finest features fo the interior is the excellent wood graining that appears on doors and much woodwork throughout the building, though some of the woodwork has been painted white.

No outbuildings or other support features remain on the property.

8. Significance

Period	Areas of Significance—Check and justify below			
___ prehistoric	___ archeology-prehistoric	___ community planning	___ landscape architecture	___ religion
___ 1400–1499	___ archeology-historic	___ conservation	___ law	___ science
___ 1500–1599	___ agriculture	___ economics	___ literature	___ sculpture
___ 1600–1699	X architecture	___ education	___ military	___ social/humanitarian
___ 1700–1799	___ art	___ engineering	___ music	___ theater
___ 1800–1899	X commerce	___ exploration/settlement	___ philosophy	___ transportation
X 1900–	___ communications	___ industry	___ politics/government	___ other (specify)
		___ invention		

Specific dates ca. 1900, ca. 1928 **Builder/Architect** Unknown

Statement of Significance (in one paragraph)

The Lucas Mansion in Hiddenite has a history and architectural form that are unique to Alexander County. The three-story, twenty-two room structure, with its elaborate porches, reflects an early twentieth century prosperity not prevalent elsewhere in the county. Beginning as a one-story structure built ca.1900, the house was enlarged to its present size between 1910 and 1928 by James Paul Lucas, a South Carolina native and international diamond merchant. "Diamond Jim," as he was popularly called, amassed considerable wealth from his business and turned much of it into enlarging and furnishing his home which far surpassed the economic growth and development of the community. He retired from the diamond trade about 1929 and moved into his Hiddenite home for the remaining twenty-three years of his life. In his business travels he had made acquaintances with some of the country's most noted celebrities, many of whom visited his home. Over the years he had collected hundreds of items, including gifts from famous international figures. The Lucas Mansion became a veritable museum and the object of local curiosity. Lucas died in 1952 and the house became a summer home and hunting lodge for out-of-state owners. In 1981 Mrs. R.Y. Sharpe of Winston-Salem purchased the property. Plans are underway to restore the Lucas Mansion and adaptively convert it for use as a cultural center and museum.

Criteria assessment:

B. Associated with the life of James Paul ("Diamond Jim") Lucas, a successful businessman of wide reputation who made Hiddenite, North Carolina his permanent home.

C. Embodies the form, ornament, and character of an unusual and expansive private residence of the early twentieth century in the western Piedmont of North Carolina, featuring an especially notable two-story wraparound porch.

National Register of Historic Places Inventory—Nomination Form

The three story, twenty-two room Lucas Mansion in Hiddenite started out as a one story structure built around 1900. Two major alterations between 1910 and 1928 brought the house to its present configuration. For its location the mansion bears an architectural uniqueness born of the prosperity of its owner, a prosperity not really enjoyed by the town in general. Although Hiddenite grew large enough to be incorporated in 1913 (the charter was repealed in 1919), the town never reached the heights promised by the discovery of precious stones, one of which gave its name to the community.[1] Development of the Lucas Mansion far exceeded the economic growth of its geographical location and reflects exclusively the wealth of its long-time owner, James Paul Lucas. Lucas, however, did not build the oldest portion of the house.

Local tradition maintains that the original one story house was built about 1900, but no records were found to establish an exact date.[2] Sometime between 1900 and 1906, W. F. Hollar moved from Watauga County to Hiddenite. He was living in the house and operating a store on the property by August 5, 1907.[3] How long before that time he had moved into the house is uncertain; so is the question of whether or not he was the builder. He sold one and a half acres, "being the dwelling and store lots" to A. G. Matlock on the above date. The selling price of $800 suggests that the improvements were modest.[4] From Matlock the property passed briefly through ownership of M. F. Patterson who sold it to James P. Lucas on December 12, 1908.[5]

James Paul Lucas was the son of James S. and Sallie Lockhart Lucas of South Carolina.[6] While in his early teens he became a "news butch" on a South Carolina train. At age nineteen he undertook a job as a "walking stick and umbrella salesman." A few years later he entered the diamond import business which was to bring him considerable wealth and an international reputation. He was first employed as a salesman by Samstag and Hilder Brothers of New York and rose to the position of general manager of the firm.[7] As the end of the twentieth century's first decade approached, Lucas was well established in the business and had traveled throughout the United States and to all parts of the world. His success in the diamond trade earned him the nickname of "Diamond Jim Lucas."[8] His first association with Hiddenite came when he visited the nearby Sulphur Springs health resort. Lucas liked the countryside and decided to buy land for his retirement years.[9]

Shortly after purchasing the house and lots in Hiddenite, "Diamond Jim" brought his parents from Blacksburg, South Carolina to live in the old Hollar house.[10] His father, James S. Lucas, was born in 1842 and enlisted for Confederate service on May 1, 1861, in York District, South Carolina. On June 4, 1861, he was mustered into the Fifth Regiment of South Carolina Volunteers where he served in the band.[11] He also saw considerable action, eventually rising to the rank of captain. According to the family, the elder Lucas's band was selected to provide ceremonial music at the surrender at Appomattox.[12] Sallie Lucas, who for some years ran a millinery store across the street, died in 1929 but James S. lived until April 27, 1940 when he died in his 98th year.[13]

James Paul Lucas remained active in the diamond business for nearly two decades after moving his parents to Hiddenite. He maintained offices in New York and California but often visited his parents. Sometime between 1910 and 1928, Lucas had the house enlarged twice. The first change called for moving the original house to the side and constructing a new first floor upon which the original house was placed to form a two story structure.

Later the second story (original house) was raised while a new second story was inserted. Presumably, the porches and railings were added at that time as were the house's own electric power plant and water system.[14] Thus, the top story is the oldest part of the house; the first floor is the second oldest; and the middle story forms the youngest portion. All of this took place while the parents of James Paul Lucas were residing in the house. Several people then living in Hiddenite recall the unusual method of enlarging the Lucas Mansion.[15]

"Diamond Jim" retired to his Hiddenite home about 1929. He had never married and his niece Ethel Pedings, whose husband John T. Pedings had died the year before, moved to the Lucas Mansion to serve as hostess for Jim and his parents. She remained in the Lucas household for twenty-three years in the capacity of hostess, house manager, and receptionist. Lucas relived the old southern life in his Hiddenite home and entertained in the finest traditions of the Old South. He was a friend of presidents (particularly Harry S. Truman), bankers, industrialists, and political leaders. Mrs. Pedings stated that he entertained almost everybody of any importance except the president.[16]

Lucas was an avid collector and the items numbered in the hundreds. Gifts came from world renown personalities such as Baron Rothschild (two canes) and General Pershing (World War I helmet). Other items included a pipe believed to have belonged to Czar Nicholas of Russia, clothes worn by Buffalo Bill, boxing gloves of John L. Sullivan and James J. Corbett, and a baseball mitt authographed by John McGraw. A special clock collection (150 pieces) included an 1804 model and one that ran for 400 days on a single winding. Diamonds up to sixteen carats, antique guns, and numerous other artifacts were included. With such valuable furnishings, security was paramount. A hedge and fence completely surrounded the house and the gate was always locked. Admittance was gained by ringing a bell to call someone to the gate. Prowlers were discouraged by the presence of large dogs not at all hospitable to strangers.[17]

In addition to the homeplace, Lucas purchased other property in Alexander County whereon he raised Jersey cattle and race horses. A devotee of bird hunting, he often invited friends to hunt on his lands using the thoroughbred dogs he had raised. A number of prize ribbons in his collection attested to the quality of show animals he bred.[18]

James Paul Lucas lived in his Hiddenite home for over twenty years. Slowly his health began to fail and a week before his death on July 15, 1952 he was taken to Davis Hospital in Statesville. His body was returned to Hiddenite where he was buried beside his parents in the town cemetery. He was seventy-three at the time of his death.[19] Much of his land and money had been lost in the depression, and the items in his extensive collection were sold at public auction in Hickory.[20] As executor of his estate, the First National Bank of Catawba County filed a plea with the court for permission to sell the homeplace to defray the cost of outstanding debts.

The public auction was held in the autumn of 1952. On October 11, Howard D. and Flora Sharpe of Belmont, Massachusetts and W. R. and Lois Thomas of Miami, Florida became the highest bidders for "the homeplace of the late James Paul Lucas."[21] The Thomas family used the Lucas Mansion as a summer home for many years. Even after the death of her husband Mrs. Renn Thomas (a niece of James Paul Lucas) returned for summer vacations to

Hiddenite where she was joined by other members of the family. Howard Sharpe preferred to use the home as a hunting lodge and often brought his northern friends to Hiddenite for sport and competition.[22]

For a few years, the house stood vacant; encroaching vines, underbrush growth, and the elements of nature threatened its continued existence. In 1981, Mrs. R. Y. Sharpe, a native of Hiddenite but now living in Winston-Salem, purchased the house and grounds from its out-of-state owners. Mrs. Sharpe fondly remembers the "golden days" of the Lucas Mansion and plans to restore its original appearance while adapting it to serve as a historical/cultural museum and learning center for Alexander and surrounding counties.[23]

FOOTNOTES

[1]William S. Powell, The North Carolina Gazetteer (Chapel Hill: The University of North Carolina Press, 1968), 225; Bill Sharpe, A New Geography of North Carolina (Raleigh: Sharpe Publishing Company, 4 vols., 1958-1965), IV, 1693; and Pamela Simon, "History Long, Colorful for Alexander County," Statesville Record and Landmark, 100th Anniversary Edition, April 8, 1974.

[2]Researcher's interviews with Mrs. R. Y. Sharpe, May 7, 1981, and Mrs. Ethel Pedings, May 18, 1981, hereinafter cited as Sharpe and Pedings interviews respectively. Mrs. Pedings related a local story that the house was built for a prospective bride but the marriage never took place and the house was sold without being lived in. No evidence to confirm the story was found.

[3]In 1900 Hollar was living in Watauga County. See Eleventh Census of the United States, 1900: North Carolina - Watauga County, Population Schedule, E. D. 132, Sheet 11, Line 70. The index for the 1900 census showed no other W. F. Hollar in North Carolina. In 1906, W. F. Hollar of Alexander County, bought approximately one-half acre of land adjoining the Lucas House property. See Alexander County Deed Books, Office of the Register of Deeds, Alexander County Courthouse, Taylorsville, Deed Book Q, 105, 106, hereinafter cited as Alexander County Deed Book. The store and dwelling were mentioned in the deed from Hollar to A. G. Matlock, August 5, 1907. Alexander County Deed Book S, 30.

[4]Alexander County Deed Book S, 30.

[5]Patterson owned the property for nine months. See Alexander County Deed Book S, 460, 385.

[6]Statesville Landmark, July 17, 1952, hereinafter cited as Landmark.

[7]Jeanette St. Clair, "Lucas House Is Landmark in Hiddenite," The Taylorsville Times, July 1, 1976, hereinafter cited as St. Clair, "Lucas House."

[8]Pedings interview; and St. Clair, "Lucas House."

[9]Sharpe interview.

[10]Sharpe and Pedings interviews.

[11]A. S. Sally (comp.), South Carolina Troops in Confederate Service (Columbia: The State Company, 3 vols., 1930), III, 10.

[12]Pedings interview.

[13]Sharpe interview; and Pedings interview.

[14] St. Clair, "Lucas House"; Pedings interview; and Sharpe interview.

[15] Sharpe and Pedings interviews.

[16] Pedings interview.

[17] St. Clair, "Lucas House."

[18] St. Clair, "Lucas House."

[19] Landmark, July 17, 1952; and Pedings interview.

[20] Sharpe interview; and researcher's interview with W. N. (Red) Watt of Taylorsville, May 20, 1981.

[21] Alexander County Deed Book 46, p. 232.

[22] St. Clair, "Lucas House" and Pedings interview.

[23] See proposal of Charles A. Phillips, architectural conservation consultant, for the Lucas House Project, April 27, 1981. Charles and Laura Phillips have been employed by Mrs. Sharpe to serve as consultants for the restoration and adaption of the Lucas House. Copy of proposal in Lucas Mansion File, Survey and Planning Branch, Archaeology and Historic Preservation Section, Division of Archives and History, Raleigh.

Alexander County Records
Deeds
Vital Statistics
Wills

Interviews
Mrs. R. Y. Sharpe, May 7, 1981
Mrs. Ethel Pedings, May 18, 1981
W. N. (Red) Watt, May 20, 1981

Phillips, Charles A. Proposal for Lucas House Project (April 27, 1981) Report filed in Survey and Planning Branch, Division of Archives and History, Raleigh.

Powell, William S. The North Carolina Gazetteer. Chapel Hill: The University of North Carolina Press, 1968.

St. Clair, Jeanette. "Lucas House Is Landmark in Hiddenite." The Taylorsville Times, July 1, 1976.

Sally, A. S. (comp.). South Carolina Troops in Confederate Service. 3 vols. Columbia: The State Company, 1930.

Sharpe, Bill. A New Geography of North Carolina. 4 vols. Raleigh: Sharpe Publishing Company, 1958-1965.

Simon, Pamela. "History Long, Colorful for Alexander County." Statesville Record and Landmark, 100th Anniversary Edition, April 8, 1974.

The Statesville Landmark, July 17, 1952.

United States Census Records. Census of 1900: North Carolina - Watauga County.

9. Major Bibliographical References

See continuation sheet.

10. Geographical Data

Acreage of nominated property ~~Less than one acre~~.

Quadrangle name Hiddenite, NC — Quadrangle scale 1:24000

UMT References

	Zone	Easting	Northing		Zone	Easting	Northing
A	1 7	4 9 1 7 2 0	3 9 7 3 4 4 0	B			
C				D			
E				F			
G				H			

Verbal boundary description and justification The nominated property is a lot of less than one acre measuring approximately 160' square, bordering Church Street on the west and other privately owned parcels on the south, east, and north, and is all the property that remains in association with the Lucas House.

List all states and counties for properties overlapping state or county boundaries

state	code	county	code
N/A		N/A	

11. Form Prepared By

name/title Jerry L. Cross, Researcher
Michael T. Southern, Restoration Specialist

organization Survey and Planning Branch
Archeology and Historic Preservation Section — date June, 1981

street & number NC Division of Archives and History
109 East Jones Street — telephone (919) 733-6545

city or town Raleigh — state North Carolina 27611

12. State Historic Preservation Officer Certification

The evaluated significance of this property within the state is:

___ national ___ state XX local

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89–665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the Heritage Conservation and Recreation Service.

State Historic Preservation Officer signature [signature]

title Deputy State Historic Preservation Officer — date July 9, 1981

For HCRS use only
I hereby certify that this property is included in the National Register

date

Keeper of the National Register

Attest: — date

Chief of Registration

GPO 938 835

APPENDIX G: CD-ROM

- All items in physical appendix in digital form
- Architectural Photographs
- Moisture Damage Photographs
- WUFI Data Reports
- Revit Working File
- WUFI working file
- Select digitized Photos from the Hiddenite Arts and Heritage Center's Collection
- Select Digitized Photos from the Western North Carolina's Preservation Office's Collection
- Digitized versions of the Architectural drawing set and specification from the 1983 renovation and addition over seen by Chuck Goode
- Select Oral Histories from the Hiddenite Art and Heritage Center's Collection
- Recordings of personal communications with Allison Houchins

Vita

Leah Simmerman was born and raised in the Blue Ridge Mountains of Southwest Virginia. Her upbringing, practicality, and insatiable desire to create led her first to the fields of craft and design. She received her B.F.A. from Virginia Commonwealth University (VCU) in Craft and Material Studies with a concentration in woodworking and metalsmithing in May 2013. While in school at VCU Leah was involved with the management of Contemporary Craft Society, was a teaching assistant for a metals department course, and taught classes regularly for the VCU Swing Dance Club. After graduating from VCU Leah worked in outdoor education, finish carpentry and home energy retro fits, before she returned to school in fall of 2016 to pursue a Master's of Science degree with a dual concentration in Building Science and Sustainable Building design and Construction at Appalachian State University (ASU). During this two-year program she has focused in durable wall assembly design and historic preservation. While in school at ASU Leah had the opportunity to work with Professor Jeff Tiller on research instrumental to achieving amendments to the North Carolina Energy Conservation Code; present research at the North Carolina Energy Conference; serve as the leader of ASU Race to Zero team and present their work on the design of a net-zero multi-family complex at the US Department of Energy competition at the National Renewable Energy Laboratory; work as a graduate assistant in a mentorship role for the IDEXlab, a student led design-build team; and work with a team of four graduate students to design and build the mobiLANDING, an outdoor classroom and research space for the Department of Stainable Technology and the Built Environment's wind energy research site. She also received the 1st place in the Sigmon

Memorial Scholarship Completion for her innovative masonry design. Leah completed her master's degree in May of 2017 and is now working as a Building Designer for Shelter Alternatives, a sustainable design-build company in her hometown of Blacksburg, VA.