

CUSE Grant Cover Page & Abstract

Name: [REDACTED] Email: [REDACTED] Grad Year: [REDACTED]

College of Enrollment: *Architecture* Class Year: *Senior - 5th yr* Scholar Type: *Sustainability Minor Capstone
Researcher/Writer*

Major(s): *Architecture*

Minor(s): *Sustainability*

Grant Type: Immersion/Discernment Conference Attendance Conference Presentation
 Research Creative Service Learning Research Assistantship Internship

Project Title: *Analysis of traditional building materials and methods in Charleston, South Carolina in light of
climate change*

Dates: [REDACTED] to [REDACTED] Location(s): *Charleston* Funding Amount: *\$ 1500*

Faculty Recommender: [REDACTED] Faculty Email: [REDACTED]

IRB Approval for Human Subjects Research: Protocol # *##-##-####*

To facilitate cost-sharing opportunities, please identify all other campus units that you are applying to:

SLA College of Science Kellogg Institute Liu Institute Nanovic Institute
 Glynn Honors Program First Year of Studies Career Center Other: *List other units*

Abstract

The purpose of this research is to identify the relationship between building materials, the way they are joined, fixed, and processed, and the external forces from the climate. Through site documentation and data collection based on past and present conditions and predicted climate patterns, I hope to show that in order to preserve the architectural heritage of the traditional Charleston house, much attention needs to be paid to the materials. I hypothesize that new construction will have to be built differently to respond to the new external forces of the predicted climate. The goal of this research project is to illustrate which materials and processes will be the best approach to new, durable construction, allowing Charleston's rich heritage to be preserved and expanded upon for centuries to come.

Introduction

Traditional building materials and methods in Charleston like most other places, historically, were selected and developed because they were readily available and resilient in the local climate. Combined with particular building forms and orientation, they not only took advantage of local resources with an aim toward durability, but mediated between the interior and exterior to maximize the comfort of the inhabitants. How will these choices which have been effective in Charleston for so long and become truly representative of the place and culture have to change in light of climate change? In particular, how will brick masonry, which has been successful in the past for working with the semi-tropical climate (local resources, temperature, wind, precipitation, etc.) of Charleston perform as house construction in the future predicted climate condition for this city? Might other materials and/or methods be more successful? Will climate change impact the availability of some materials?

Studying building materials and how they are formed, treated, and joined is extremely important because they play a vital role in how the building performs as a complete envelope. Neglecting to build in concern with the climate can lead one to be largely dependent on high energy consuming climate control systems for interior comfort. Instead, if houses are built with climatic design strategies including the right materials, the building can better maximize the exterior conditions in order to become as self-sufficient as possible. Along with creating a comfortable indoor climate, all houses need to protect themselves from the climate's external forces in order to last for the long term. For Charleston, investigating the traditional building materials is important so as not to introduce something new that conflicts with the unique architecture heritage that makes the city proud. However, as climate changes in upcoming years,

so too must the way we build to optimize the interior space, resist harsher external conditions, and adjust to the changing availability of local materials

Background

This topic is as old as man himself and dates back to the primitive hut. The shelter, or dwelling, has always been made to fulfill two basic human needs: protection from elements and a favorable interior atmosphere (3). The house continues to be designed to meet the problem of climate control. The principal climatic elements to be considered with human comfort are solar radiation, air temperature, humidity, wind and precipitation (2). In the typical single family house, one can see many of Charleston's humid subtropical climate factors addressed. The side yard house is characterized by long side porches which combat the heat and humidity by allowing more ventilation through the porch and house. The large hung-type windows, high ceilings, window alignment, and interior door placement are designed to complement the porch for this ventilation. The porches were typically located on the south and west sides to protect from later afternoon sun when Charleston is its hottest (4). Brick walls would provide high thermal mass resistance in front of the mass of the structure, and so reduce the rate of heat to flow from the external surface, and high heat capacity at the interior to absorb any penetrating heat with little elevation in temperature (2).

However, it is predicted that the annual global and local average temperatures will rise, the amount of precipitation will increase, and sea levels will continue to rise. A higher water level makes it more likely that storm waves will wash over the barrier islands and threaten homes and other structures. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms (1). Because of these changes we expect

to occur, the houses that once worked well for the climate may not be as successful in these harsher climate condition of the future.

Since the 1920s, Charleston has taken many steps to preserve its architectural heritage, especially the houses in the historic district (5). The style and construction are valued because they reflect the materials success of its planter and merchant aristocracy (6). However, not only do they represent the depth of their history and time when Charleston was prominent, but they are also valued because they are effective in offering an elevated manner of living in terms of ceiling heights and generous windows. One important preservation example is that of The Russell House. The wind, rain, and flooding that came with Hurricane Hugo in 1989 caused considerable water damage to the house and challenged its structural integrity. With this case, preservationists realized one of the most challenging issues for the preservation community in the aftermath of the hurricane concerned the standards to which property owners were going to be held in making their storm-related repairs. The Board of Architectural Review decided that storm damage should be repaired using original, historical materials in order to preserve architectural integrity (5). I question if using the original materials in the same manner as before is the right answer in all cases. It would be a shame to spend the preservation funds on repair, just to see the next hurricane cause the same damage. That is why I ask, “Will these preservation methods and construction guidelines work for the future climate of Charleston?” I want to bridge the gap between preserving the architectural culture and becoming resilient to increased climatic factors.

Project Methodology

My first research method will be site documentation. While in Charleston, I will visit many side yard houses, as well as other buildings in the historic district, to note how the

materials are assembled. This joinery is documented but not widely accessible in scholarly literature or outside the local preservation community. While on site, I will also notice any types of material failure (i.e. spalling is a type of brick failure due to water retention). By studying which failures are common and where they typically occur, I will be able to better figure out how to build in order to prevent them.

My second research method will be to meet with a few people who are experts in the overall topic and have had much experience with Charleston specifically. I will meet with Ralph Muldrow, a professor at the College of Charleston whose primary research interest is preservation, particularly focused in Charleston. I will discuss with him what he sees as the biggest struggles with preservation in Charleston, such as availability of traditional local materials. Are historic methods of buildings still as effective as we begin to see the effect of climate change? Has the maintenance type and timeline changed? Which preservation techniques have been most successful? What types of mistakes have been made, today and historically, in the construction of buildings (i.e. the improper connection of windows in masonry walls, ties holding cavity walls together, etc.)? I will meet with instructors in masonry and preservation at the American College of the Building Arts because their work is in training craftsmen both to build new in a traditional manner and to care for existing structures. Meeting with someone in this field will help me better understand how the materials are made in Charleston and what goes into the making (i.e. the composition of brick, mortar, tabby, etc.) I will also meet with Jennifer Bevan, an architect in the area who specializes in traditional design and is a vocal advocate for traditional building practices. When speaking with her I plan to ask the following: How do changes in production methods and assembly affect traditional forms and materials' durability? What is the impact of codes including seismic and hurricane?

Credentials

As an architecture student, I have studied the topic of building materials and their relation to climate in some depth. I have had experience relating this topic to the present day buildings and technologies while working on the Green Scale Research Project under Professor Aimee Buccellato. As a sustainability minor, I understand the importance of climate change and have been introduced to a variety of ways to possibly mitigate it, and what to expect our climate to become. I am aware of how materials and building sustainably go hand in hand. Also, for the past three summers I have been an architectural intern at a variety of firms. Through this, I have learned and been responsible for accurate site documentation which will be a critical foundational component of my work. I will work with my faculty mentor, Professor [REDACTED] through bi-weekly meetings over the remaining fall and spring semesters to discuss my findings and evaluate my graphics and written work that will form my conclusion.

Research Goals

I look forward to learning about the traditional material and methods used to make Charleston's unique architecture. I hope to discover ways to improve their historic preservation and new construction to better address future climatic conditions while still expressing their unique architectural heritage. This work will help me to further develop an approach to sustainable building techniques which I can apply to my future work in research and design as an architect. This project will also help me significantly in completing my Sustainability minor capstone. My research and findings will be the foundation to my capstone project, and I plan to share these results represented in my final capstone project with Charleston's Board of Architecture Review.

Works Cited

1. EPA. "What Climate Change Means for South Carolina." Aug. 2016.
2. Givoni, Baruch. *Man, Climate and Architecture*. N.p.: Applied Science, 1982. Print.
3. Olgyay, Victor. *Design with Climate: Bioclimatic Approach to Architectural Regionalism*. N.p.: Princeton UP, 2015. Print.
4. Tung, Anthony M. *Preserving the World's Great Cities*. N.p.: Clarkson Potter, 2001. Print.
5. Weyeneth, Robert R. *Historic Preservation for a Living City: Historic Charleston Foundation, 1947-1997*. N.p.: U of South Carolina, 2000. Print.
6. Zierden, Martha A., Elizabeth Jean Reitz, and Joseph P. Riley. *Charleston: An Archaeology of Life in a Coastal Community*. N.p.: U of Florida, 2016. Print.