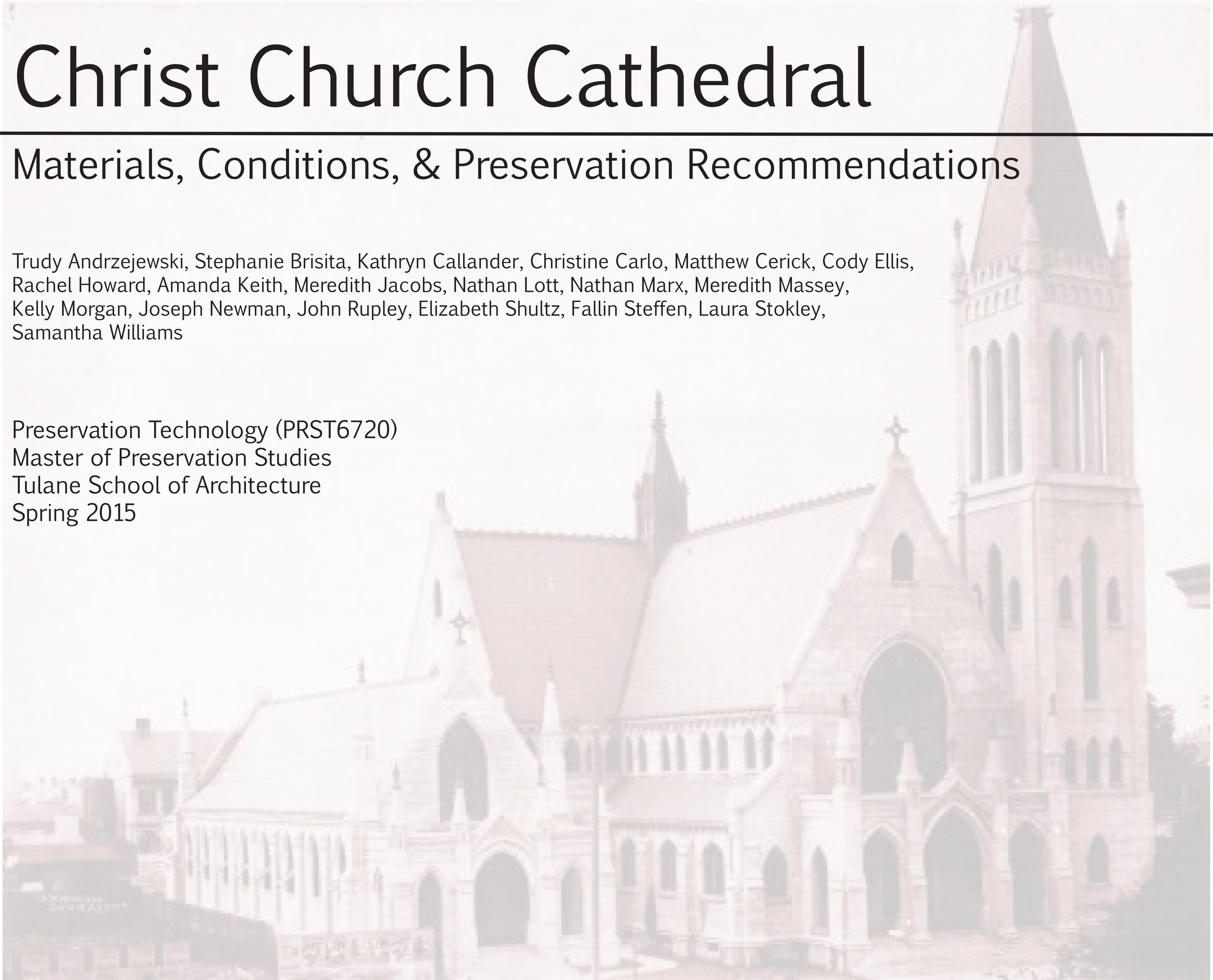

Christ Church Cathedral

Materials, Conditions, & Preservation Recommendations

Trudy Andrzejewski, Stephanie Brisita, Kathryn Callander, Christine Carlo, Matthew Cerick, Cody Ellis,
Rachel Howard, Amanda Keith, Meredith Jacobs, Nathan Lott, Nathan Marx, Meredith Massey,
Kelly Morgan, Joseph Newman, John Rupley, Elizabeth Shultz, Fallin Steffen, Laura Stokley,
Samantha Williams

Preservation Technology (PRST6720)
Master of Preservation Studies
Tulane School of Architecture
Spring 2015

One the Cover: ***Christ Church Cathedral and J.L. Harris Memorial Chapel.*** Circa 1890. Thomas Sully Office Records, Southeastern Architectural Archive, Special Collections Division, Tulane University Libraries.

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Preface

The goal of this project was to advance the preservation of Christ Church Cathedral and give Tulane School of Architecture Master of Preservation students the opportunity to learn and apply documentation, assessment, research, and reporting skills in a real life setting. The Master of Preservation Studies program was contacted by David O'Leary, Chairman of the Christ Church Cathedral Property Committee in August of 2014 regarding the potential of student participation in the ongoing preservation efforts at the property. Since March of 2014, restoration consultant Robert "Dimitri" Roby had been studying the preservation issues at Christ Church Cathedral and providing the Property Committee regular reports on his findings and recommendations. Mr. Roby had identified many of the key issues of deterioration at the property and had begun incremental changes to improve conditions. He and Mr. O'Leary reached out to the MPS program to augment this work. When the student project began in January of 2015, Mr. Roby graciously shared all of the materials, findings, and knowledge of the buildings he had collected.

The Preservation Technology course of the Tulane School of Architecture Master in Preservation Studies program provides an overview of preservation technology and building materials conservation. It focuses on the properties and performance of historic building materials and the basic methods that can be employed for their study, characterization, and treatment. The Christ Church Cathedral project was designed to compliment the other coursework through practical application. Based on the known history and conditions of the building and the curricular goals of the course, nine topics were chosen for focused student research: architectural history, masonry, roofing, decorative exterior appurtenances, drainage, landscape, environmental conditioning, and architectural finishes. One to four students were assigned to each topic depending upon its anticipated complexity. The scope of work called for students to thoroughly investigate their given topic such that they would not only fully understand the involved materials, pathologies, and treatment options themselves, but will be able to present and explain them to the building's community and stakeholders.

Over the course of the semester, students conducted site visits to Christ Church Cathedral to investigate their topics; performed archival research at repositories such as the Southeastern Architectural Archive and the Louisiana Research Collection, Special Collections, Tulane University Libraries; and referenced technical materials, case studies, and contacted experts to make informed assessments and recommendations. This report presents their historical research, conditions assessments, and preservation recommendations. It is intended to serve as a permanent record of the property's conditions in the Spring of 2015 and as a preservation planning tool for the future of Christ Church Cathedral.

-Laura Ewen Blokker
Instructor, PRST6720

Acknowledgments

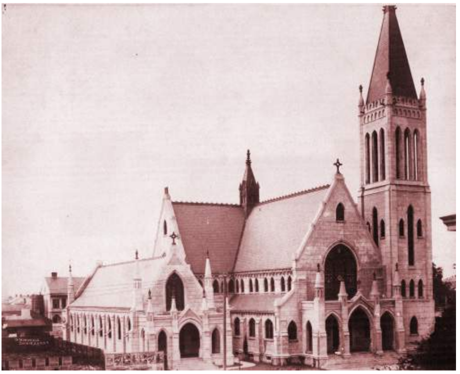
The successful completion of this project would not have been possible without the gracious assistance of Christ Church Cathedral Parish Secretary, Suzette Follette; the Reverend Canon Steven M. Roberts; Property Committee Chairman, David O'Leary; and Robert "Dimitri" Roby of Chymist Company. Each facilitated building visits and shared their understanding of the building's history and individual elements to the benefit of this report.

Building Timeline

June 1886
Cornerstone
laid

April 10, 1887
Daily Picayune proclaims
“The Beautiful House of
God to be Opened
Today”

June 6, 1889
Harris Memorial Chapel
“A Beautiful Addition to
Christ Church”
consecrated



Christ Church Cathedral and J.L. Harris Memorial Chapel. Circa 1890. Thomas Sully Office Records, Southeastern Architectural Archive, Special Collections Division, Tulane University Libraries.

November 3, 1889
Daily Picayune devotes
ten paragraphs to
description of new interior
decorative finishes

Undated image showing the decorative scheme that was executed in 1889. C. Bennette Moore, photographer. Christ Church Cathedral. Interior. Undated. New Orleans Churches, Southeastern Architectural Archive, Special Collections Division, Tulane University Libraries.

CHURCHES SUFFER HEAVILY FROM FURY OF STORM

Scarcely a Single House of Worship Escapes Damage. Several Must Be Rebuilt.

September 1915
Christ Church is one of many churches across New
Orleans to lose its spire in to the Great Storm of 1915.

Christ Church after the loss of its spire in the Great Storm of 1915. Collection of Christ Church Cathedral.

Construction underway on new cloister between chapel and parish house. c. 1959. Collection of Christ Church Cathedral.

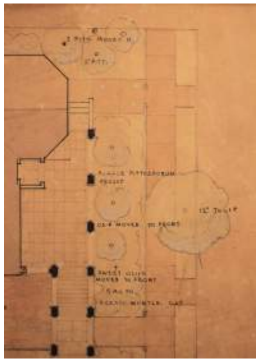
1966-67

A major repair and redecorating campaign prompted by the damages of Hurricane Betsy is completed. Work included closure of the roof at the location of the fleche and rearranging of ridge tiles as seen in progress above.

THE TIMES-PICAYUNE, NEW ORLEANS, LA., SATURDAY MORNING, NOVEMBER 11, 1967

Eucharist and Loyalty Dinner Planned Friday

Bishop Stuart will be the celebrant of the Anniversary Eucharist to be offered in the newly restored and redecorated Cathedral building. Some $172,000 was spent during a two-year period to rehabilitate the Cathedral following damages inflicted by Hurricane Betsy, the



Section of Koch and Wiedorn garden plan. 1942. Collection of Christ Church Cathedral.

1959

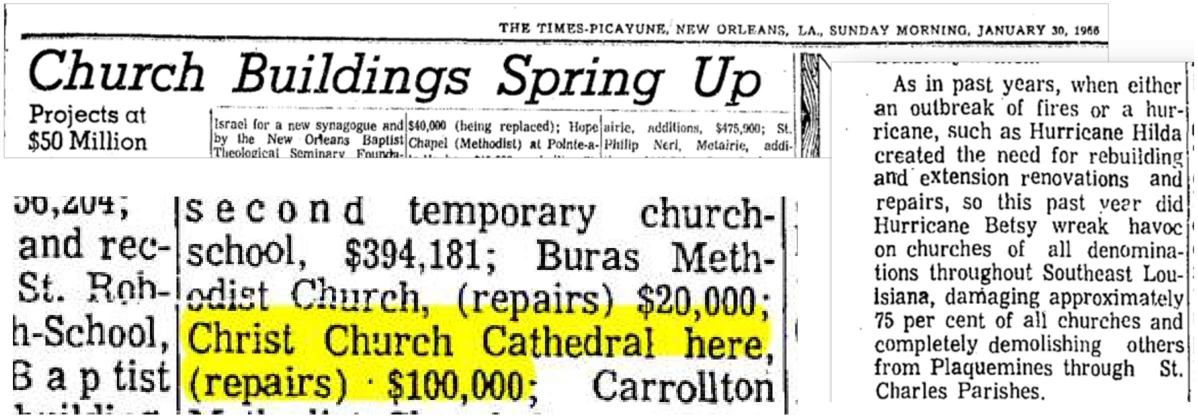
The Christ Church Cathedral site is substantially changed with the addition of a new Parish House by the firm of Freret and Wolf. The new construction includes offices, nurseries, a library, Sunday school rooms and paved courtyards and replaces earlier buildings

1940s-1950s

Several projects are executed by Richard Koch including remodeling of the chapel with a new reredos featuring carvings by Enrique Alferez; alterations to the sacristy; and a new garden plan prepared in collaboration with landscape architect, William S. Wiedorn.

September 1965

Hurricane Betsy causes extensive building damages across region.



THE TIMES-PICAYUNE, NEW ORLEANS, LA., SUNDAY MORNING, JANUARY 30, 1966

Church Buildings Spring Up

Projects at $50 Million

second temporary church-school, $394,181; Buras Methodist Church, (repairs) $20,000; Christ Church Cathedral here, (repairs) $100,000; Carrollton

As in past years, when either an outbreak of fires or a hurricane, such as Hurricane Hilda created the need for rebuilding and extension renovations and repairs, so this past year did Hurricane Betsy wreak havoc on churches of all denominations throughout Southeast Louisiana, damaging approximately 75 per cent of all churches and completely demolishing others from Plaquemines through St. Charles Parishes.

Architectural History

Nathan Marx

Figure 1.1: Chacoal Perspective by Feret & Wolf in 1959. Courtesy of Southeast Architectural Archives.

Introduction

Christ Church Cathedral is the earliest non-Catholic Church founded in the entire Louisiana Purchase territory. The church has undergone transformations in both location and architectural style as the congregation has evolved within the city of New Orleans. Between 1816 and 1886 the congregation progressed through four distinct church buildings. Each reflected the changing taste, culture, and attitudes of the congregation of Christ Church Cathedral and spoke of the changes that occurred within the city of New Orleans and United States over time.

The First Christ Church:

The origins of the first Christ church building began on April 30, 1805 when a notice by the Louisiana Gazette proposed an alternative to the Roman Catholic Church, which led to the creation of Christ Church. The site of Christ Church was bought at, "two contiguous lots facing Canal Street (at Bourbon)."[1] The architect who designed the first Christ Church building was Henry Latrobe. Henry Sellon Latrobe was the son of the prominent English architect, Henry Benjamin Latrobe. Plans for the first Christ Church building began in 1815 and would be completed soon after in 1816. Although no records, plans or images exist of the building, it was described as "a plain octagon without any architectural merit of design or execution; but at the same time it has no offensive features."[2] The first Christ Church building was demolished in 1835 and replaced with a new building at the same location for the rapidly growing congregation.

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1 New Orleans Public Library, Records of the City Council, April 22, 1815.

2 Samuel Wilson, Jr., ed., Impressions Respecting New Orleans by Benjamin Henry Boneval Latrobe (New York, 1951), xii, xv; idem, "New Orleans Houses," New Orleans States, April 11, 1953.

The Second Christ Church:

The second Christ Church building began in 1835 and was completed in 1837 by the influential architectural firm of Gallier & Dakin: James Gallier Sr. and Charles B. Dakin. The second Christ Church building was built in the then popular Greek Revival architectural style. The building was described as "a fine Ionic building... the form of the ceiling, being a very flat dome, is much admired."[3] By 1840, the new rector of the second Christ Church, The Reverend Francis Lister Hawks, desired a church "that looked more like a Christian church than a Greek temple."[4] As a result of the growth of the congregation and changing taste in architectural style, the second Christ Church building and land were sold in 1840 and the building subsequently demolished between 1850 and 1856.

The Third Christ Church:

The third Christ Church building began in 1846 and was completed in 1848 by the English architect Thomas Kelah Wharton who had arrived in New Orleans with The Reverend Francis Lister Hawks. James Gallier Sr., who had designed the second Christ Church, was involved in the construction of the building. The location of the third Christ Church building was located at the intersection of Canal and Dauphine Street. The third Christ Church building was drastically different architecturally than the second Christ Church building, being in the Gothic Revival architectural style. In 1884 the congregation wanted to move uptown and sold the church building and land.

The Fourth Christ Church

The fourth Christ Church is the present building used by the congregation. The building began in 1886 and was completed in 1887 by the well-known architect, Lawrence B. Valk with the local builder Thomas O' Neal. The location of the fourth Christ Church building is at the intersection of St. Charles Avenue and Sixth Street in the Garden District. The building was designed in the popular Gothic Revival architectural style. Over time, the fourth Christ Church would add a chapel, parish house and rectory building, after recognition as a Cathedral in 1891. A 1940 alteration to the chapel and a large addition in 1959 emulated the architectural style of Gothic Revival. Today Christ Church Cathedral continues to serve the community of New Orleans and nation with a congregation of eight hundred people.

Christ Church Cathedral: Location


Figure 1.2: Photograph of Christ Church after completion. Courtesy of Louisiana State Museum

The location of Christ Church Cathedral at the intersection of St. Charles Avenue and Sixth Street in the Garden District of New Orleans, displayed an important social and cultural shift that took place within the city during the 19th century. During the early to mid 19th century, "the city was legally divided into three separate municipalities (the original French/Spanish city was the First Municipality, the newer "American" section was the Second, and the area to the east of the "old city" was the Third)."[5] Although these three separate municipalities would be unified in 1852; the Francophile section of town that included the Vieux Carré and its expansive Esplanade Avenue, and the Anglophile section of town which included everything 'upriver' from Canal Street and its extensive St. Charles Avenue would remain distinctly separate spheres of influence in regards to society and culture.

Many Americans lived in the so-called 'Anglophile' sector of the city around the time that Christ Church Cathedral was constructed in the Garden District. In 1884, two years before the construction of Christ Church Cathedral, The World's Fair Exhibition of The Cotton Centennial was held in the Uptown section of the city, which exposed many to the large mansions, gardens, and benefits that early suburbanization could offer. Throughout the mid to late 19th century St. Charles Avenue was the favored location for the construction of large mansions for wealthy American merchant families. An important distinction of the area surrounding Christ Church Cathedral on St. Charles Avenue and Sixth Street is that it is directly along the St. Charles Streetcar Line, which had begun in 1835. The proximity near the streetcar allowed for congregation members to easily attend the church. The location of Christ Church Cathedral neighboring the large mansions of the wealthy on St. Charles Avenue displayed the importance Christ Church held within the community as well as spoke of the congregation member's social standing. Today Christ Church Cathedral is a contributing part of the New Orleans Garden District Historic District, which is listed on the

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[3] Gibson's Guide and Directory of Louisiana, New Orleans and Lafayette (New Orleans, 1838), p. 310.

[4] Wilson, Samuel. The Buildings of Christ Church. New Orleans, Louisiana: Louisiana Landmarks Society, 1997, p. 29.

[5] "Guide to Early (1760-1861) Records: Introduction." City Archives New Orleans Public Library. http://nutrias.org/~nopl/inv/neh/nehintro.htm.

National Register of Historic Places. It is also part of the St. Charles Avenue Historic District.[6] This district, which "encompasses all properties fronting on St. Charles Avenue between Jackson Avenue and Jena Street,"[7] is a full-control district[8] under the jurisdiction of the New Orleans Historic District Landmarks Commission.[9] Its status as a full-control local historic district means that the preservation professionals of the city government's Historic District Landmarks Commission[10] are mandated to review all proposed work done to the exteriors of the buildings contained therein and issue certificates of appropriateness for exterior work done to any of the structures that exist within the district.[11]

Figure 1.3: Map of New Orleans with The Garden District higlighted. Provided by ArcGIS

Episcopalian Church Architecture & Gothic Revival

The architectural change in style exhibited by Christ Church over its long history, reveals an insight into the city of New Orleans and the United States during the 19th century. The architectural style of the third and fourth Christ Church buildings, completed in the Gothic Revival style, differ heavily from the second Christ Church building, completed in the Greek Revival style. The transformation in architectural style from Greek Revival to Gothic Revival at Christ Church Cathedral, reveals the changing nature of Protestant Episcopalian thought and philosophies during the 19th century, which became symbolically and culturally linked to the construction of religious buildings in England and the United States.

Origins of Gothic Revival Architecture

Gothic Revival architecture has its roots "in the form of English Gothic architecture, with its preference for the English medieval parish church as a model for ecclesiastical architecture."[12] Pointed arches, vaulted roofs, buttresses, large windows and spires define the style. English Gothic architecture can be categorized into three distinct periods, which express the progression the style held over time. These periods are: Early English (c.1180-1275), Decorated (c.1275-1380), and Perpendicular (c.1380-1520). The Early English period is defined by a Romanesque inspiration with Gothic pointed arches. The Decorated period is defined by its complicated window tracery and either has a geometric or curvilinear form to the decorative components on church buildings. Lastly the Perpendicular period is characterized by an emphasis on vertical lines and rigidity.[13] These three periods of English Gothic architecture form the basis for Gothic Revival in England and the United States during the mid to late 19th century. The renewed interest in English Gothic architecture during the early 19th century began with two important movements in theology and architecture known as The Oxford Movement and The Cambridge Camden Society, which heavily influenced church design throughout the century.

The Oxford Movement & The Cambridge Camden Society

The Oxford Movement and The Cambridge Camden Society held profound impacts on the diffusion of knowledge and popularity of Gothic Revival architecture in England and the United States. The Oxford Movement was, "the largest and most important contemporary counterpart of the parish church revival in England."[14] The movement began in 1833 at Oxford University in England and developed into a philosophical belief for the re-installment of older Christian traditions of faith into Anglican liturgy and theology. The individuals associated with the movement were known as 'tractarians' after a series of publications titled The Tracts for the Times, published form 1833 to 1841. The publication by

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[6] Dominique M. Hawkins of Preservation Design Partnership, LLC for the New Orleans Historic District Landmarks Commission, "St. Charles Avenue Historic District," The City of New Orleans, Louisiana (2011), 1. Online access provided by the City of New Orleans via http://www.nola.gov/nola/media/HDLC/Historic%20Districts/St-Charles.pdf.

[7] Hawkins, "St. Charles Avenue Historic District," 1.

[8] Louisiana State Division of Cultural Resources, "New Orleans, LA Local Historic Districts," http://www.crt.state.la.us/Assets/OCD/hp/nationalregister/NOLAdistricts/NRHP_Districts_WallMap_20121005.pdf

[9] The City of New Orleans, LA, "Historic District Landmarks Commission," http://www.nola.gov/hdlc/.

[10] Ibid.

[11] Ibid.

[12] Stanton, Phoebe B. The Gothic Revival & American Church Architecture; an Episode in Taste, 1840-1856. Baltimore, MD: Johns Hopkins Press, 1968, p. xvii.

[13] Sharpe, Edmund. The Seven Periods of English Architecture Defined and Illustrated. 2nd ed. London, England: E. & F.N. Spon, 1871.

[14] Stanton, Phoebe B. The Gothic Revival & American Church Architecture; an Episode in Taste, 1840-1856. Baltimore, MD: Johns Hopkins Press, 1968, p. Xix.

The Oxford Movement, "stressed the elements of tradition and continuity in the Church, its 'Catholic past' in the Middle Ages."[15] While the Oxford Movement was underway, The Cambridge Camden Society was formed in 1839, at Cambridge University in England. The society was formed by students who wished to pursue the promotion and study of English Gothic architecture and antiquities from the Middle Ages. The society published a monthly journal, The Ecclesiologist, which advised church architects and advocated a medieval style for church architecture in England. The Cambridge Camden Society believed that the corruption and viciousness of the 19th century could be escaped by recapturing the piety and magnificence of the Middle Ages. At its height The Cambridge Camden Society had over 700 members, many of whom were bishops in the Church of England and Members of Parliament. The Oxford Movement and the Cambridge Camden Society melded Anglican and Episcopalian theological philosophies with a renewed interest in English Gothic architecture in England and The United States throughout the 19th century.

The United States and Gothic Revival Architecture

The United States since its English colonial past has held a long history with English Gothic architecture, which mimicked the abbeys and churches of the famous English architects Christopher Wren and James Gibbs. When the Oxford Movement & The Cambridge Camden Society began in England, it advanced into a vast network that involved both Anglican and Episcopal Churches within the United States, which adhered to the theological philosophies and architectural styles of the movements. The United States during the 19th century received a constant stream of immigrant architects from England, which resulted in New York becoming the movement's epicenter and subsequent dispersal throughout the United States. Although:

> the Episcopal church- the American version of Anglicanism- represented an influential slice of the population, it was a tiny one. Nonetheless, although the United States was ultra-protestant, it was also profoundly middle class in its values, and quite conscious of the demands of status and appearance.[16]

The United States differed heavily in regards to religious denominations than England, comprising many diverse and opposing Protestant theologies and practices. Although Episcopalians are a minority within the United States in regards to religious denominations, the importance and mass appeal that Gothic Revival architecture held, helped spearhead the style nationwide. Gothic Revival architecture became entrenched in cultural and social normative displays during the 19th century, a factor highly considered by the American middle class of the time. In this manner, Gothic Revival architecture became the approved social architectural style for protestant churches, regardless of their individual theological philosophies. The melding between architectural style and theological philosophical beliefs is exemplified in Christ Church Cathedral, which displays the exemplary transference of architectural taste for Gothic Revival and an adherence to 'high church' principles which Christ Church implemented for their congregation with the fourth Christ Church building.


Figure 1.4: Photograph of Christ Church during the 1930s. Courtesy of The New Orleans Historic Collection.

Descriptions of the Fourth Christ Church

The fourth Christ Church was written about in the local newspaper, The Daily Picayune, which covered the construction and subsequent completion extensively. The importance placed by the local newspaper on reporting the fourth Christ Church building, displayed the significance the church held for the community and city of New Orleans. The Daily Picayune in June of 1886 described the building, which was under construction as a church that:

> will be built in the Gothic style of architecture, of brick, cemented, with trimmings of Indiana limestone, and will cost about $55,000 to $60,000, exclusive of the lot on which it is to stand. The brick will be done by Mr. WA. Jordan and the carpenters' work by Mr. Thomas O Neil. Major B.M. Harrod is superintending architect.[17]

Another local newspaper article from June of 1886, described the progress the church had made when it said that:

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[15] Dixon, Roger, and Stefan Muthesius. Victorian Architecture. New York, N.Y.: Oxford University Press, 1978, p. 193.

[16] Lewis, Michael J. The Gothic Revival. New York, N.Y.: Thames & Hudson, 2002, p. 97.

[17] "Christ Episcopal Church: Ceremony of Laying Cornerstone for the Oldest Protestant Church Organization in the City." The Daily Picayune, June 11, 1886.

> the rafters for the roof are being hoisted into position, and the side and end wall have all been raised. Some idea of the magnificence of this new church when completed can already be formed, and that it will be in every respect worthy of the fine site it occupies as well as of its wealthy congregation, there is not the least doubt."[18]

When the church was completed in April of 1887, the building was written about comprehensively:

> the church, cruciform in shape, consists of a nave, transepts, choir, and apses, or chancel…solidly constructed of brick, and covered on the exterior with stucco, it has the appearance of being built of gray stone. The style of architecture is the English Gothic, which combines elements of elegance, grace, and lightness with strength and durability. The exterior is symmetrical and the main entrance with its porch and finials, the long pointed windows and the arched doorways produce a pleasing effect on the spectator. There are three entrances, the first leading from St. Charles street through the porch into the vestibule, paved, as are the floors in other portions of the building, with encaustic tiles. The second entrance is through the tower of the steeple and the third through the porch of the north transept."[19]

The importance given in the description of the shape, materiality, and location for the fourth Christ Church reveals the congregations; taste, style, and theological beliefs which would have been understood by locals of New Orleans for their adherence to Gothic Revival architecture and prominent location within the city.

<u>The Architect, Lawrence B. Valk</u>

Lawrence B. Valk, the architect of the fourth Christ Church building was originally from New York, the center for Gothic Revival architectural design. During his long career he designed numerous churches and residences throughout the United States between 1859 and 1924. Valk's early designs were in the architectural style of Gothic Revival, later transitioning to the architectural style of Romanesque Revival, and then late in his career to the architectural style of the Arts and Crafts.

Between 1859 and 1890, Lawrence B. Valk, held an architectural firm in Manhattan, sharing an office in 1860 with the influential architect, Alexander Saeltzer. In 1885, Lawrence B. Valk made his son, Arthur Valk, junior partner, forming L.B. Valk & Son. After 1890 the firm moved to Brooklyn.[20]

Lawrence B. Valk was influentialprominent and well known for his church buildings, helping to populate a new church form, which he broadly advertised and ultimately published in an 1873 book titled, The New Form of Plan for Churches. The new church form that Valk helped populate was a semi-circular apse where the preacher would speak from the pulpit, creating a functional amphitheater for sermons. The new church form spearheaded by Valk would come to dominate Protestant ecclesiastical architecture in the United States for the next two generations.[21] Although Valk helped spur the movement for the usage of the 'New Church Plan', Christ Church Cathedral employs the traditional cruciform plan with a nave, crossing, trancepts, and chancel with even spacing for the pews. The possible reasoning the congregation did not employ the 'New Church Plan' could be that the congregation wanted to adhere to a more traditional example of Gothic Revival architecture and theological philosophical beliefs. Episcoplian church's did not utilize the 'New Church Plan', a design that was more used by other Protestant denominations. Other books that Lawrence B. Valk, wrote were: Church Architecture: General description of some of the most prominent buildings recently erected in iron, brick and stone, together with full explanation of the new form of plan for churches in 1873 and Architecture for the Country: Valk's Cottages and Villas in 1869. These books were widely distributed throughout the United States during the 19th century. Valk described his personal beliefs on the problems of church design in Church Architecture when he said:

> We see around us what may be called dead churches, with no working power in them, simply because the form of the building itself is more at fault than anything else. Some are dark, dismal and gloomy, some over-loaded with ornament and stained glass, high peak roofs supported by columns obstructing the view of chancel or platform, and the main essential, the comfort of the audience, entirely lost sight of [22]

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[18] "Work Progress's on Christ Episcopal Church." The Daily Picayune, September 1, 1886.

[19] "Christ Church: The Oldest Protestant Congregation Organized in this City. Interesting Review of its History." The Daily Picayune, April 10, 1887.

[20] "Architects of Colorado: Biographical Sketch: Valk, L.B. & Son." Office of Archaeology and Historic Preservation: Colorado Historical Society. October 28, 2006. http://www.historycolorado.org/sites/default/files/files/OAHP/Guides/Architects_valk.pdf.

[21] Jaeger, Robert. "A Biographical Dictionary of Architects in Maine: Lawrence B. Valk 1838-1924." Maine Historic Preservation Commission 5, no. 20 (1988).

[22] Lawrence B. Valk, Church Architecture: General Description of Some of the Most Prominent Buildings Recently Erected in Iron, Brick and Stone, Together Will Full Explanation of the New Form of Plan for Churches, New York, 1873, p. 3.

Lawrence B. Valk believed that church design first and foremost should adhere to the comfort of congregation members. Valk elaborated on his philosophical beliefs in Church Architecture when said "churches are built for the salvation of souls, not for architectural display to the sacrifice of comfort, of acoustic, lacking in cheerfulness, and the very essentials to make religious worship a matter of pleasure."[23] An important factor in Valk's designs for church architecture was the significance that acoustics played for sermons and congregation members. In relation to the design of Gothic Revival architecture, Valk wrote that buildings should be:

> with simple inexpensive details, without elaborate carvings or useless architectural forms or ornaments; every effort having been made to produce the greatest utility and economy, combined with beauty to the exterior and most particularly the interior, to obtain every comfort of seeing and hearing, and to make the audience rooms as churchlike as possible[24]

Valk did not believe that superfluous decorative elements should take precedent over the religious sermons that congregation members came for. The important design considerations by Valk of in regards to comfort and, acoustics are evident in Christ Church Cathedral, however the church differs in Valk's design considerations in the cathedrals interior space. The interior of the cathedral has a high peak roof supported by a series of elaborately carved and clustered columns, elements seen by Valk to be superfluous. Throughout Valk's career, he was written about extensively in architectural periodicals and newspapers, which hailed his church designs, in regards to being economically practical. One such comment was that:

> No architect stands higher than he in Congregational circles, and his great ingenuity, his philosophical comprehension of the chief needs to be met, and the eminently practical character of his mind, commend him, his design and suggestions to the confidence, especially of those i in moderate circumstances, who desire the best church building for the least possible money[25]

The economic resourcefulness of Valk's church designs mixed with his prestige and knowledge of Gothic Revival architecture were probable strong considerations for gaining the commission for the fourth Christ Church building. During the construction of the fourth Christ Church, Valk had a budget between $55,000 to $60,000 and to save on the high cost of expensive materials, utilized brick covered in stucco for the exterior, which gave the illusion of expensive gray stone. Christ Church Cathedral is a prime example of the beliefs that Lawrence B. Valk held in regards to church design and Gothic Revival style. Some other important churches designed by Valk include: The Church of the Disciples on Madison Avenue in New York, which was the congregation of Ulysses S. Grant, and the Park Avenue Methodist Church in Philadelphia, Pennsylvania, which had a similar ventilation cupola and tower to Christ Church Cathedral. A list of numerous other works by Lawrence B. Valk in the Gothic Revival style are:

First Presbyterian Church (Canton, NY - 1876)
Ossining Methodist Church (Ossining, NY- 1877)
Second Presbyterian Church (Paterson, NJ - 1877)- Similar tower but without spire
Congregational Church (Groton, NY- 1883)
Presbyterian Church (Flint, Ml - 1885)
First Presbyterian Church (Hastings, NE - 1888)
Congregational Church of Patchogue (Patchogue, NY - 1893)
St. Paul's Episcopal Church (Watertown, NY - date unknown)
Congregational Church (Germantown, PA-date unknown)
St. Johns Episcopal Church (Baltimore, MD - date unknown)

Although, all of the listed church designs are in the Gothic Revival architectural style by Lawrence B. Valk and share similarities such as towers, steeples, and use of segmented arches, they are each individually constructed with an understanding of the specific congregation needs as well as budgetary restrictions taken into account. Furthermore, the wide array of Protestant religious denominations and numerous locations across the United States displayed in the list, exhibits the full acceptance of the Gothic Revival architectural style within the United States during the 19th century.

The Builder, Thomas O'Neal

Thomas O'Neal was the builder of the fourth Christ Church building. O'Neal was a prominent builder within the city of New Orleans, helping to construct numerous buildings across the city. He arrived in the city of New Orleans from Ireland in 1849 and quickly became a foreman. In 1853 he created a business for himself as a builder and general contractor, becoming one of the largest contrac-

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[23] Ibid.

[24] The Year Book of the Congregational Christian Churches of the United States by General Council of the Congregational and Christian Church's of the United States. 1898. p. 28.

[25] Ibid. 22.

tors within the city.[26] Some of the buildings that involved Thomas O' Neal were:

St. Joseph Church- 1869-1884
St. Stephen Catholic Church in 1871-1877
The Morris Building (Cigali Building)- late 1880s
The Produce Exchange Building- 1887-1890
The Newman Residence- 1892- Destroyed

The buildings listed above that involved Thomas O' Neal are diverse in scope, ranging from residential to commercial to religious, which exemplifies the economic boom of the late 19th century in New Orleans. The two church buildings, St. Josephs Church and St. Stephen Catholic Church are quite different than Christ Church Cathedral. Both church buildings are built of brick and do not have a cruciform plan. Of the two, St. Stephen Catholic Church is more similar to Christ Church Cathedral in regards to having a large tower and steeple, however it is octagonal. The two church buildings reveal the diversity of ethnicities and cultures that permeated New Orleans in the late 19th century with St. Stephen Catholic Church being built for German immigrants and St. Josephs Church built for African Americans. The diversity of types of buildings and for differing clients displays the competence and recognition that Thomas O'Neal held within the city of New Orleans and probable reasoning for gaining the commission as builder of Christ Church Cathedral.

The Chapel, Parish House and Rectory Building

When Lawrence B. Valk began construction for the fourth Christ Church building in 1886, the congregation desired a chapel to be built adjacent to the cathedral. A lack of funds postponed the construction of a chapel until 1888, which was swiftly completed in 1889. The funds for the completion of the chapel, parish house, and rectory building were all erected in memorial to a local vestryman by the name of Joseph L. Harris who had passed away. The architect-builders of the chapel were Sully and Toledano, a local architectural firm.[27] The chapel was designed in the Gothic Revival style and was meant to compliment the designs of Lawrence B. Valk. The chapel, known officially as the Harris Memorial Chapel, has a more decorative element to its design,, incorporating a larger amount of evenly spaced pinnacles with terra cotta and a quatrefoil frieze and pediment. The chapel is similar to the design of Lawrence B. Valk in that it has pointed arches and tracery windows as well as brick over stucco giving it the appearance of stone. The interior of the chapel has "roof trusses which are of the old English hammer beam order with the beam ends finely carved and all of the weight of the roof plainly shown….the trusses which ascend to the sharp angled roof and although massive have an appearance of lightness and airiness as the trusses are of open work"[28] The roof trusses of the chapel are different to that of the Cathedral in their complicated and English inspired design. The altar of the chapel is highly carved and the pulpit is a copy of "that in the church-an eagle carved of the same wood used in the interior effects."[29] The detailed ornamentation within the chapel displays the influence of the architects Sully and Toledano, who although followed similar design elements of Valk's church, created their own interpretation of the space. Around the same time as the construction of the Chapel adjoining the fourth Christ Church building, a parish house was constructed next to the chapel. The architects of the parish house were Sully and Toledano who had designed the chapel. After the completion of the chapel and parish house in 1891, "Davis Sessums, was elevated to the episcopate, and became Bishop of Louisiana, garnering Christ Church the new title of Christ Church Cathedral."[30] A rectory was built soon after. The building was described as "a new brick and frame, slated rectory built back of the church, facing Sixth Street, for which Duval and Favorot were the builders."[31] The parish house and rectory building would remain unchanged until further additions were needed in 1959 for the growing congregation.

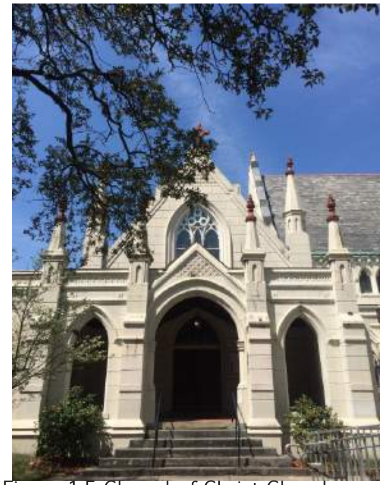
Figure 1.5 Chapel of Christ Church Cathedral today. Photo by Nat Marx,

The 1940's Alteration

In 1940, plans were made for the remodeling of Christ Church Cathedral's chapel interior, whereby:

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[26] Biographical and Historical Memoirs of Louisiana; Embracing an Authentic and Comprehensive Account of the Chief Events in the History of the State, a Special Sketch of Every Parish and a Record of the Lives of Many of the Most Worthy and Illustrious Families and Individuals ... Vol. 1. New Orleans, LA: Goodspeed Pub. 292, 1892.

[27] Wilson, Samuel. The Buildings of Christ Church. New Orleans, Louisiana: Louisiana Landmarks Society, 1997, p, 50.

[28] "Harris Chapel: A Beautiful Addition to Christ Church." The Daily Picayune, June, 7, 1889.

[29] Ibid.

[30] Ibid. 50.

[31] "Christ Church Chapel Addition." The Daily Picayune, September 1, 1892.

> The interior length of the chapel was reduced by one, and a new paneled wall with an elaborately carved coved cornice, a gilded carved wood triptych, and an extended altar were erected."[32]

The architect for the alteration was Richard Koch while the woodwork was completed by cabinetmaker, Morris Broverman and the sculpture completed by the influential artist Enrique Alferez. The alterations were done in the Gothic Revival style. The highly decorated woodwork and detailing of the 1940 alteration are quite different than that of the original interior design by Sully & Toledano and that of Valk's designs for the cathedral which Lawrence B. Valk did not favor such ornament.The additional adornment within the chapel displays a changing cultural taste in interiors over time, the influence of Dean Nes had with high church principals and the importance of large commemorative memorials within a community and city.

Figure 1.6 Interior view of Christ Chuch Chapel. Taken by Joseph Newman, 2015.

<u>1959 Addition to Christ Church Cathedral</u>

In the 1950s, extensive plans were begun for the development of Christ Church Cathedral's properties including the parish house and rectory building. The plans were developed to support a need for the growing congregation and its functions. The architectural firm of Freret and Wolf implemented the project. The plans, completed in 1959, demolished the parish house and rectory building but built a "new two-story building facing Saint Charles and the arcade connecting it to the porch of the chapel, enclosing the attractive cloister garden"[33] The new building adjoined the chapel and created an enclosed cloister garden between the 1959 addition and the chapel. The building was completed in the Gothic Revival architectural style and compliments the designs of Lawrence B. Valk and Sully and Toledano. According to the local newspaper

> The construction will represent the first phase of a three part-building program at the cathedral. Phase two will be the erection of a building on Sixth to contain a parish hall with a seating capacity of 300 and kitchen facilities and will include a parlor for accommodating smaller groups. Phase three will provide a number of renovations and improvements to the cathedral proper.[34]

According to the Feret & Wolf plans, the addition on the first floor facing St. Charles Avenue added a foyer, a cloister to connect to the chapel, a secretary, library, a dean and canons office, a wet and dry nursery, two workrooms and restrooms. The second floor added seven classrooms and restrooms. The attic space held the mechanical equipment. The first floor continued toward the rear of the cathedral through a cloister-enclosed courtyard in the back of the ambulatory. This space contained a kindergarten classroom, kitchen, parlor, A.C. equipment room, laundry, storage space, and restrooms. Connecting these rooms is a corridor, which leads to the parish hall. The diversity of specified room uses and overall expansion of the original cathedral and chapel displays the important and widespread scope of importance that Christ Church Cathedral held for both the congregation and community of New Orleans during the mid 20th century.

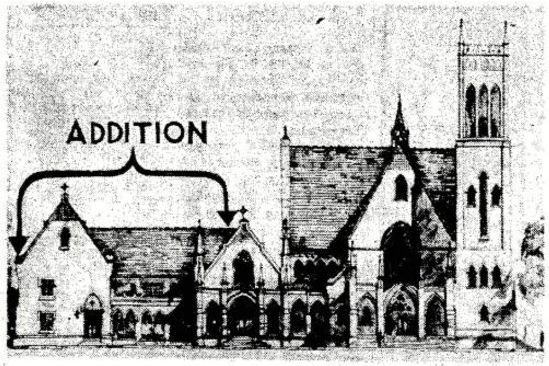

Figure 1.7 Newspaper clipping of additon to Christ Church Cathedral by Freret & Wolf in 1960. Provided by The Times Picayune.

The 1959 addition is complimentary but also different than the cathedral and chapel. The addition, which faces St. Charles Avenue, uses the customary Gothic Revival form of pointed arches for the doorway and a tracery stained glass window for the facade. The building was built of stucco over brick, giving the appearance of stone, which is consistent with the cathedral and chapel as a whole. The addition is different than the chapel and the cathedral due to the utilization

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[32] Wilson, Samuel. The Buildings of Christ Church. New Orleans, Louisiana: Louisiana Landmarks Society, 1997, p, 50.

[33] Ibid. 52

[34] "Christ Church Cathedral Announces Building Plans." The Times Picayune, March 3, 1960.

of two simple, square, non-arched windows for the St. Charles façade which are different than any windows on the site. The addition also features cast concrete copings and ornamentation such as buttresses and corbels. . However, there is a rhythm and symmetry to all three structures as a whole: cathedral, chapel, and 1959 addition. The buildings, which are parallel to one another, display the changing architectural tastes in style and ornamentation while creating consistency with each other. The 1959 addition displays a modern interpretation of Gothic Revival architecture while complimenting the adjoining buildings at Christ Church Cathedral.

Figure 1.8: 1959 Addition from St. Charles Ave. Photo by Nat Marx, 2015.

Conclusion

Christ Church Cathedral, the earliest non-Catholic Church founded in the Louisiana Purchase territory has evolved and grown with the community and city of New Orleans over its long history. Since the congregation's inception in 1816, Christ Church Cathedral has gone through four distinct church buildings, which reveal the changing attitudes and tastes within the city. These transitions are displayed in the architecture of the buildings built by Christ Church. The fourth Christ Church building, located in the Garden District and designed by Lawrence B. Valk, display the importance that location and architectural style held during the 19th century for church designs. Christ Church Cathedral is an important architectural and religious building within the city of New Orleans. Over its 129-year history (1886-2015), the building has played an integral part within the community. Christ Church Cathedral is significant as the only surviving churches within the Garden District from the late 19th century and as one of the only Episcopalian church within the district. Nearby Trinity Episcopal Church in the Lower Garden District is similar in architectural style, materiality, and denomination however the church does not have the monumental tower or adjoining buildings such as the chapel and 1959 addition. The chapel and the 1956 addition further display the changes over time that occurred for both Christ Church Cathedral but also the changing dynamics of the city of New Orleans. Today Christ Church Cathedral has become a landmark for both locals and tourists alike, which will continue into the future.

Masonry

Stephanie Brisita, Matthew Cerick, John Rupley

Figure 2.1: View of Column Base on Sixth Street Side of Cathedral. Photo By Matthew Cerick 2015.

Introduction

The primary material forming the exterior walls and foundation piers of Christ Church Cathedral is masonry. According to a Times Picayune article, the church was originally going to be built of stone, but due to financial constraints it was instead built with brick covered in stucco scored to look like stone. The walls are one to two feet thick. Through examination it can be stated that some bricks were laid in a header course while others were laid in the stretcher bond just beneath the stucco. The cornerstone of Christ Church Cathedral was laid on June 10, 1886 with the brickwork completed by Mr. W. A. Jordan, builder of New Orleans. The church was completed in March-April 1887. [1] Payment for construction of the church can be found in receipts dating back to just after the church's construction. A receipt of payment for putting down the cornerstone is made out to F. Jahncke on February 18, 1888. Another receipt dated in the fall of 1887 talks about how Mr. Jahncke cut concrete and put asphalt around. The construction of the chapel had also started at the same time, but was not completed until 1889. The steps leading to the vestibule of the chapel were made of stone.[2]

Maintenance of the church was under the care of Norris Bell; receipts of payment dating from 1888 shows that he has been performing sexton

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[1] Daily Picayune, June 11, 1886.

[2] Ibid; Episcopal Diocese of Louisiana records, 1805-1998, Collection 558, Louisiana Research Collection, Tulane University, New Orleans, La; Daily Picayune, June 6, 1889.

services for the church for years until his death in November of 1903.[3] A receipt dated May 19th 1888 indicated that F. Jahncke had been hired to redress the steps to the church as well as pave the sidewalk. Repairing was also done on the cementing on the outside of the church by Theodore Janiszewski, a painter. He was paid for labor and materials. His business performed house, sign, and ornamental painting including kalsomining, graining, and glazing. [4]


Figure 2.2: View of Header Course in Sixth Street Portico. Photo By Stephanie Brisita 2015.

A receipt dated August 27, 1888 shows that 2 liters of muriatic acid was being used at the time for maintenance as well.[5] According to a volume of Engineering and Contracting from 1910, sandblasting as well as the use of muriatic acid would be the preferable method of cleaning stucco. It is recommended that one part acid is diluted in four to five parts water.[6] In 2000, the National Park Service recommended that "acids, particularly hydrochloric (muriatic) acid, which is very powerful, should not be used on historic masonry, because it can dissolve lime-based mortar, damage brick and some stones, and leave chloride deposits on the masonry."[7] Over time the continued use of muriatic acid on the building would eventually strip the stucco layer by layer. As suggested in Engineering and Contracting, the acid would be used for cleaning smaller areas while sandblasting would be used for larger areas.[8] The humidity and amount of rainfall in New Orleans receives yearly is enough to constantly be creating water stains and biological growth on the building. Because it would take time for staining to grow exponentially sandblasting would probably have not been used too often, but the abrasive effects of sandblasting stucco are powerful enough that doing so a few times a year would strip the stucco as much as the muriatic acid. Today the National Park Service also does not recommend the use of sandblasting because it causes the surface to deteriorate faster.[9] Because sandblasting and muriatic acid still exist today and are even recommended by many, it is possible that both methods may have been used occasionally, if not often to clean the church throughout its history.

Other repairs were done throughout the years. A receipt dated in February 1st 1889 is made out to Bulger and Breidy, a company specializing in plumbing, for repairing brickwork of heated furnace in September of the prior year. Another receipt dated on February 9th 1889 is made out to Mr. Henry H. Hill for repairing brickwork in the basement of the church.[10] In 1915, a hurricane hit the city and removed the spire from atop the tower.[11] It is possible that the hurricane could have knocked the spire onto the cathedral or chapel. Though water entered the tower during the hurricane, evidence of water damage today is not apparent.

As early as 1896, the church is described as being covered in vines. It was something common among church architecture in New Orleans was considered aesthetically beautifully. Receipts dating back to 1912 and

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[3] Ibid; Ancestry.com. New Orleans, Louisiana, Death Records Index, 1804-1949 [database on-line]. Provo, UT, USA: Ancestry.com Operations Inc, 2002.

[4] Episcopal Diocese of Louisiana records, 1805-1998, Collection 558, Louisiana Research Collection, Tulane University, New Orleans, La.

[5] Ibid.

[6] Moyer, Albert. "Methods of Stuccoing with Suggestions for Finishing and Coloring Stucco." Engineering and Contracting. Vol. 33, no. 25 (1910): 564. Accessed February 20, 2015. Google eBook.

[7] Mack, Robert C., and Anne E. Grimmer. "Preservation Brief 1: Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings." National Park Service. November 2000. Accessed February 20, 2015.

[8] Moyer, Albert. "Methods of Stuccoing with Suggestions for Finishing and Coloring Stucco." Engineering and Contracting. Vol. 33, no. 25 (1910): 564. Accessed February 20, 2015. Google eBook.

[9] United States. National Park Service. "The Secretary of the Interior's Standards for Rehabilitation & Illustrated Guidelines for Rehabilitating Historic Buildings-Masonry." National Park Service. Accessed February 20, 2015.

[10] Episcopal Diocese of Louisiana records, 1805-1998, Collection 558, Louisiana Research Collection, Tulane University, New Orleans, La.

[11] Wilson Jr., Samuel. "The Fourth Church." In The Buildings of Christ Church, 41-52. New Orleans, LA, 1992

1913 are made out to a few florists who on a monthly basis would trim and maintain the vines. This aesthetic trimming saved the entire building from being overgrown with vines, but as it is stated in American Architect and Architecture it clings to the building. [12] In order to do so it had to have penetrated the stucco in some way, causing cracking. According to the NCPTT, “vine growth can dislodge exterior features [and] heavy vine cover traps moisture against the building, accelerating decay of wood and masonry.”[13] A postcard dating to 1908 shows the growth pattern of the vine and it looks unmaintained at this time. Its growth covers parts of the chapel and had worked its way to the tower. Photos dating to the 1920s show the immense amount of vine growth between the chapel and cathedral. The masonry would have most likely retained the water it absorbed from ground, rain, and humidity.[14] In a photograph dating from 1972 a great amount of staining can be seen on the walls of the cathedral and chapel; it is possible that this staining is from biological growth that would have accumulated while the vines were still on the building. A photograph exists with Douglass V. Freret in front of the building where there were still vines attached to the church, most likely in the 1950s when the renovations were happening.[15] It appears that there was vine coverage on the cathedral and chapel for over half a century. The extent to which the vines may have caused damage to the stucco and underlying brickwork during this time is uncertain. Vines do not appear in images from the 1960s. It is plausible that any damage done to the cathedral and chapel when the vines were removed would have been repaired using contemporary methods of that era, most likely using similar materials were being used for the additions.

Figure 2.3: Photograph of Congregation Members with Vines on Cloister, 1920s. Episcopal Diocese of Louisiana records, 1805-1998, Collection 558, Louisiana Research Collection, Tulane University, New Orleans, La.

Figure 2.4: View of St. Charles Avenue elevation showing staining on the facade, 1972. Tulane School of Archicture, New Orleans Virtual Archive.

The method that was used to remove the vines is unknown. Supposing an herbicide was used, the amount of vines that existed on the building would have required a sizeable amount of herbicide. The height to which the vines grew would have made a mechanized way for spraying the herbicide easier to manage. According to Caitlin Oshida,

“Water and chemicals from herbicides applied to or near structures can enter the material through absorption (capillary effect) and spread throughout the material, causing deterioration from the inside-out. Most herbicides are salt based. When salt-based herbicides are applied, this can lead to salt crystallization (efflorescence) occurring on and within the material. Efflorescence development can increase deterioration of the material through its hydration cycle (the expansion and contraction within cracks as it becomes wet and liquefies then dries and solidifies) causing the cracks to widen.”[16]

If it was applied by pressure washer, not only would cracking have hap-

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[12] “Ecclesiastical Architecture in New Orleans--An Incident--The Battle Abbey--Tennessee Centennial.” American Architect and Architecture Vol. 52 (1896): 115. Accessed February 20, 2015 Google eBook; Episcopal Diocese of Louisiana records, 1805-1998, Collection 558, Louisiana Research Collection, Tulane University, New Orleans, La.

[13] Smith, Debbie. “Reestablishing Vines on Historic Buildings.” NCPTT. September 27, 2010. Accessed February 20, 2015. http://ncptt.nps.gov/blog/reestablishing-vines-on-historic-buildings/.

[14] Episcopal Diocese of Louisiana records, 1805-1998, Collection 558, Louisiana Research Collection, Tulane University, New Orleans, La; Christ Church, 1972. New Orleans Virtual Archive. Tulane School of Architecture. Tulane University, New Orleans, La.

[15] Episcopal Diocese of Louisiana records, 1805-1998, Collection 558, Louisiana Research Collection, Tulane University, New Orleans, La.

[16] Oshida, C. A. “THE EFFECT OF HERBICIDE ON STONE AND MASONRY MATERIAL”, The University of Georgia, 2011.

pened, but the abrasion caused by the pressure washer would have also stripped the stucco as well and pushed the herbicide further into the cracks created by the vegetation.

In the late 1950s the rest of the Cathedral complex was added to the site. Though the majority of the work focused on new additions to the site, the cathedral was said to be worked on in the final phase of the project. The vines wrapped the corner of the chapel and extended along the side façade. In order to attach the cloister to the chapel some vine removal was performed. In 1962 the ambulatory was added behind the chancel, turning an exterior wall into an interior one.[17] These historic repairs and maintenance patterns likely contribute to some of the conditions seen today.

CONTEMPORARY ISSUES

The administration of the church, around mid-1990 made the decision to cover the stucco in a coating touted at the time to be the end all product of protecting your historic building from moisture problems: elastomeric coatings. These coatings were originally developed as a waterproofing solution for stucco to prevent cracking and cover existing cracks. They are an exterior or interior coating that are offered in multiple resin chemistries, including acrylic and latex products, silicones, and polyurethanes.[18] Each of the elastomeric coatings mentioned above are marketed for stucco and offer varying levels of breathability and water proofing. Elastomeric coating is designed to protect concrete structures from carbonation and chloride ingress. It can be used as a U.V. stable waterproof coating for exterior finishes. It is easily applied by roller or brush in at least two coats and has a flexible capacity to fill and cover hairline cracks, while providing an even matte finish.[19] This coating was applied to the exterior stucco of the cathedral and chapel buildings. The elastomeric coating was applied in lieu of traditional paint, in the belief that the material would better protect the historic building from water intrusion. According to buildingconservation.com, perhaps the most common reason for the failure of stucco is neglect, largely associated with the failure of rainwater disposal systems, which in turn can lead to excessive water penetration and a breakdown of the stucco's surface.[20] To combat this problem elastomeric coating was applied as it goes on five to ten times thicker than traditional paints. [21] Elastomeric Coatings are applied at 10 to 20 mils per coat DFT (Dry Film Thickness) while traditional paints go on at 2-3 DFT.[22] This was also done in an attempt to seal the building for better insulation from an energy stand point as well. Knowledge at the time of the material being used on historic buildings was limited and speculative at best, however manufacturers promoted its low maintenance requirement and suggested that one would spend less over time. Unfortunately when this work was done at Christ Church Cathedral, a full understanding of how water interacts with historic masonry walls was not taken into account. The elastomeric coating which was relatively new had not seen any analysis of how it would perform over the years on such a building. The elastomeric coating at the time offered little to no breathability. Since then elastomeric coating companies state that they have reformulated their elastomeric coating formula to be able to allow water within the wall to escape if necessary. The paint company Behr advertises, "This extremely durable, mildew & dirt resistant waterproofing finish has superior elasticity & elongation properties to resist cracking. It withstands 98 mph wind-driven rain. The 100% acrylic latex formula provides a breathable film, releasing moisture that builds in walls."[23] Historic masonry specialist John Speweik maintains that, "The shear

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[17] Wilson Jr., Samuel. "The Fourth Church." In The Buildings of Christ Church, 41-52. New Orleans, LA, 1992; Times Picayune, March 5, 1960.

[18] Helsel, Jayson L, PE. Journal of Architectural Coatings 4.1 (Jan/Feb 2008): 50-51.

[19] Products & Technologies: Elastomeric Coating. J. Sidheshwar Gubbi Civil Engineers, Mumbai
NBM & CW, Jan 14, 2012

[20] Constantinides, Ian, and Lynne Humphries. "Exterior Stucco." www.buildingconservation.com. January 1, 2003. Accessed March 4, 2015.

[21] LSM Building Conservation- Cabildo Exterior Restoration Phases I & II

[22] Lick, Dave. "The Case of the Two Towers: Tips for Specifying and Applying Elastomeric Coatings." PaintInfo. Web. 20 Mar. 2015.

[23] "Elastomeric Masonry, Stucco & Brick Paint | Behr Paint." Behr Paint. Web. 20 Mar. 2015.

thickness of most load-bearing masonry walls keep the water out. The original building materials made for quick evaporation of the water on the surface of the walls and kept the inside dry, but this breathability does take its toll on old lime mortar joints and they need to be repointed in high moisture areas every 75 to 100 years or so…Where waterproofing and harder cement-based mortars are applied we find decay patterns that are surprising – in just a decade after application. Instead of the mortar surfaces wearing, there is a new pattern of brick and stone decay. Strong osmotic and hydrostatic pressures build up in brick and stone that are subjected to these hard, strong, and water resistant materials."[24]

Starting at the source of the problem in concerns to the brick, mortar, and stucco is water. Living in south Louisiana we are constantly in a delicate balance with living with moisture all around us. Our ancestors realized that we must adapt our buildings to the concerns of moisture with passive ventilation techniques. This is how the church was able to stand with limited maintenance since it was constructed until the modern luxury of air conditioning was introduced for comfort. The church and chapel builders originally had the good sense to install vents in the base of the walls of these buildings that passively dried the area under the church and chapel. The vents were originally 36"x 16" and consisted of a metal grill that allowed air movement into the basement and an amount of light that helped dry the building.[25] These areas were undermined in a variety of ways since the church was built. The vents have since been blocked by years of organic growth, making the ability for the crawl space to breathe more difficult. This organic growth has caused the pooling of water around the base of the building and has blocked the ability for the sun to evaporate the excess water. The vegetation around the building has led to biological growth growing on the sides of the building. Since the soil around the foundations has been raised blocking the vents from being able to breathe and remove the water passively, water sits higher than in the past around the masonry piers.

Besides the introduction of organic growth blocking the existing vents on the front and patio side of the chapel, the additions to the building compound in the late 1950's to early 1960s have blocked many of the vents that were situated on the Baronne Street and Seventh Street side of the chapel with the addition of new foundation walls. These foundation walls have made it so ventilation to this part of the church has been reduced allowing the buildup of water around the masonry piers. There is also no adequate ventilation between the chapel and the cathedral. The addition to the back apse with the ambulatory walkway has also negatively affected the moisture levels in this part of the church. The rear of the cathedral originally had three vents that were blocked off with the construction of this walkway. The new walkway wall, in the ambulatory area, is a16" thick brick masonry wall which was built without a slate course and without ventilation openings.[26]

All of the factors described previously are contributing to a hostile environment for the brick piers in the crawl space, allowing the accumulation of moisture to potentially affect the brick piers. The ambulatory walkway was never constructed with a slate course and the event of rising damp is inevitable. Since the crawl space has had a higher level of moisture in the area and nowhere for it to go the moisture is penetrating the bricks and the mortar in an attempt to escape from the over saturated area. This is usually combated with adequate ventilation and a slate course to prevent rising damp, but these defense systems have been undermined throughout the church's and cathedral's life. Dimitri Roby, the restoration contractor for the church, put forth the following theory about the condition of rising damp within the masonry walls. Usually when rising damp occurs the water often takes the path of least resistance through the bricks and mortar and exit through the exterior wall, where it can be evaporated by the sun and wind. Though rising damp is bad in itself, Christ Church Cathedral's rising damp is a result of a potentially worse problem. There is a capillary suction problem which has been amplified by the low vapor permeability of the elastomeric coating. The case for rising damp as the primary issue within the cathedral was investigated with a Ryobi PinlessMoisture Meter, where readings on various wall locations on March 5, 2015 with the temperature being a mean of 60F and March 21, 2015 with the temperature being a mean of 64F. The Seventh Street side of the cathedral shows readings ranging from 37% to 100% moisture content/saturation at 4 feet above the floor. One reading on the wall closest to St. Charles Avenue read that one foot above the floor was at 46%, four

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[24] Speweik, John. "Moisture – Part One, Watertight Envelope Theory." www.johnspeweik.com. October 13, 2011. Accessed March 3, 2015.

[25] Roby, Dimitri. "Dimitri's Narratives: Letter # 3, May 6, 2014

[26] Roby, Dimitri. "Dimitri's Narratives: Letter # 5, May 11, 2014

feet above floor at 97%, and eight feet above the floor at 86%, showing a higher concentration of moisture higher in the wall. Readings taken on the St. Charles Avenue side of the cathedral showed a range of 62% to 100% moisture content/saturation at 4 feet above the floor. A reading on the Seventh Street side of the main entrance on this wall read 56% at one foot above the floor, 61% at four feet above floor, and 69% at eight feet above the floor, showing moisture higher in the wall. The Sixth Street side of the cathedral showed a range from 40% to 100% moisture content/saturation at 4 foot above the floor. A reading on this side of the chapel closest to the tower room read that one foot above the floor, humidity was at 37%, four feet above floor at 70% and eight feet above the floor at 67%, showing moisture higher in the wall as well. The Baronne Street side of the cathedral showed the largest evidence of rising damp in the Ambulatory and the Cathedral Sacristy. The ambulatory showed a range of 30% to 100% moisture content/saturation at 4 feet with the higher readings being closest to the Sixth street side of the Ambulatory. One reading near the Seventh Street side in the Ambulatory read that one foot above the floor was at 39%, four feet above floor at 41% and eight feet above the floor at 32%, showing moisture relatively stable within the section of wall. The Sixth Street side of the ambulatory saw almost complete saturation of the wall that read that one foot above the floor was at 71%, four feet above floor at 100% and eight feet above the floor at 100%, again supporting the theory of rising damp. The Cathedral Sacristy read that one foot above the floor was at 58%, four feet above floor at 100%, and eight feet above the floor at 100%, showing moisture higher in the wall. The readings that showed inconsistency at varying levels shows something more dynamic occuring, besides rising damp. These readings can possibly be combined factors of the under building ventilation, elastomeric coating, presence of salt, and the influence of climate control. Overall the overwhelming evidence of rising damp was located on the Sixth Street side of the ambulatory and the Cathedral Sacristy. These two areas also display the highest level of damage done to the wall finishes.

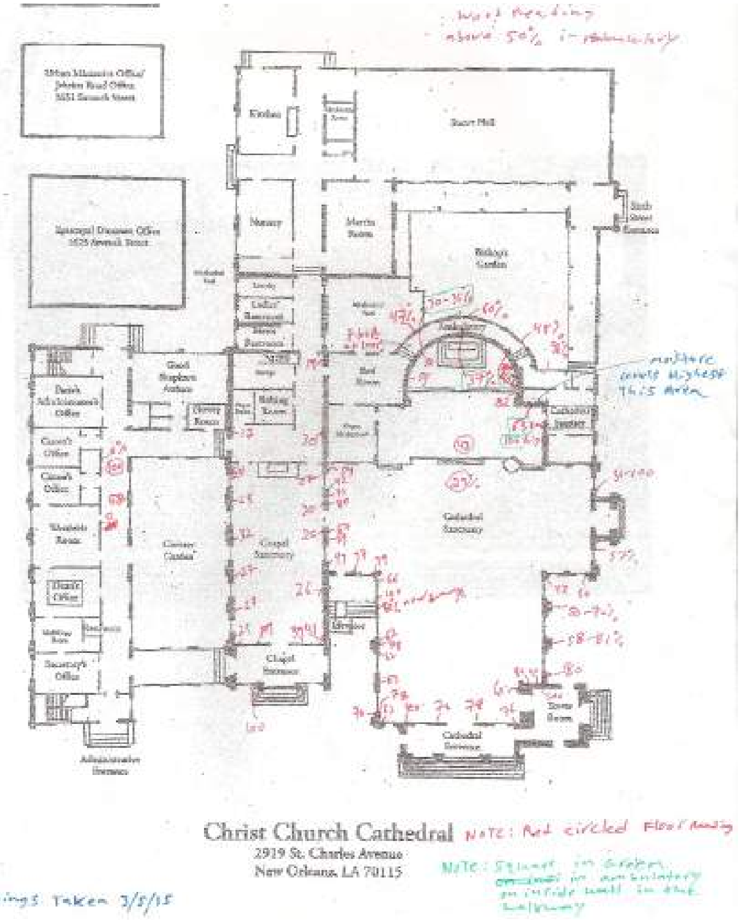

Figure 2.5: Plan of Christ Church Cathedral Showing Moisture Readings at Four Feet. Readings by John Rupley. 2015

While the cathedral showed evidence of high moisture content within certain wall locations, the chapel did not. This could be attributed to the recent opening of the crawl space vents on the Seventh Street side of the chapel to allow for adequate air flow, negating further rising damp. The Seventh Street wall of the chapel on the interior had moisture readings that showed the walls to be low in moisture with readings from 24% to 32% moisture content/saturation at 4 feet above the floor. One reading in the middle section of this wall read that one foot above the floor was at 72%, four feet above floor at 30%, and eight feet above the floor at 25%, which shows the typical pattern of rising damp. The wall of the chapel closest to Sixth Street showed higher moisture meter readings that ranged from 26% to 47% moisture content/saturation at 4 feet above the floor. One reading closest to St. Charles Avenue on the Sixth Street side wall read that one foot above the floor was at 40%, four feet above floor at

47%, and eight feet above the floor at 47%. These readings were slightly higher than the Seventh Street side of the chapel due to the possibility that this wall is further from the vents that have recently been reopened on the Seventh Street side of the chapel. According to the moisture meter readings taken, the chapel is not currently showing the same degree of saturation in the walls as the cathedral.

With the basis of why the church used an elastomeric coating on the exterior and the current conditions of the crawl space of the church, we can now paint the picture of how these two things react together. The elastomeric coating was used because it is great at preventing moisture from entering the building. The issue with coatings such as this is that they also inhibit any moisture that is inside the building and in the soil below the foundation to escape. Thus, the water cannot exit through the exterior wall and is constantly sitting and saturating the bricks and mortar. One can speculate that with nowhere for the water to escape to, the water is migrating through the interior causing deterioration of the walls on the inside of the chapel and cathedral. Along with this issue, the building material in general does not help the situation. Historic bricks are especially porous due to the process of the manufacturing of the bricks. This allows water to infiltrate the bricks easier. When the water meets with already existing salts in the bricks, the salts become a soluble solution. When the water evaporates in the bricks, it leaves behind the crystallized salts within the bricks. This is called subflorescence.[27] Subflorescence can create added pressure causing the load bearing strength of the brick and mortar to decline which contributes to cracking and spalling. This is posing a potential structural issue and left unattended the problem could erode the foundation and walls of the chapel and the cathedral.

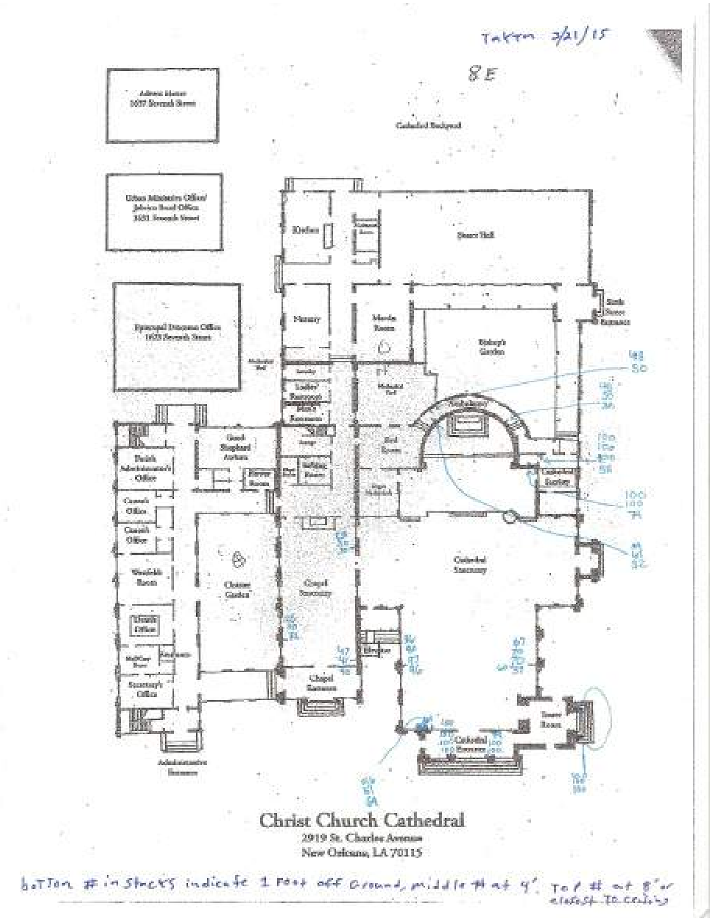

Figure 2.6: Plan of Christ Church Cathedral Showing Moisture Readings at Spot Locations atOne,Four, and Eight Feet. Readings by John Rupley. 2015

Another factor that is affecting the building is the difference in temperature from inside to outside. The church originally did not have air conditioning. The installation of air conditioning has created a drastic temperature difference between inside and outside when warm and humid weather prevails. This condition is driving the water horizontally in the wall, with the direction of water movement depending on which is hotter, the interior or the exterior. This moves the water and the salts in the soluble solution toward either direction leaving crystallization on the wall surface called efflorescence.[28] On the exterior, there is potentially a buildup of crystallized salts in the bricks and stucco may be being trapped inside by the elastomeric coating. On the interior portion of the masonry walls, this is leaving a buildup of crystalized salts which are deteriorating the interior finish. This is evidenced by the presence of crystallized salts on the interior, supporting the theory of efflorescence in the masonry

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[27] Experimental investigation on bricks from historical Venetian buildings subjected to moisture and salt crystallization. Foraboschi, P ; Vanin, A Engineering Failure Analysis, 2014 Oct, Vol.45, pp.185-203

[28] Experimental investigation on bricks from historical Venetian buildings subjected to moisture and salt crystallization. Foraboschi, P ; Vanin,

walls, which also indicates subflorescence within the walls.

If the moisture and salts due to efflorescence are pushing salts horizontally to the exterior of the walls as well as the interior, and creating a buildup of salts just under the layer of the of the elastomeric coating, this could be deteriorating the stucco, which usually occurs through delamination. [29] This could be responsible for some of the chipping that is occurring to the stucco on the exterior.

While examining the condition of the exterior wall of the Seventh Street elevation of the chapel it was evident that some cracks have occurred underneath or along the sills of the windows. Though these cracks seem to have been repaired recently, this could be due to the water intrusion, efflorescence within the wall, or settlement issues. There is also some damage to the cornice, which also could be attributed to the crack in the gutter above allowing water intrusion. This elevation also has a considerable amount of water damage to the pilasters on the façade, which is being caused by ineffective downspouts and gutters. The St. Charles Avenue elevation of the chapel shows a number of cracks that have formed throughout the years. This can be attributed to years of organic growth on the building, where vegetation can root in hairline cracks. Eventually with the growth of this organic material, the cracks enlarge. This organic growth can be seen in archival photographs from the 1910s to the 1950s. This damage is also visible on the pinnacles of the elevation and there are a number of cracks in the base of this section of the elevation. It is currently apparent that there still is a moderate amount of organic growth that is attributing to the damage of this façade. The pilaster directly to the left of the archway seems to have evidence of iron oxide on its face, otherwise known as rust. This is especially interesting as this appears to be the only location in which this evidence is visible. The cast stone concrete steps leading up to the chapel entry show evidence of delamination. This could be attributed to water intrusion and the effects of freezing and thawing. It is possible the steps here were having settlement issues and to bring the riser heights to a uniform level they could have put a toping layer of concrete to these bottom risers, which could account for the way the steps are chipping.

Figure 2.6: Picture of the Seventh Street Elevation of the Chapel Showing Cracks Under the Windows. Photo by Matthew Cerick. 2015

Figure 2.7: Picture of the St. Charles Avenue Elevation of the Chapel Showing Cracks. Photo by Matthew Cerick. 2015

Figure 2.8: Picture of the St. Charles Avenue Elevation Chapel Steps Showing Cracks. Photo by Matthew Cerick. 2015

The cast-iron railings are a later addition, which show no signs of corrosion where they are anchored. The Sixth Street elevation of the chapel shows the same conditions as the front façade to the turrets and shows a moderate amount of water damage on this side. The recessed entry between the chapel and the cathedral shows evidence of water damage to the stucco face.

The Seventh Street elevation of the cathedral shows the same level of water damage, marking the building stucco around the cornice in a number of different spots. The St. Charles elevation of the cathedral shows some hair line cracks within the stucco of the front pilasters and a small amount of organic growth in the area around the pediment. Three of the middle sections of risers and the top riser between the entire middle opening leading up to the level of the cathedral portico have been replaced with what appears to be a type of flagstone. There have also been additions of cast iron railings between the bays and show no

Figure 2.9: Picture of the St. Charles Avenue Elevation Between the Chapel and Cathedral Steps Showing Water Damage. Photo by Matthew Cerick. 2015

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[29] LSM Building Conservation- Cabildo Exterior Restoration Phases I & II


Figure 2.10 Picture of the Seventh Street Elevation Cathedral Showing Water Damage on the Recessed St. Charles Avenue Portion of the Facade Cornice. Photo by Matthew Cerick. 2015

signs of corrosion where anchored. The portico also appears to have issues with rising damp due to the amount of blistering accruing on the inside of the exterior wall between the bays. This could also be attributed to improper surface preparation since this is the only area showing evidence of blistering. The interesting but concerning thing about the portico is that there are the same cracks developing above the headers on both the side window and above the door header leading into the Tower Room. This gives reason to believe that the portico foundation maybe experiencing differential settlement issues. This is supported further by a substantial horizontal crack that can be seen along the foundation base closest to Sixth Street. The tower façade on the St. Charles Avenue side appears to be in relatively good shape, besides a small amount of water damage at the top of the tower and some organic growth near the gargoyles.


Figure 2.11: Picture of the St. Charles Avenue Elevation Cathedral Steps. Photo by Matthew Cerick. 2015


Figure 2.12: Picture of the Cathedral Portico Showing Blistering. Photo by Matthew Cerick. 2015

The Sixth Street elevation of the tower is also in relatively good shape, with a slight amount of water damage and biological growth attributed to shrubbery near the building's base. The top of the tower has a small amount of organic growth, which could be the cause for hairline cracks in the stucco under the finials. The Carondelet Street elevation of the tower shows a significant amount of staining due water damage to the façade, though this appears to be only cosmetic. The entry to this side of the building is relatively free from visible damage besides the base which shows the markings of organic growth around the entire Sixth Street elevation.


Figure 2.13: Picture of the Catherdral Portico Showing a Crack Above the Window. Photo by Matthew Cerick. 2015


Figure 2.14: Picture of the Catherdral Portico Showing a Crack Above the Door. Photo by Matthew Cerick. 2015


Figure 2.15: Picture of the Catherdral Tower Showing Organic Growth. Photo by Matthew Cerick. 2015

The Carondelet Street elevation of the building shows signs of water damage and evidence of green staining due to vegetation on the back side of the ambulatory. There is evidence of potentially what once was a large problem about three feet off the ground of the ambulatory. It appears that there was a substantial crack running horizontally along the semicircular façade. This has since been filled in with a caulking element and painted over. One could speculate that this is a cold joint running along the side of the building but it seems to be a repair. The flat sections of


Figure 2.16: Picture of the Catherdral on the Sixth Street Side. Photo by Matthew Cerick. 2015


Figure 2.17: Picture of the Ambulatory on the Carondelet Street Side. Photo by Matthew Cerick. 2015


Figure 2.18: Detail Picture of the Crawl Space Entry on the Carondelet Street Elevation Near the Crawl Space. Photo by Matthew Cerick. 2015

Figure 2.19 Picture of the Carondelet Street Elevation Cathedral Showing Water Damage on the Facade and Showing the Copper Plating. Photo by Matthew Cerick. 2015

the gable above the ambulatory have stainging due to water damage and a small amount of organic growth. It is worth noting that the Carondelet Street elevation is painted brick and lacks the stucco finish the other facades have. To the right of the ambulatory closest to the Seventh Street side, there is water damage to the bricks and the side wall is covered in copper plating that has shown its age with a well-worn patina.

COMPARABLE CASE STUDIES

As rising damp related issues are something many historic buildings experience in climates like New Orleans', it is most useful for the Christ Church to look at case studies where both the environmental and circumstantial conditions are as similar as possible to the ones found at Christ Church Cathedral. The main factors to be considered when studying other historic masonry buildings are the relative humidity and annual rainfall of the climate, and the application of a watertight sealant to the exterior of the masonry walls in an attempt to keep water from entering the building. Fortunately, there are numerous examples of similar circumstances in the immediate region as well as in other comparable locations across the globe that may help to draw conclusions about appropriate treatment and maintenance options for Christ Church.

The Cabildo building in New Orleans' Jackson Square is one prominent example only a few miles from Christ Church. Currently undergoing exterior restoration work by the New Orleans architectural firm Koch & Wilson, the Cabildo is experiencing many problems similar to Christ Church as it is constructed of brick and lime mortar with a coating of stucco. For decades, a limewash was applied to the stucco about every ten years, and although the building always experienced some moisture-related issues, they were generally manageable with proper stucco repair/replacement. In 2003, a layer of elastomeric paint was applied to the building's exterior in an attempt to solve all existing moisture issues. This attempt backfired however and the negative effects have been significant and worrisome. As a result the conservators working on the Cabildo are currently involved in remedying the situation while minimizing additional damage to the structure's exterior. Conservation team materials consultant Dorothy Krotzer has recommended removal of the elastomeric coating entirely, as "The coating has trapped moisture in the walls, causing expansion of metals in the walls, moisture pockets on masonry wall surfaces, and delamination of exterior stucco and interior plaster."[1] One only has to walk by the façade of the Cabildo today to see the obvious failures of the buildings' stucco as a result of this coating having been applied in an honest attempt to do the opposite.

Another regional case study of the effects of elastomeric coating applied to an historic masonry building can be found at the Old State Capitol building in Baton Rouge, LA. The restoration and repair work were completed by historic masonry specialist John Speweik and restoration architect John Campbell. It was determined that in the 1980s the building was covered with an elastomeric coating, and as a direct result, two decades later the majority of the building's stucco surfaces had failed. Even more severe, the coating caused such a significant transformation in the building envelope climate that toxic mold began to appear on the interior walls, posing a public health and safety risk and requiring immediate and costly repair.[2] It is worth noting that the toxic indoor mold in question is stachybotrys chartarum, and it can be exceedingly hazardous to human health. Stachybotrys mold requires consistently wet conditions to initiate and maintain growth, conditions that can be caused by condensation due to poorly designed or faulty HVAC systems, among other

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1 Tullos, Jr., Mark A. "Cabildo - Exterior Restoration Phases I & II." LSM Building Conservation. October 28, 2014. Accessed March 3, 2015.

2 "The City of New Orleans – Design Guidelines – Elastomeric Paint Analysis." VCC. April 12, 2005. Accessed March 4, 2015.

reasons.[3] The mold can be tested for but preliminary visual identification is also possible as, "the fungus will usually produce large amounts of conidiophores and conidia giving the substrate a black appearance that can be slightly shiny when fresh and powdery when dry."[4] During a telephone consultation with Mr. Speweik concerning the elastomeric coating at Christ Church, he stated that such elastomeric coatings like the one covering the Old State Capitol was "like a plastic bag over the building that would start a slow death for the structure, quite literally causing moisture to eat the building away."[5] He further stated that the possibility for toxic black mold formation was very real, and that if it began to grow it would likely first form on interior corners, window wells and windowsills.[6] Fortunately there are currently no signs of toxic mold infestation in Christ Church Cathedral, however the risk of such a development is real, and as with any measures affecting human health and safety, precautions should be taken immediately to reduce the probability of any sort of mold growth development on the interior of the building as a result of excess moisture and poor ventilation.


Figure 2.20 Photo of Stachybotrys mold infestation on the backside of gypsum board. Photo credit to Home Improvement Solutions.

An additional case study applicable to Christ Church occurred at St. James Church in Kolkata, India. Though far from Louisiana, the tropical climates are similar in their heat and relative humidity throughout most of the year. In fact, Kolkata falls on latitude 22.57° while New Orleans sits only seven degrees north at 29.95°, and annual recorded rainfall in each location totals 68.3 inches and 60.7 inches, respectively.[7] Rising damp problems at St. James were compounded by a lack of regular maintenance and inappropriate repair interventions, and became an issue to the point where, "Parishioners could feel the dampness rising from the floor."[8] The first step in addressing these masonry issues was to remove all existing cement render from the exterior walls and leave them to dry for six months. Regionally traditional mortar and plaster mixtures were then matched from samples and reapplied to the building. Since the church had no existing damp course in its foundation, rising damp was then arrested approximately two feet above grade by grouting a silicone solution just above the plinth of the church. Weeds growing on the parapet were then sprayed with an herbicide and not pulled out, in order to kill the roots that had taken hold inside the masonry walls. Additionally, drainage issues were addressed by repairing and replacing sections of the long neglected gutter and downspout system. Lastly, conservators elected to protect the masonry of the exterior walls with a traditional lime and sand plaster, coated with a microporous silicone paint into which was mixed an unspecified herbicidal additive.[9] The conservators acknowledged that the silicone paint used was less porous than the limewash that was used traditionally, however believed the calculated concession in breathability to be justified due to the enormous amount of water exposure the building experiences, particularly during monsoon season.


Figure 2.21 Picture of St. James Church in Kolkata, post-restoration work. Photo credit to Manish Chakraborti.

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[3] Nelson, Berlin D. "Stachybotrys Chartarum: The Toxic Indoor Mold." The American Phytopathological Society. November 1, 2001.

[4] Ibid.

[5] Speweik, John. "Regarding Elastomeric Coating at Christ Church." Telephone interview by author. March 3, 2015.

[6] Ibid.

[7] "Climate Data for Cities Worldwide." Climate-Data.org.

[8] Chakraborti, Manish. "The Historic Anglican Churches of Kolkata." www.buildingconservation.com. January 1, 2012.

[9] Ibid.

TREATMENT RECOMMENDATIONS

The first step in effectively treating the moisture-related masonry issues at Christ Church is to ensure that any and all work to be undertaken is managed and performed by a licensed and well-informed restoration architect and contractor(s). Beyond that there are many steps that can be taken to mitigate the problem of rising damp and the damage it is causing to the Cathedral's masonry and exterior walls. These steps range from relatively minor and easy to employ to increasingly demanding from a technical and financial standpoint. Mr. Dimitri Roby outlined a number of strategies to quickly and effectively reduce the rising damp in walls and improve ventilation throughout the buildings, one of which it he has already implemented by clearing the soil that had been blocking three ventilation openings at the bottom of the chapel wall facing the cloister garden.[10] A number of these strategies will be reiterated here:

1. Closely monitor the plant beds and ensure they remain below the existing slate course. This is a larger issue surrounding the chapel, as comparisons with historic photos as well as test digging around exterior walls found no evidence of a significant raise of grade around the main cathedral walls.

2. Repair drainage systems to reduce the amount of wall exposed to ground moisture and minimize the wicking effect into the masonry.

3. Further reduce moisture in the crawl spaces by addressing the consistently sweating HVAC pipes that run through the areas. This can be accomplished by fitting the pipes with foam, fiberglass, rock wool, or slag wool insulation, as a result diminishing potential heat loss/gain and reducing condensation.[11]

4. Improve overall ventilation by retrofitting vents into the Ambulatory walkway's foundation as well as the Chapel's foundation walls. Services of a structural engineer will be required.

5. To further maximize ventilation throughout the building, a reconstruction of the cathedral's cross-ventilation tower, which was part of the originally designed ventilation system, might be considered. Such an intervention would be expensive and substantial, however. A new ventilation tower would have to be designed and installed due to a lack of plans or photographs of the original. However, the new ventilation device could easily be concealed from the street and would not necessarily affect the cathedral's historic appearance, as it would serve a purely functional purpose. An intervention of this magnitude should only be considered if all other recommended steps towards mitigation of the existing moisture problems have been taken, and after continuing evaluations have failed to significantly improve the conditions of the masonry.

These measures to reduce moisture and increase ventilation throughout the structure will indeed help alleviate the pressure on the church's masonry, but they fail to address the main root of the problem- that being the elastomeric coating that was applied to the building's stucco walls approximately 20 years ago. The elastomeric coating is the main source of the building's masonry problems, and in order to treat and begin to reverse its adverse effects, put simply it needs to be removed entirely from the building. There are a number of methods and products for achieving this, though as every building is different it is advised that test patches be used in several discreet locations in order to determine the effectiveness of numerous different products on the existing stucco.

1. The Vieux Carre Commission advocates that for historic structures the technique of soda or walnut hull pressure applications may be tried as these techniques are designed to remove soft membranes without damaging harder materials (i.e. stucco).[12]

2. According to historic masonry specialist John Speweik, the chemical agent Peelaway 7 is effective in removing the elastomeric coating from existing, and even damaged, stucco walls.[13] This solvent-based paint

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[10] Roby, Dimitri. "Dimitri's Narratives: Letter #11." June 15, 2014.

[11] "Piping and Equipment Insulation." North American Insulation Manufacturers Association.

[12] "The City of New Orleans – Design Guidelines – Elastomeric Paint Analysis." VCC. April 12, 2005. Accessed March 4, 2015.

[13] Speweik, John. "Regarding Elastomeric Coating at Christ

remover may be sprayed onto the surface of the building and must be properly rinsed and disposed of.

3. According to experienced New Orleans based restoration developer Joseph Stebbins, Prosoco Enviro Klean is also an effective agent for removing elastomeric coatings without damaging the underlying stucco and masonry.[14]

4. The ongoing Cabildo restoration by architects Koch & Wilson recommends testing any or all of the following products in order to determine their effectiveness:

a. Cathedral Stone MasonRE S-301 General Purpose Stripper or S-303 Light Duty Stripper, both containing main active ingredient benzyl alcohol.

b.Dumond Chemicals Peel Away 7 Solvent Based Paint Remover, which is formulated without methylene chloride and is non-caustic and thus safer for the environment.

c. Enviro-Prep Systems 33703 Chemical Stripper, designed to remove leaded paints and claiming to be disposable as non-hazardous solid waste.

d. Franmar Chemical Bean-e-doo Mastic Remover, a product that is non-caustic, releases no toxic fumes, and is biodegradeable.

e. Franmar Chemical Soy Gel Paint & Urethane Remover, a similar product which also contains no methylene chloride.

f. PPG Dura Prep 200 Architectural Coating Remover, which is non-toxic and is marketed specifically towards elastomeric coating removal.

It should be noted that each of these suggested products for use on the Cabildo are proprietary, yet all adhere to the specifications that they be low-odor, water-based and water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing masonry, stone, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.[15] It is recommended that the same precautions and specifications be taken into consideration when testing for a suitable product for the removal of the elastomeric coating at Christ Church Cathedral.

Once the best method/agent for removal has been determined, the stucco and masonry itself must be addressed. There is a good chance that existing failures in the stucco will have become more pronounced as a result of the elastomeric coating having been removed, as well as a high probability that new damage has occurred in the at least 20 years since any previous repairs were made. It is vital to discover and document each instance of stucco, brick and mortar failure so that the proper repair techniques can be applied to the entire structure simultaneously.

The next step is to repair the failed masonry by matching to the best of ability the exact lime mortar composition of the original as well as determining the composition of the existing stucco and matching that as well. Matching the mortar composition can be done through a variety of methods, combining visual inspection and lab analysis in order to determine what the aggregate is made from, which in historic buildings is almost always locally available sands and clays. "The local mortar is in effect a regional man-made sandstone. Using these same aggregates and resident clay fines for replica mortar- making ensures that patches are materially compatible."[16] Ideally the replacement mortar and stucco can be replicated using commercially available aggregates with the appropriate binders, in the same manner as any repair work would have been completed in the decades after original construction.

A close match is important for both aesthetic and structural purposes. Matching aesthetics can be difficult, as the replacement recipe often must be tested and adjusted numerous times in order to get a suitable match. It is worth noting that clay fines are often left out of replacement mixtures today due to readily available washed masonry sands and the idea that they are unnecessary due to their variable physical and chemical characteristics- yet it has been thoroughly documented that the addition of locally sourced clay fines have been crucial in matching original mortar and render compositions on historic buildings throughout the country.[17]

Church." Telephone interview by author. March 3, 2015.

[14] Stebbins, Joseph. "Regarding Elastomeric Coating at Christ Church." Telephone interview by author. February 27, 2015.

[15] Koch & Wilson. "Historic Treatment of Plain Painting 090391."

[16] Lee, John Greenwalt. "Matching Historic Renders Using Locally-Available Materials: The Art and Science – A Conservator's Approach".

[17] Ibid.

Aesthetics are important for obvious reasons, but more essential to the building's long-term health is the structural compatibility of any materials used in repairs that are intended to last over several decades. "Changing materials, like using a portland cement-based or polymer-modified material or even different aggregate, can change the thermal expansion, adhesion, cohesion, water transmission, hardness, flexibility, and other characteristics of the mortar or render. These will significantly affect the way the material ages, weathers, and works with the rest of the building."[18] If the goal is to restore the durability of the masonry's mortar and stucco in order to maximally extend the longevity of the building, then great care should be taken in the process of matching these materials so that they perform well with the existing building components.

Once a suitable match for both the mortar and stucco has been found, a mason with suitable experience should be entrusted with completing the necessary repair work. Given the historic significance of Christ Church Cathedral, it is recommended that the highest quality craftsmen available be commissioned. Qualifications used to determine appropriate masonry contractors for the Cabildo specify that only a qualified historic masonry repair specialist having completed at least five first-class historic restoration projects similar to the type, complexity and size of the project will be considered.[19] Equally rigorous qualifications should be applied in finding a historic plastering specialist to repair the stucco at Christ Church, adding that expertise in matching and performing the types of historic plasterwork is key to success of the project.[20]

According to masonry conservation experts, cracks should be addressed in the following manner, "Cracks greater than 2mm in a lime-based stucco should be carefully cut out to form a slight undercut which will act as a key, and thoroughly flushed out with water to remove dust and loose debris before being filled with fresh mortar based on trial results. Obviously a finer aggregate will be required where the crack is fine or hairline and it is often deemed unnecessary to undercut as the space is easily filled especially if limewash is to be applied."[21] Additionally, in order to minimize the potential effects of capillary suction via miniscule cracks in the stucco and mortar, there is the option to inject dispersed hydrated lime into each crack with a syringe. This product remains flexible over time and allows the wall to breath while simultaneously repelling water from penetrating the wall. [22] This may cause a small reduction in overall breathability, but given the wet and humid climate of New Orleans, the compromise may be considered justifiable as in the case of St. Joseph's Church in Kolkata where the structure was coated with a microporous silicone paint.

Procuring trade specialists with the appropriate qualifications will not only ensure attention to detail in creating and applying the matching mixtures, but will also bring to the table knowledge and experience with using modern materials in conjunction with historically used, local ingredients in order to help produce suitable and cost-effective mortar and stucco repair mixtures.


Figure 2.22 Photo depicting the scaffolding required to paint a church facade and bell tower. Photo credit to First Congregational Church of Rowley, MA.

Once the stucco has been repaired and is allowed to properly cure, it is recommended that the building then be coated with either a traditional limewash finish or a microporous silicate paint. Either solution provides will provide a certain degree of permeability going forward, allowing the masonry to breath and the building to ventilate better as a whole, helping to alleviate the numerous moisture-related issues that Christ Church is currently experiencing.

A traditional limewash composition will allow the building and its masonry to breath the most going forward. Correctly applied, the limewash will absorb into the stucco and create a hardened surface. This

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[18] Ibid.

[19] Koch & Wilson. "Historic Brick Unit Masonry Repair 040322."

[20] Koch & Wilson. "Historic Treatment of Plaster 090320."

[21] Constantinides, Ian, and Lynne Humphries. "Exterior Stucco." www.buildingconservation.com. January 1, 2003.

[22] Speweik, John. "Moisture – Part Two, Capillary Suction." www.johnspeweik.com. October 14, 2011. Accessed March 4, 2015.

surface will not trap moisture in the wall however, and should directly help to alleviate the issues of rising damp through the building as limewash has a vapor permeability rating of 350 units, while most masonry paints have a vapor permeability rating of less than 75.[23] The significantly improved breathability of the masonry walls should effectively allow them to dry out and return to moisture levels that are appropriate and were taken into account when the building was constructed. The limewash will eventually wear thin, however, and it is recommended that it be replaced in an identical fashion every three to five years in order to replenish the protective qualities of the coating. The drawbacks with applying a limewash finish are the costs involved with proper routine maintenance as well as the difficulty in procuring a properly trained limewash specialist to apply the product.

There also exist today numerous commercially available silicate paint products that are designed for masonry. Products available from KEIM, Cathedral Stone, Edison Coatings, and Lime Works all fall under the category of potassium silicate mineral paints specifically for use on historic stucco, and purport to be highly water resistant yet vapor permeable, claiming up to 92% vapor permeability.[24] These silicate mineral paints soak into the stucco, binding chemically with the substrate while forming a pore size that allows the passage of vapor while being small enough to prevent the entrance of rainwater.[25] Such a semi-permeable membrane is highly preferable to the non-permeable elastomeric coating currently on the building's exterior. In fact silicate paint compounds have been in use on historic structures for over 100 years in Europe and they have been found to perform adequately in that time span.[26] The main advantages silicate paints offer to traditional limewash are the anticipated life expectancy and ease of application, and therefore the resulting cost reduction in long-term maintenance.

Given the sheer size of Christ Church Cathedral and the logistics of coating the entire structure every three to five years, traditional limewash appears to be the more cost-prohibitive and less practical option. Commercially available microporous silicate paints tend to perform at a minimum of fifteen years from their application. It is recommended that a high quality silicate paint be selected and applied to Christ Church once the masonry and stucco has been successfully repaired, and that the interior and exterior surfaces of the building's masonry be closely monitored in the following year, both visually and periodically with moisture meters, in order to determine any effects the coating may have had on the masonry's moisture levels and breathability. Presuming the silicate paint coating is as permeable as it claims, then the moisture problems should begin to abate almost immediately after application and continue to normalize back to levels considered acceptable when the building was first designed and built, helping to prolong the strength and longevity of Christ Church's historic masonry infrastructure.

have been found to perform adequately in that time span. The main advantages silicate paints offer to traditional limewash are the anticipated life expectancy and ease of application, and therefore the resulting cost reduction in long-term maintenance.
Given the sheer size of Christ Church Cathedral and the logistics of coating the entire structure every three to five years, traditional lime-

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[23] Bennett, R.H., and John Speweick. "Limewash Returns." Period Homes, June 1, 2000.

[24] Koch & Wilson. "Historic Treatment of Plain Painting 090391."

[25] Davies, Gareth. "Vapour Permeable Paint." www.buildingconservation.com. January 1, 1996.

[26] Ibid.

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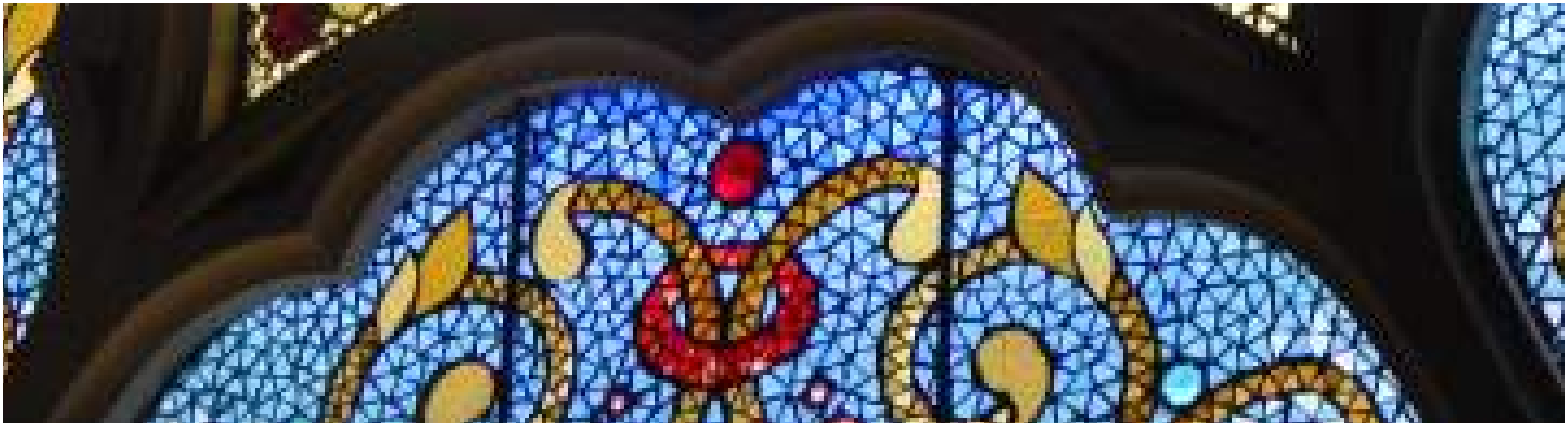
The Stained Glass Windows of Christ Church Cathedral and Harris Memorial Chapel

Meredith Massey - Rachel Howard - Samantha Williams - Elizabeth Shultz



Introduction: Twenty-First Century Preservation and the Stained Glass Windows of Christ Church Cathedral and Harris Memorial Chapel

While the current Christ Church Cathedral building is historically significant and worthy of the attention and efforts of preservation professionals for a vast array of reasons, its present-day location on the 2900 block of St. Charles Avenue, at the corner of St. Charles Avenue and Sixth Street, locates it within the St. Charles Avenue Historic District.[1] This district, which "encompasses all properties fronting on St. Charles Avenue between Jackson Avenue and Jena Street,"[2] is a full-control district[3] under the jurisdiction of theNew Orleans Historic District Landmarks Commission.[4] Its status as a full-control local historic district means that the preservation professionals of the city government's Historic District Landmarks Commission[5] are mandated to review all proposed work done to the exteriors of the buildings contained therein and issue certificates of appropriateness for exterior work done to any of the structures that exist within the district.[6] Due to the fact that, according to the New Orleans Historic District Landmarks Commission, "Windows and doors typically comprise at least one quarter of the surface area of exterior walls of most historic buildings,"[7] the windows of the Christ Church Cathedral are of special significance to the preservation of the building. Some of this significance is a consequence of the fact that windows "define the character of each individual building and provide a visual feature on the streetscape, help define [the] architectural style and building type, help date the age of construction, provide natural light and ventilation, [and] act as a transition from the exterior to the interior."[8] The stained glass windows of the Christ Church Cathedral and the adjacent Harris Memorial Chapel therefore require special understanding of their historic significance to best devise appropriate schemes for their detailed care and maintenance. This report will consequently discuss the history of stained glass production as it is relevant to the Christ Church Cathedral and Harris Memorial Chapel, the current conditions of the present windows, the recommendations for best practices in regards to treatment and maintenance, and a discussion of how the symbolism and installation history of the current pieces of stained glass in the buildings is a reflection of the overall history of the Christ Church congregation.

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[1] Dominique M. Hawkins of Preservation Design Partnership, LLC for the New Orleans Historic District Landmarks Commission, "St. Charles Avenue Historic District," The City of New Orleans, Louisiana (2011), 1. Online access provided by the City of New Orleans via http://www.nola.gov/nola/media/HDLC/Historic%20Districts/St-Charles.pdf.

[2] Hawkins, "St. Charles Avenue Historic District," 1.

[3] Louisiana State Division of Cultural Resources, "New Orleans, LA Local Historic Districts," http://www.crt.state.la.us/Assets/OCD/hp/nationalregister/NOLAdistricts/NRHP_Districts_WallMap_20121005.pdf

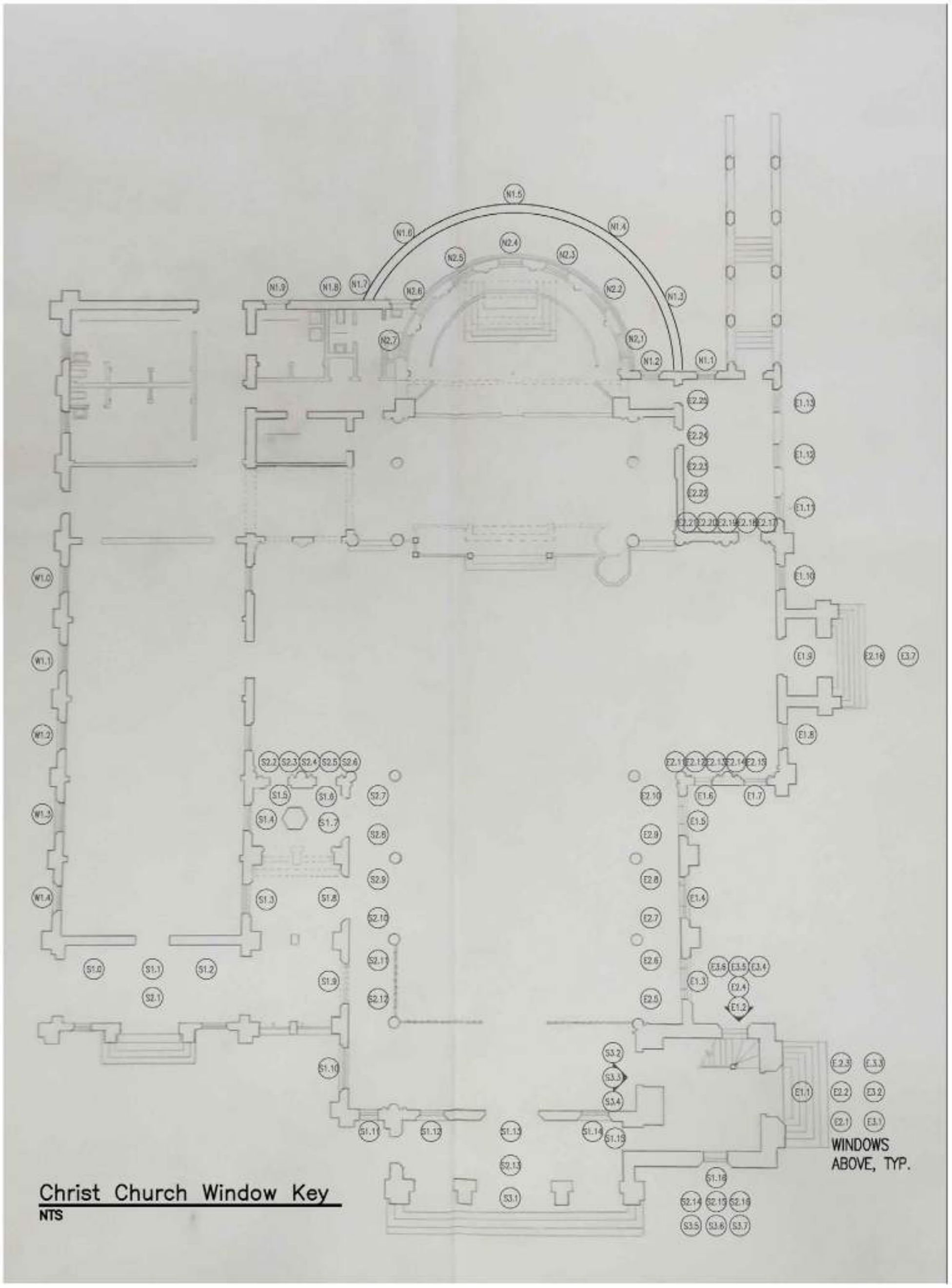
[4] The City of New Orleans, LA, "Historic District Landmarks Commission," http://www.nola.gov/hdlc/.

[5] *Ibid.*

[6] *Ibid.*

[7] Historic District Landmarks Commission, "Guidelines for Windows and Doors," http://www.nola.gov/nola/media/HDLC/Guidelines/08_Windows-Doors_201208.pdf.

[8] *Ibid.*



WINDOW TYPES

TYPE A:
PROTECTIVE GLAZING: WITHIN FRAME
NOT VENTED
REPLACE WITH VENTED SYSTEM

WINDOWS: S2.2, S2.3, S2.4, S2.5,S2.6, S2.7, S2.8, S2.9, S2.10, S2.11, S2.12, E2.5, E2.6, E2.7, E2.8, E2.9, E2.10, E2.11, E2.12, E2.13, E2.14, E2.15, E2.17, E2.18, E2.19, E2.20, E2.21, E2.22, E2.23, E2.24, E2.25, N2.1, N2.2, N2.3, N2.4, N2.5 N2.6, N2.7

TYPE B:
PROTECTIVE GLAZING: WITHIN FRAME/TRACERY
NOT VENTED
REMOVE, ASSESS STAIN GLASS & FRAME, REPAIR AND REPLACE AS NEEDED WITH VENTED SYSTEM

WINDOWS: S1.7, S1.8, S1.9, S1.10, E1.3, E1.4, E1.5

TYPE C:
PROTECTIVE GLAZING: FRONT OF FRAME
SINGLE VENTED
NEEDS MULTIPLE VENTS IN ORDER FOR AIR TO CIRCULATE

WINDOWS: W1.0, W1.1, W1.2, W1.3, W1.4, S1.3, E1.6, E1.7, E1.8, E1.10

TYPE D:
PROTECTIVE GLAZING: WITHIN FRAME
NOT VENTED
REMOVE AND REPLACE WITH VENTED SYSTEM UNLESS PROTECTIVE GLAZING IS UNNECESSARY

WINDOWS: S1.11, S1.12, S1.14, S1.16

THESE WINDOWS HAVE SERIOUS PAINT FAILURE WITH S1.11 HAVING FRAME CRACKING

TYPE E:
PROTECTIVE GLAZING: FRONT OF FRAME
SINGLE VENTED
NEEDS MULTIPLE VENTS IN ORDER FOR AIR TO CIRCULATE

WINDOWS: S1.0, S1.2

TYPE F:
PROTECTIVE GLAZING: NONE

HEAVY MAINTENANCE IS REQUIRED.

WINDOWS: S2.14, S2.15, S2.16, S3.2, S3.4, S3.5, S3.7, E2.1, E2.3, E2.4, E3.4, E3.6

TYPE G:
PROTECTIVE GLAZING: NONE

HEAVY MAINTENANCE IS REQUIRED.

WINDOWS: S3.3, S3.6, E3.2, E3.5

TYPE H:
PROTECTIVE GLAZING: NONE

HEAVY MAINTENANCE IS REQUIRED.

WINDOWS: E1.11, E1.12, E1.13, N1.1, N1.8,

TYPE I:
PROTECTIVE GLAZING: UNKNOWN, LOOKS PERFORATED

WINDOWS: S3.1, E3.7

TYPE J:
PROTECTIVE GLAZING: FRONT OF FRAME
NOT VENTED

REPLACE WITH VENTED SYSTEM OR REMOVE ALTOGETHER AS THEY ARE PROTECTED

TRANSOM WINDOWS: S1.1, E1.9

TYPE K:
PROTECTIVE GLAZING: WITHIN TRACERY
NOT VENTED

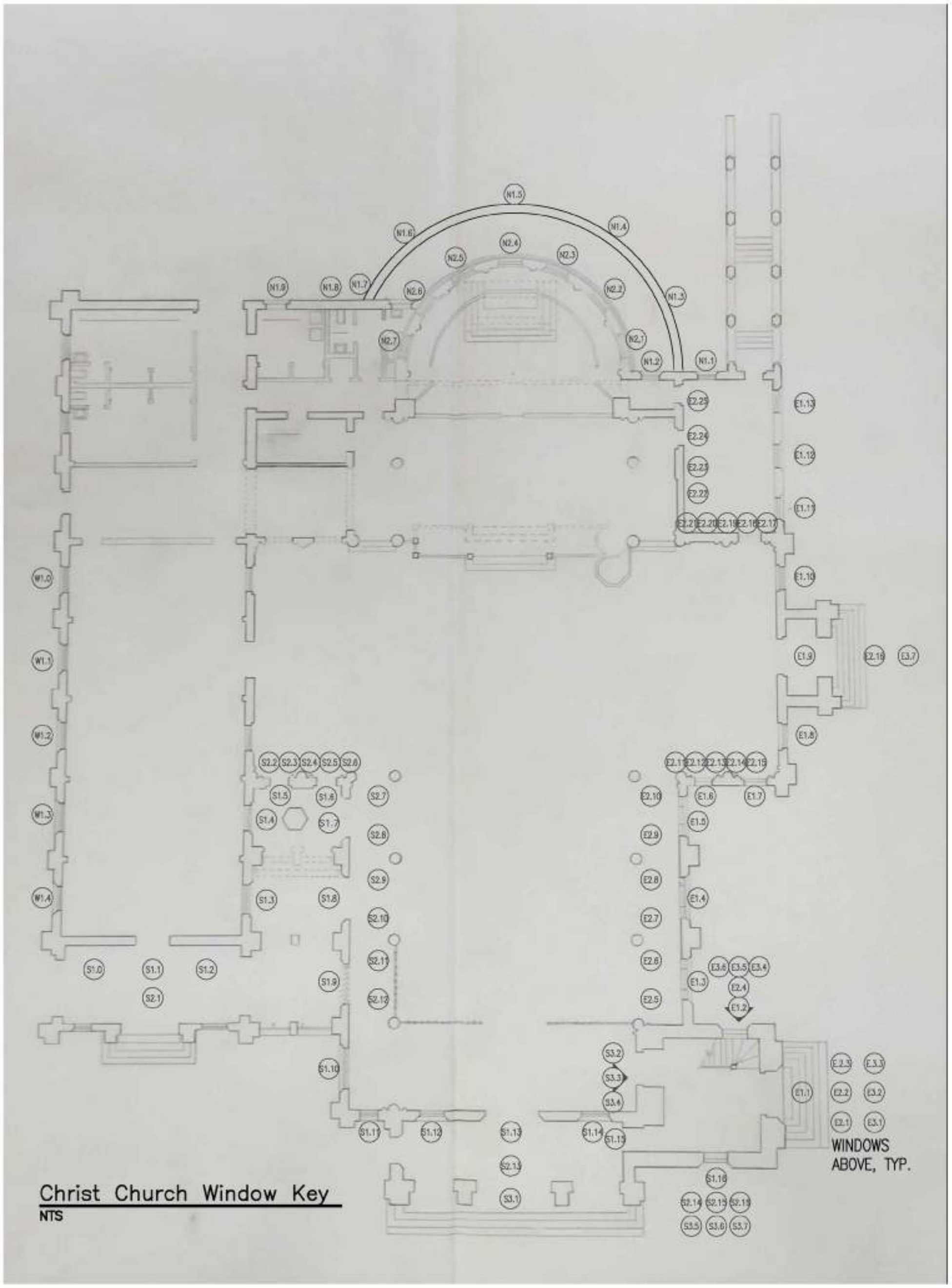
REPLACE WITH VENTED SYSTEM OR REMOVE ALTOGETHER AS IT IS PROTECTED

TRANSOM WINDOW: S1.13

TYPE L:
PROTECTIVE GLAZING: FRONT OF FRAME
NOT VENTED

REPLACE WITH VENTED SYSTEM

TRANSOM WINDOW: E1.1



WINDOW TYPES

TYPE M:
PROTECTIVE GLAZING: WITHIN FRAME
NOT VENTED

REPLACE WITH VENTED SYSTEM OR REMOVE ALTOGETHER AS IT IS PROTECTED

TRANSOM WINDOW: S1.15

TYPE N:
PROTECTIVE GLAZING: WITHIN FRAME
NOT VENTED

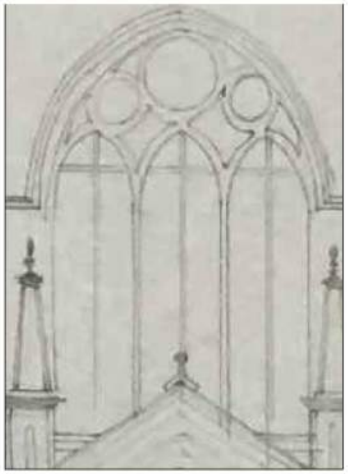
REPLACE WITH VENTED SYSTEM OR REMOVE ALTOGETHER AS IT IS PROTECTED

TRANSOM WINDOW: S1.5

TYPE O:
PROTECTIVE GLAZING: FRONT OF FRAME, SEMI TRACERY MIMICKING, SINGLE VENTED

REQUIRES MULTIPLE VENTS FOR AIR CIRCULATION

WINDOW: S2.1



TYPE P:
PROTECTIVE GLAZING: WITHIN TRACERY
SINGLE VENTED
REQUIRES MULTIPLE VENTS FOR CIRCULATION

WINDOW: S2.13

TYPE Q:
PROTECTIVE GLAZING: FRONT OF FRAME
NOT VENTED
REMOVE AND REPLACE WITH VENTED PROTECTIVE GLAZING

WINDOW: E2.16

History of Stained Glass

Meredith Massey

Stained Glass Window Overview in Christ Church Cathedral and Chapel:

When first entering Christ Church Cathedral and Chapel, it is unavoidable to notice the overwhelming number of the stained glass windows throughout each structure. Stained glass refers primarily to the glass employed in making ornamental or pictorial windows and has been a popular window type in churches and cathedrals as a way to represent biblical scenes as well as saints, bishops, etc; historically, these were utilized as a way for storytelling for members of the congregation that were illiterate. Some of the greatest stained glass windows date as early as the 12th and early 13th centuries.[1] However, the art of stained glass continues to stay relevant amongst more modern constructions. Keeping with tradition, many churches and cathedrals still incorporate these stained glass windows into their designs.

History of the Craft:

Early Processes of Stained Glass Making:

As mentioned, stained glass became a popular technique beginning in the 1300s. Essentially, artists were able to make glass from melting sand down at high temperatures and blowing it into a bubble. Once this stage is reached, the bubble must be opened and flattened before the glass can cool down so that it is still pliable. Color would have been added per batch to individual pots. The red glass would be the only one done by a different process. The red would be obtained through a 'flashing' process. This flashing is achieved by coating the glass during the blowing, if added to the pot mixture, the color was typically too dark. The glass panes were small and each window had to be pieced together individually in lead

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[1] Robert W. Sowers, "Stained Glass," Encyclopedia Britannica, accessed March 3, 2015. http://www.britannica.com/EBchecked/topic/562530/stained-glass.

grooved cames. Not all of the details of the design would have been created solely through the placement process. Additional designs were done by flat line drawings applied directly to the glass. The drawings were done with a brown paint mixed with powdered glass that was adhered during an additional firing. Early glaziers would have only used paint specifically for these lines allowing for the glass to be translucent. [1]

Glass Paints in the 16th and 17th Centuries:

In the 16th and 17th centuries these techniques became obsolete with the introduction of glass paints. The thick and heavy lead used to create depth and contrast in between the panes traditionally, was also lost seeing that there was no longer a necessary. The translucence that artists were known for in the 13th and 14th centuries was also compromised through the use of these opaque paints because they were used to achieve these colors rather than applying color to the glass making process. [2]

19th Century Revivalists in America:

America in the 19th century brought about change when painter, John La Farge, criticized the opaque glass paints and hoped to revive the pot-metal glass making techniques. Unfortunately the same processes were not used. Rather than the leaded strips throughout the windows creating depth and shapes, La Farge and his followers used the molten glass and molded it into ripples to create a similar effect. However, though his intentions were commendable, this technique was unsuccessful and did not achieve the same look.

William Willet was the first to debunk La Farge's practices and in 1898 returned to what was considered to be the Gothic ideal: thick lead, translucent glass, flat decorative design lines and all assembled through the mosaic process of individually placing glass into small panes. [3]

The 20th century has brought more technical advances and innovations in stained glass making. Slab glass and concrete are now used in lieu of the previous masonry techniques popular particularly in Islamic architecture using cement tracery that were popular prior to this innovation.[4]


Figure 3.1: Photo by Meredith Massey: three lancet window

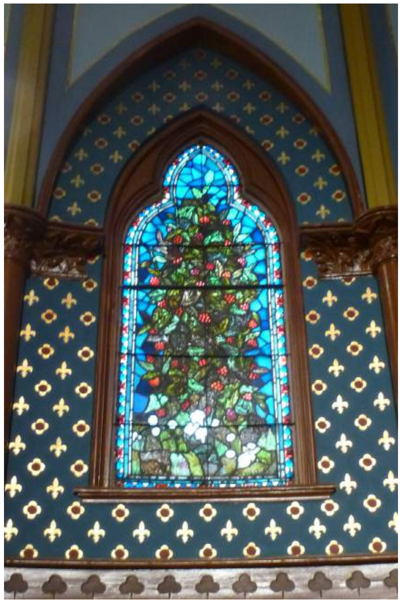
Figure 3.2: Photo by Meredith Massey: example of floral windows above altar

Christ Church Cathedral and Chapel – Stained Glass Windows

Following the construction of the fourth Christ Church Cathedral, stained glass windows have been installed in phases. The only set of windows original to the previous Christ Church Cathedral structure is the three lancet window over the door that leads between the cathedral and the chapel. The flower windows above the altar are thought to have been put in during the most recent construction, however, there is no specific information available on the maker available. In the chapel, there once was a large mosaic stained glass rose window over the altar. With the additions made to the chapel in 1940-41, it is no longer visible for the general public to view. The choir room is the only room where the window can be seen. The remaining stained glass windows throughout both the chapel and the cathedral were contracted out to different companies, primarily along the east coast. Four companies can be attributed the remaining stained glass windows: Willet, Howard, Burnham, and Payne. Although they were contracted to these companies, the church did not typically pay

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[1] Helen McCloy, "A Lost Art Re-Born: Recent Developments in American Stained Glass," *Parnassus*, accessed March 3, 2015. http://www.jstor.org/stable/771213?Search=yes&resultItemClick=true&searchText=stained&searchText=glass&searchText=symbolism&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Dstained%2Bglass%2Bsymbolism%26amp%3Bacc%3Don%26amp%3Bwc%3Don%26amp%3Bfc%3Doff%26amp%3Bgroup%3Dnone&seq=1#page_scan_tab_contents.

[2] *Ibid*

[3] "A Lost Art Re-Born."

[4] "Stained Glass."

for the individual pieces, often times the families would donate funds for these windows in memory of a loved one. [5]

Willet Studios:

Most notable of the studios contracted to work on pieces contracted for the cathedral is Willet Studios based out of Philadelphia, Pennsylvania. This studio was founded in 1898 by artist, William Willet, a noteworthy stained glass artist to whom is attributed to the revitalization of leaded stained glass making. He returned to the traditional methods of stained glass production that date to Gothic times.[6] The church commissioned work to the Willet Studio and the majority of pieces are from this studio. Forty-four of the stained glass windows between the chapel and cathedral can be attributed to Willet Studios. Most of these commissions can be dated from 1959-1981.

Figure 3.3 Photo by Rachel Howard: Example by Willet

Willet Studios continued to grow after their founding at the end of the 19th century and in the 1950s, began experimenting with new techniques. They were one of the first American studios to design and fabricate faceted glass windows. They also experimented with methods of laminating stained glass and developed a famous gold sculpture window technique.[7] Christ Church's chapel has two of these gold sculpture windows, depicting the Ascension and the Pentecost.

Len R. Howard (Howard, Gisler, and Rowe):

Len R. Howard is credited with the creation a few of the earlier stained glass windows. Howard was a native of London but moved to Boston in the early 20th century. Following WWI, he moved to New York City where he eventually established his own company, Howard, Gisler, and Rowe. In 1921, the company closed and he moved to Kent, Connecticut, where he continued his designs and work.[8] Christ Church has five of his pieces dating from 1950 and 1951. Four of these pieces are the archangels above the choir and the last was the depiction of the Transfiguration, located in the nave of the cathedral.

Figure 3.4: Photo by Rachel Howard: Example by Howard

Wilbur H. Burnham Studio:

Wilbur Burnham also did work for the Christ Church. Founded in 1922, William H. Burnham Studios was based out of Boston, Massachusetts and; specialized in traditional stained glass works. His studio was selected by the Smithsonian Institution as being one of the four finest stained glass studios in the country.[9] Burnham was commissioned for four windows in 1953 and 1954. His work depicted four biblical scenes and are located in nave of the cathedral.

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[5] Christ Church Cathedral 8/82

[6] "Willet Studios," Willet Hauser, accessed March 3, 2015. http://www.willethauser.com/aboutwh/ourstory/willet.asp.

[7] *Ibid.*

[8] Madeleine Howard Pasha, "Len R. Howard Stained Glass," Ancestry, accessed March 3, 2015. http://boards.ancestry.com/thread.aspx?mv=flat&m=9825&p=surnames.howard.

[9] "About Burnham and LaRoche Associates, Inc.,"Burnham and LaRoche Associates, Inc., accessed March 4, 2015. http://www.bostonglassservice.org/about_us.html.

Payne Studio:

Payne Studio was based out of Patterson, New Jersey. Payne Studio was a family business where many members learned the artistry behind stained glass making and passed it down through the generations. During the time that Payne Studio worked on pieces for Christ Church, George Payne would have been the primary artist. Payne was known by churches and synagogues for his distinctive style and artistry.[10] Payne was commissioned to do six of the saints in the cathedral: St. Andrew, St. Matthew, St. Thomas, St. James, St. John, and St. Peter. Each of these pieces was done between 1958 and 1960.

Emil Frei Inc.:

There is one additional window commissioned for the church that was not by any of the other practicing studios. A window located in the vestibule called "O'er Waters of Death Walks Death Eternal" was made as a memorial in 1948 and donated to Christ Church. Emil Frei Inc. was also an early glass studio in America. In 1898, the Bavarian immigrant finally settled in St. Louis, Missouri, and started his own company, Emil Frei Art Glass. Similarly to other stained glass companies, Emil Frei Inc. has remained a family business. Later generations of Frei's would have been the ones commissioned for the piece donated to the cathedral. Under Emil Frei Jr., the studio saw an effort to promote the revival and modernization of stained glass.[11] This effort can be seen in the piece at Christ Church. There is a definite stray from tradition in aesthetics of the stained glass, the shapes and panes are much sharper and the colors even a bit more modern.

Figure 3.5: Photo by Rachel Howard: Example by Frei

Belcher Mosaic Glass Company

Henry H. Belcher founded the Belcher Mosaic Glass Company in New York City towards the end of the 19th century. At that time, Belcher's technique was a modern innovation which demonstrated a new way to create and design decorative windows. A catalog dates the existence of the Belcher Mosaic Glass Company to as early as 1886 and provided insight to this new style of window production. The mosaic approach to glass making came about as Americans were shifting away from traditional methods of decorative glass making. The mosaic style strayed from the traditional pictorial stained glass and focused on creating harmonious arrangement of diverse colors. The modern technicians approached the mosaic glass making much more like an artist would rather that a glass maker. They concentrated on how light and shade would affect their combination of colors and prismatic light.[12] The hallmark of Belcher was his tendency to phase colors. This meant that he would use primarily one color to be the overall scheme of his work and would fade from dark to light within the art window. The advancement in technologies allowed for this to be done more affectively due to a wider production of color.[13]

http://www.theageofelegance.com/galleries/victorian/special/ae456-vo/ae456-vo.htm

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[10] "George Payne Stained Glass Studios," Rohlf's Stained & Leaded Glass, accessed March 4, 2015. http://www.rohlfstudio.com/george-payne-stained-glass-studios/.

[11] "History: The Early Years, Emil Frei Sr., Artist and Visionaire," Emil Frei, accessed March 4, 2015. http://emilfrei.com/history/.

[12] "Mosaic Art Glass of 1880 – Belcher," CTG Publishing, accessed April 12, 2015. http://ctgpublishing.com/tag/belcher-mosaic-glass-co/.

[13] "Victorian Specialty Glass," Age of Excellence, accessed April 12, 2015. http://www.theageofelegance.com/galleries/victorian/special/ae456-vo/ae456-vo.htm.

The Windows of Christ Church Cathedral and Harris Memorial Chapel: Conditions Assessments and Recommendations

Rachel Howard

Causes of Decay:

The 1915 hurricane blew away the spire from the church's bell tower and likely the cupola.[5] Then, in 2005, Hurricane Katrina caused damage that necessitated replacement windows. Faulty downspouts and drains, which are discussed in Section 6 of this report, contribute to the jeopardized stability of the walls and therefore the stability of the windows' casements. When the trapped hot air and moisture rises within the walls, it will try to exit through the path of least resistance, in this case, the windows.[6]

The roof leaks[7], which causes more moisture damage resulting in both decreased strength, and also peeling paint problems (casements). Other factors contributing to decay are the combination of moisture wicking up and leaking down through the susceptible brick and stucco; and the lack of adequate ventilation; "overgrown" shrubs and plants; and the lack of a slate course in the ambulatory.[8]

Previous Interventions:

Severe weather has been the leading cause of past interventions. Additionally, a window was removed or destroyed when the ventilation system was being updated[9] and has been replaced with a wooden panel (see Figure 1).

Previous Interventions:

Severe weather has been the leading cause of past interventions. Additionally, a window was removed or destroyed when the ventilation system was being updated[10] and has been replaced with a wooden panel (see Figure 1).

Figure 3.6: Wooden board where stained glass window used to be

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[5] Forman, "Christ Church Cathedral" 8.

[6] Cukierski, "Moisture Condensation at the Windows"

[7] See "Section 4: Roof" of this report.

[8] See "Section 2: Masonry" of this report.

[9] Roby, "Christ Church Cathedral" 48.

[10] Roby, "Christ Church Cathedral" 48.

Conditions Assessments:

Visual assessment has been conducted for each of the windows. This preliminary process included looking at the whole window to see if it has any waves in the structure of the window; if waves are present, the lead is weakening and will soon break, causing the glass to fall out in the worst case scenario. Looking at the bars of the windows at the solder joints to see if the bar has pulled away from the window, is another way to tell if the lead is weakening. Also, inspecting the lead itself, for example, looking for cracks, is another way to detect signs of lead damage. Furthermore, when up close to the window, the sections that make up the whole window will be visible; if a repair is necessary, these sections can be taken out individually, thereby avoiding pulling out the whole window. It should be noted that any time a repair is done, some breakage of the glass usually happens. There are ways to minimize this, depending on the nature of the condition of the windows.[11]

The altar windows all show signs of failing structural stability. The window on the far left side has twelve main sections created by the interior support beams. The section on the lower left is a wavy. The adjacent window has waving in the top left and bottom right; the third window has a rather homogeneous horizontal waving pattern; the fourth window's damage is mostly concentrated on the right transept of the cross. Because of the highly ornate and busy quality of the design, it may be difficult to discern the damage in the following images (Figures 2 – 8). The fifth window has a diagonal wavy pattern; the sixth altar window shows the most severe waving near the thickest central support beam; and the last window shows damage near the top and at both bottom corners.

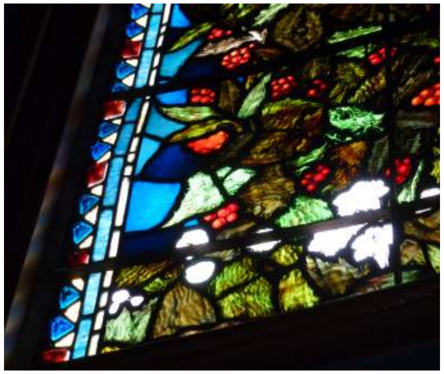

Figure 3.7: Moving from left to right, altar window 1 of 7

Figure 3.8: Altar window 2 of 7

Figure 3.9: Altar window 3 of 7

Figure 3.10: Altar window 4 of 7

Figure 3.11: Altar window 5 of 7

Figure 3.12: Altar window 6 of 7

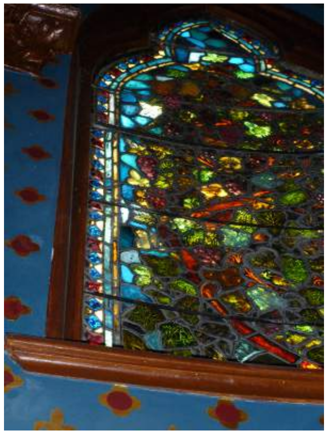

Figure 3.13: Altar window 7 of 7

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[11] Ruth, Email Consultation.

The choir clerestory window has a concave planar deformation in the circles of the window's Venetian design. There is also cracked glass under the lily near the support beam (see Figure 9).

Figure 3.14: Cracks in window

Many other windows show severe planar deformations like bowing and waving, and make a creaking sound as they move under even the gentlest of pressure. The warping and flexibility of the windows is most pronounced throughout the Sixth Street elevation interior, less on the St. Charles elevation, and even less still inside the chapel.

Recommendations:

Certain recommendations are more urgent than others; a list of priorities with accompanying explanations follows:

1. The Rose Window: It is irreplaceable and very significant. Before the addition of a second floor to the chapel in the 1940s, this window was over the altar.[12] It is comprised primarily of small pieces of glass with comparatively thinner cames. The most dramatic waving is in the center of the window with the bottom right also showing planar deformations.
2. The apse skylight: Its health and its ability to ventilate, directly affects the blue paint of the apse.
3. The ambulatory walkway: It directly affects the windows in the apse. The ceiling in the apse is plaster, which means that it is highly vulnerable to erosion/destruction via moisture. Plaster can be completely lost via wicking water, especially when the water contains soluble salts, which it almost certainly does in this situation due to the plants and potential fertilizers used to grow them; the nitrates from the bodies buried nearby underground; and the pollutions inherent to a street as busy as St. Charles, just to name a few likely sources. As the salts impact the wall, the windows will suffer.
4. The casements should be scraped and repainted to undo what seem to be incompatible layers of paint.[13]
5. Caulking should be removed from around the windows. Caulking was likely used to prevent leakage, however, strictly closing paths for water to escape will only force the water to continue moving through the building's materials, causing increased damage. Also, caulking is aesthetically intrusive and usually not conservation-grade.
6. The storm windows should be removed or ventilated along the second floor of the apse since they do not breathe well,[14] and therefore are creating a humid micro-climate ideal for biological growth and breakdown of the lead cames.

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[12] Cathedral "CCC Interiors" 3.

[13] Please see "Section 9: Architectural Finishes" in this report.

[14] Roby, "Christ Church Cathedral" 42.

Protective Glazing Systems

Samantha Williams

Overview of Protective Glazing Systems

Protective glazing systems have primarily involved a second glass or plastic unit located on the exterior of stained glass windows. The main issues with these systems are condensation, heat build-up which increases the expansion/contraction of the glass, the elimination of natural ventilation, and the hindrance of maintenance which leads to the deterioration of the stained glass, leading cames, and frames that are being protected. It is a common mis-perception that the protective glazing hermetically seals out all weather, but without proper maintenance the sealants become the weak point and deteriorate over time. As a result, a micro-climate can occur within the interspace, creating a greenhouse effect.

The European VIDRIO project (2002-2004) was created to better understand preservation/conservation measures for ancient stained glass by understanding the environmental effects. The project focused on two windows on the Sainte Chapelle, a Gothic chapel in Paris, France built in the 13th Century by Louis IX. One window was left exposed while another was fitted with protective glazing. The results of the survey work showed that the protective glazing system "…reduced the thermal shocks…"[1] on the protected window. However, there was a chance of exposing the stained glass to the greenhouse effect, which is caused by the increase of temperature on the protected window versus the unprotected, but they believed that the thermal protection outweighed the effects of the greenhouse gases[2]. The way to counteract the greenhouse effects, which is imperative, is by making sure the protective glazing is ventilated. Further research on ventilation is discussed below.

Figure 3.15: Left window shows protective glazing without regard for tracery and the right window was restored and the protective glazing removed. Credit: Neal A. Vogel and Rolf Achilles via The Preservation and Repair of Historic Stained and Leaded Glass

A benefit of leaving windows uncovered is that exposure to rainwater allows the windows to be routinely cleaned for surface dust and dirt. While this exposes the stained glass to the elements/environment it is accessible to routine maintenance that cannot always be achieved when a protective glazing is in place.

There is also an aesthetic impact to the overall design of the building and the stained glass windows (see Fig. 1). These systems can alter the perception of depth, verticality, texture, color and light. For tracery windows the most successful installation aesthetically speaking is when it is fit within the tracery (see Fig: 2) Improper installation can accelerate the deterioration of the supporting frame, leaded glass and surrounding elements.

In March of 1995, Inspired Partnerships began a field survey of 100 protective glazing installations. They broke it up to four regional areas of the United States to find a representation for different climates.

Figure 3:16: Sacred Heart Catholic Cathedral, Tampa, FL, Example of Tracery Protective Glazing, Photographer: Dr. Roy Winkelman

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[1] C. Saiz-Jimenez. *Air Pollution and Cultural Heritage*, (London: CRC Press, 2004), 136

[2] *Ibid.*

Group D was made up of the Southeast region and the surveys were performed in Charleston, SC and Savannah, GA. They were chosen for their concentration of historic churches, strengths in preservation, building documentation and vulnerability to hurricanes which can be relatable to New Orleans. It was discovered that with Hurricane Hugo the majority of damage to stained glass was caused by flying debris and not the wind and rain of the storm. The stained glass that survived was not covered with a protective glazing system. The reason for this is that stained glass itself has a higher resistance to wind pressure. Some of the stained glass with protective glazing was blown out in its entirety. The humidity and use of air conditioning also gave this group the highest rate of condensation issues.[3]

There are four ways to ventilate a protective glazing system. They are to the exterior, interior, isothermal to the interior and then no venting. According to European studies no venting has proven to be the most detrimental to the stained glass system. Venting allows for condensation to evaporate and leave the interspace, the pressure to equalize, and the heat to escape. If protective glazing is required there is a strong need to determine the cause of deterioration in order to install the appropriate system. A lot of research has been conducted on European stained glass, but one must remember that stained glass in Europe is medieval while stained glass in the United States is considered modern. The difference being that medieval stained glass was made with potash which makes it more susceptible to corrosion. While medieval glass and modern glass are different, the studies can still be beneficial to stained glass systems in the United States, as in the above mentioned VIDRIO Project.

For hot and humid climates venting to the exterior introduces warm, moist air to the interspace which interacts with the air conditioned interior space thus creating the possibility of condensation on the stained glass. Ideally, interior vents would solve this problem yet the feasibility and cost are higher because it involves altering the stained glass to incorporate the vents. Exterior vents should be located at the top and bottom in order to create an air flow. In the article "Analyzing the Impact of Protective Glazing on Stained Glass," authors Mark Gilberg, Sue Reilly, and Neal Vogel write that, "Increasing the depth of the airspace from 1 to 5cm has been shown to increase the flow rate significantly through the clearance between the protective glazing and the stained glass window."[4] The protective glazing should be installed in a separate frame between 5/8" and 1" from the glass.[5] By creating an independent frame the wear on the original window is less and the ease of maintenance is increased. For ventilation of glass systems a gap is left at the top and bottom of the system. With the plastic systems holes can be drilled at the top and bottom.

Types of Protective Glazing Systems:

1. Polycarbonates
2. Acrylics
3. Laminated glass
4. Plate glass
5. Tempered glass
6. Leaded
7. Isothermal Polycarbonates

Polycarbonates have a high resistance to impact due to its flexibility, but are more prone to scratching due to this characteristic. They are also known to degrade in color and clarity due to UV. rays (see Image: #). It has a high co-efficient for expansion so if installed improperly it will affect the performance of the system. This expansion can break the sealant thus allowing water behind the glazing and if not properly drained can deteriorate the wood frame. The most commonly known product is Lexan. A deep rebate frame is recommended to allow for expansion and a silicone caulk, but if the windows are leaded it cannot be used if acetic or other organic acids are released during curing.[6]

Acrylics are harder than the above polycarbonates and have a higher resistance to scratching. However, it is also affected by thermal expansion, yellowing and hazing for ultra-violet radiation. Its most popular product is Plexiglas.

Laminated glass is a combination of glass and plastic technology where the plastic is located between two or more pieces of glass. The glass will shatter, but remain intact. One benefit is that it reduces sound trans-

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[3] Inspired Partnerships, Inc., *Protective Glazing Study 1996-06* (Chicago: NCPTT, 1996), 20

[4] Mark Gilberg, Sue Reilly, and Neal Vogel. "Analyzing the Impact of Protective Glazing on Stained Glass Windows", *Studies in Conservation* 47.4 (2002): 161-174

[5] Neal A. Vogel and Rolf Achilles, "The Preservation and Repair of Historic Stained and Leaded Glass," *National Park Service* (2007), http://www.nps.gov/tps/how-to-preserve/briefs/33-stained-leaded-glass.htm

[6] Inspired Partnerships, Inc, "Protective Glazing Study 1996-06", 106.

mission if it is laminated insulating glass. Through testing it was shown to be better than plastics and monolithic glass in this regard. Using a product such as Monsanto's Saflex for the interlayer can provide better U.V. protection as well.

Plate glass is created by casting and rolling it into a solid plate and then further grinding and polishing is required. It has one of the lower impact resistance rates of the types, but is the most economical.

Tempered Glass is considered a safety glass. It is created by a process of heat application and chemical treatments allowing it have a higher strength than normal glass. Its biggest downfall is that it must be manufactured to the specific window as it cannot be cut once the process is completed.

Leaded glass has been used to break up large pieces of glass and glare. They are either figurative or geometric and have the highest aesthetic quality in regards to the stained glass. The downside to leaded protective glazing is its expense, but this system could be better used for primary stained glass windows. It has a higher rate of use in Europe because it was originally designed for cathedrals there.

Isothermal has been determined to be the best option for venting the interspace in Europe. It completely separates the stained glass from the exterior. This is done by placing the glazing where the stained glass was located and adjusting the frame members if possible or a new frame is built so that the stained glass is supported on the interior.

The pros to the plastic products are its strengths, weight, installation ease and being less expensive than their glass counterpart. The cons are its ability to scratch, haze, yellow due to UV rays, and its higher thermal expansion and contraction. Plastic protective glazing systems all share the same results. Historically, the plastic will cloud and yellow due to weather and UV rays making the stained glass irrelevant. Although technology is constantly evolving, GE, the maker of Lexan, has created an updated product that claims to resist the yellowing and hazing while providing U.V. protection. It is called Extended Life LexanA.

The pros to glass products aesthetically superior, will not bow, scratch or haze. The cons being that it is more expensive, heavier and more difficult to install. From the research provided it seems that a laminated glass with a solar interlayer provides the most protection if U.V. protection is your primary goal.

Protective Glazing at Christ Church Cathedral:

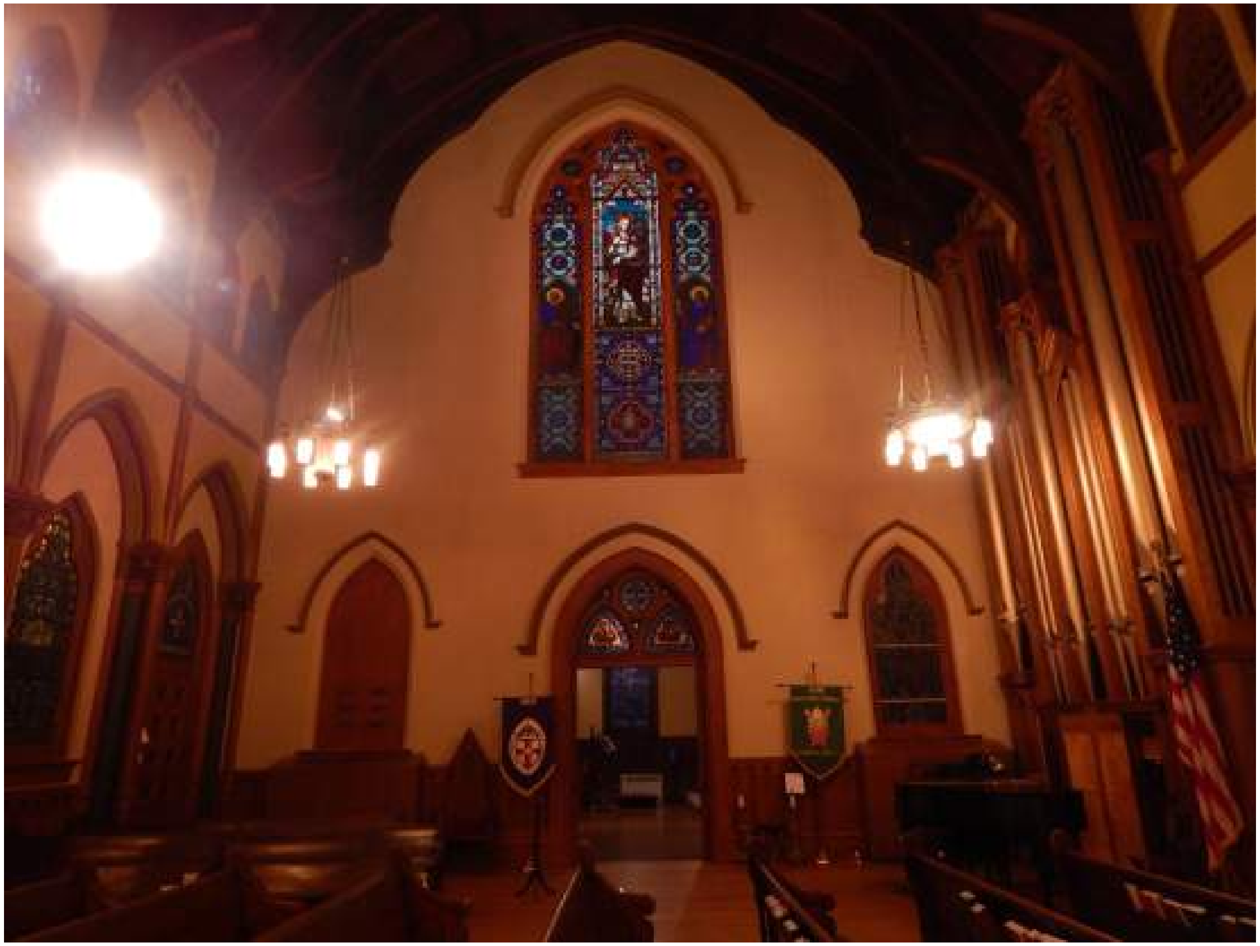
Christ Church Cathedral has numerous examples of failed protective glazing units. The majority of glazing systems are either not vented (see Fig: 3) at all or have only a top vent which does not allow for air circulation (see Fig: 4). This has resulted in hazing to the point of opaqueness (see Fig: 5) and sealant failure (see Fig: 6)

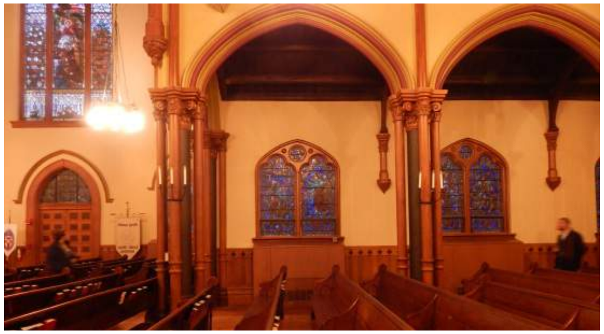

Figure 3.17: Non-vented window/transom at Cathedral main entrance.


Figure 3.18: Single vented window on West Chapel Exterior Wall


Figure 3.19: Non-vented opaque/failed protective glazing example on West Cathedral wall.. All photos on this page credited to Samantha WIlliams


Figure 3.20: Sealant failure and debris visible behind glazing system. Window on East Chapel Wall, by Cathedral western entrance.





The Story of Christ Church as seen through the History of the Symbolism and Installation Patterns of its Stained Glass

Elizabeth Shultz

While there is a long history of stained glass artistry in many of the churches in New Orleans, a great deal of the significance of the stained glass that is on display in the Christ Church Cathedral is a result of the church's dynamic approach to stained glass use throughout the twentieth century. The continued installation new stained glass pieces throughout the twentieth century in both the Cathedral itself as well as in the adjoining Chapel is an apt and appropriate reflection of the transitions that the church congregation itself historically underwent in its quest to achieve its final location on the corner of St. Charles Avenue and Sixth Street. This report on the history and motifs present in the stained glass windows of Christ Church Cathedral circa 2015 will demonstrate the remarkable extent to which both the history of church congregation and the evolution of the liturgical practices of the church are reflected in the changes over time to the decorative glass artistry of the building.

Remnants of the Third Church and the High Style Gothic Revival in Three Lancet Windows: St. Peter (1873), The Good Shepard (1880), and St. John (1873)

The earliest stained glass windows in the Cathedral, which is the fourth architectural iteration of the Christ Church congregation's home base, are actually not native to the structure that was erected at the corner of St. Charles Avenue and Sixth Street.[1] The oldest windows in the Christ Church Cathedral are located in the North Transept of the building.[2] Today this ecclesiastical address translates to mean that this trio of historic stained glass windows can be seen above the entryway that connects the main sanctuary of the Cathedral proper with the adjacent Harris Memorial Chapel, which was added to the north side of the main body of the Cathedral in 1889.[3] While today they seem happily homed in the Uptown St. Charles neighborhood of New Orleans, they were originally crafted to decorate what is today colloquially referred to as the Third Christ Church. This church was historically situated at the lakeside corner of Canal Street and Dauphine Street,[4] in what is today the heart of New Orleans' Central Business District. In his short, but detailed, history of the Christ Church parish and its parishioners, William Harper Forman Jr. writes that, "The third building [for the Christ Church congregation] was Gothic in style with buttresses and a central tower."[5] Accordingly, the decorative glass designs for this grand high style Gothic Revival church appropriately included the typical religious imagery that would have not been religious doctrine. Both of these stained glass windows were first installed in the Third Christ Church building at the corner of Canal Street and Dauphine Street in 1873 through the generosity of the a prominent parishioner, Mrs. Cora A. Slocomb.[6] The creation of these two pieces of stained glasswork is credited to the partnership of Alphonse Friedrick & Bro, out of Brooklyn, New York. The central panel of this grouping, which is also the largest, portrays an image of Jesus Christ as the good Shepherd, and thus is appropriately entitled "The Good Shepherd."[7] This piece was created and installed in 1880 to honor the memory of the second bishop of the state of Louisiana, the Right Reverend J. C. R. Wilmer, D.D., and was funded by the Ladies Aid Society at that time.[8] As demonstrated by the image of this trio, which can be seen to the right in Figure 3.21, these three stained glass windows are of such design, style, and subject matter as to be appropriate in a high style Gothic Revival Church, nestled amongst soaring stone columns on the interior and solid flying buttresses on the exterior of the building - a characterization that, of course, comes from historical narratives that provide descriptions of the Third Christ Church in downtown New Orleans.[9]

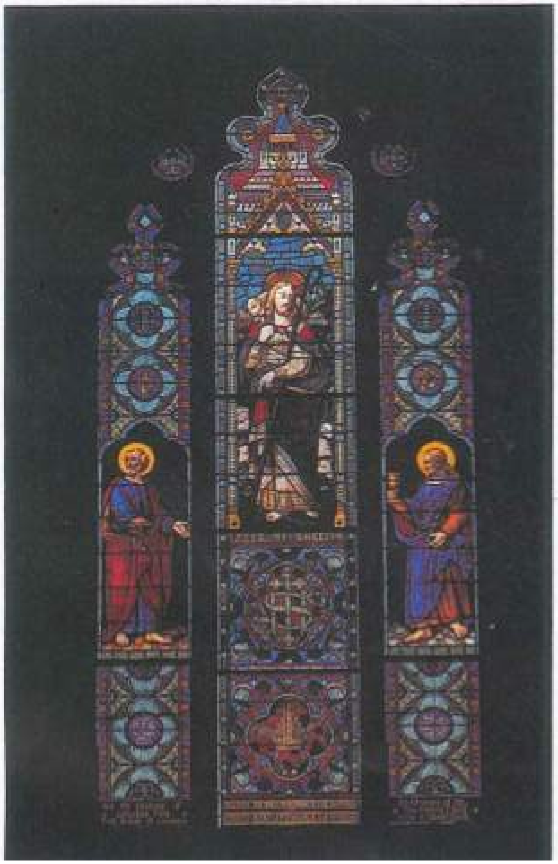


Figure 3.21: An image of the lancet windows from the Third Christ Church that are now featured prominently in the structure on St. Charles Avenue. Photo believed to be circa 1983. Courtesy of the Christ Church Cathedral and digitized by Nathan Marx and Elizabeth Shultz.

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[1] Christ Church Cathedral, "Christ Church Cathedral," 3.

[2] *Ibid.*

[3] *Ibid.*

[4] Harper Forman Jr., *Christ Church Cathedral: The Third Century Begins,* 3.

[5] *Ibid.*

[6] *Ibid.*

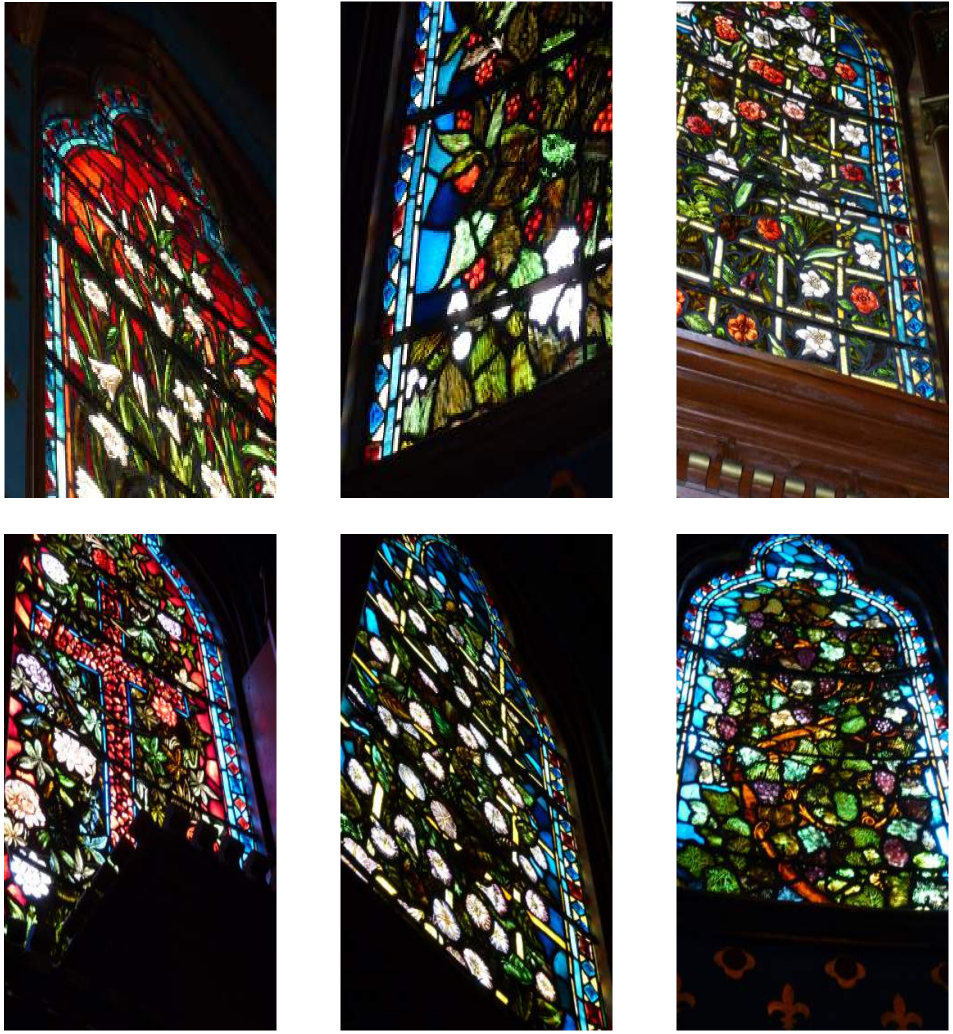
[7] *Ibid.*

[8] Christ Church Cathedral, "Christ Church Cathedral," 2.

[9] Harper Forman Jr., *Christ Church Cathedral: The Third Century,* 1-12.

Transition to Uptown and the Twentieth Century: The Early English Arts & Crafts Style of the Stained Glass Artistry above the Altar of Christ Church

While the Fourth Christ Church, which was later consecrated as a Cathedral in 1892,[10] exhibits an exterior that was planned and constructed in the Gothic Revival style that has long been recognized as a near given in the world of ecclesiastic architecture design,[11] numerous small details of the interior, including the oldest original pieces of stained glass that were created specifically for their installation in the uptown structure that was erected at the corner of St. Charles Avenue and Sixth Street as the fourth premises of the Christ Church parish, hints at the transitional stirrings of movement in the world of design towards a greater appreciation of raw materials and the naturalistic landscape, and thus heralds the forthcoming arrival of English Arts & Crafts motifs in North American architecture. In the PBS produced discourse entitled "God in America: The City Guide to Sacred Spaces, New Orleans, LA," it is noted that while the interior of the Fourth Christ Church features some of the expected Gothic Revival details, such as pointed arches and the lancet windows[12] that were discussed above (which, again, were removed from a distinctly high style Gothic Revival church to be rehoused in this building on St. Charles Avenue), "The space was designed in the Arts and Crafts Style, with original simple windows depicting images from nature."[13] These "original simple windows"[14] are still featured in Christ Church Cathedral in what is arguably the most prominent and symbolically significant location - at the very front of the church, above the altar. These six pieces of stained glass artistry are reported by Christ Church historians to have been purposefully designed for their present location and were there installed while the building was first being constructed.[15] Each one of these six panels presents a depiction of a different floral bouquet, and the flowers contained therein all symbolically communicate the moral ideals that were popular during the decades that bridge the blooming of the twentieth century in the United States. With the installation of these stained glass pieces highlighting the natural world, and operating in conjunction with the naturalistic simplicity of Christ Church's oak pews,[16] the original design and architecture of the structure powerfully convey the *zeitgeist* of the era in which the Fourth Christ Church was constructed.



Counterclockwise from top left: Figures 3.22-27. Detail photographs of the stained glass windows above the altar at the front of the Christ Church Cathedral Sanctuary. All six of these windows present pleasing naturalistic imagery. Photos taken 03/25/2015 by Rachel Howard.

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[10] Harper Forman Jr., *Christ Church Cathedral: The Third Century,* 7.

[11] Phoebe B. Stanton, *The Gothic Revival and American Church Architecture: An Episode in Taste, 1840-1856* (Baltimore, MD: Johns Hopkins UP, 1997), 3.

[12] PBS, "God In America: The City Guide to Sacred Spaces, New Orleans, LA," http://www-tc.pbs.org/godinamerica/art/nola_cityguide.pdf, 23.

[13] PBS, "God In America: The City Guide to Sacred Spaces, New Orleans, LA," 23.

[14] *Ibid.*

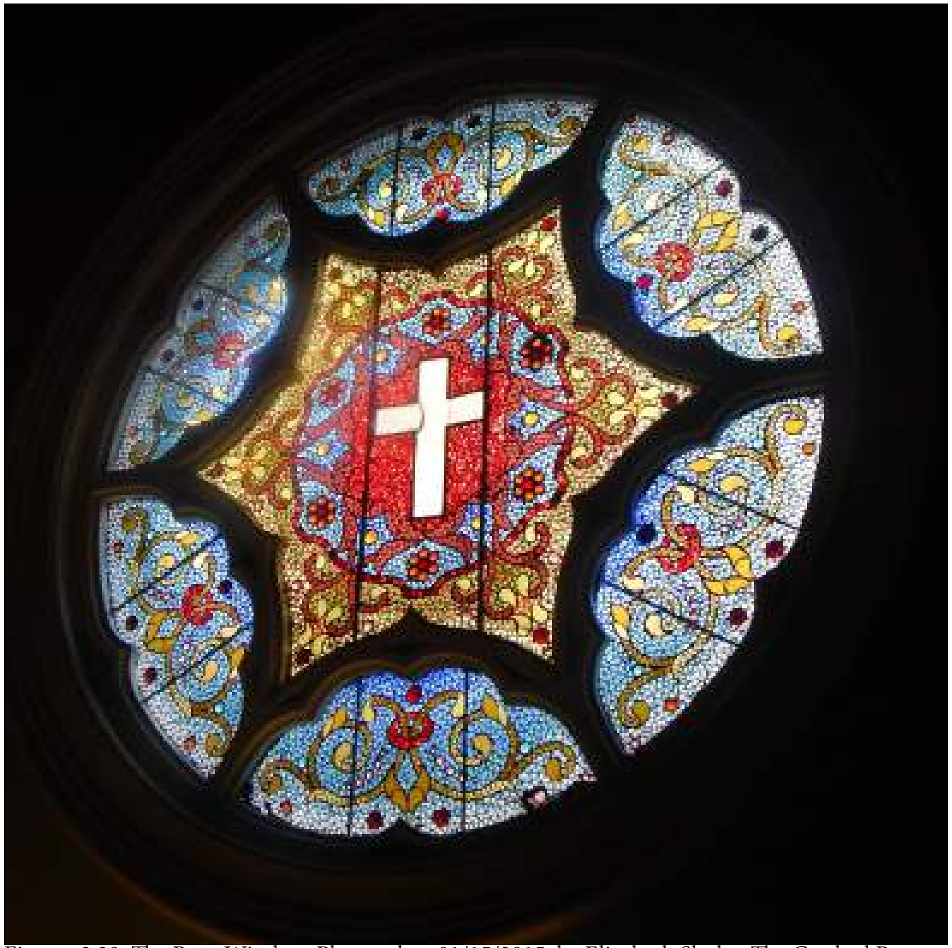
[15] Christ Church Cathedral, "Christ Church Cathedral," 2.

[16] PBS, "God In America: The City Guide to Sacred Spaces, New Orleans, LA," 23.

Bridging the Temporal and the Ethereal Worlds: The Rose Window of the Harris Memorial Chapel as a Link Between the Stained Glass of the Nineteenth and Twentieth Centuries in Christ Church

The Rose Window above the altar in the Harris Memorial Chapel was formerly the dominant decorative element in the space prior to a twentieth century restoration enclosed it within a modern choir practice space.[17] This window, which has been recognized within the wider community of stained glass aficionados for its unique and complicated method of construction and its associated beauty, is an excellent representation of the transitional liturgical phase that was entered into by the Christ Church congregations as they simultaneously embraced the twentieth century. The design of this particular piece of stained glass highlights some of the naturalistic elements that had previously been featured in stained glass in the main Christ Church Cathedral sanctuary - in the six floral stained glass panels that are located above the altar in that space - whilst also hinting at what the future of stained glass at both Christ Church Cathedral and Harris Memorial Chapel would bring. The design of the Rose Window, with leafy vines and delicate floral- esque shapes encircling a cross, is the first know St. Charles Avenue piece of stained glass that is decorated with specially Christian imagery. Accordingly, the design of this window heralds what is to come in being throughout the building during the twentieth century.

Figure 3.28. Detail photo of the rose window that is now located in the choral practice room above the Harris Memorial Chapel. Prior to renovations that added the choral practice space, this window was situated above the altar in the Chapel. Photo taken 01/15/2015, by Elizabeth Shultz.



Figures 3.29. The Rose Window. Photo taken 01/15/2015, by Elizabeth Shultz. The Gradual Return to Rome-Inspired Liturgical Conventions in the Episcopalian Denomination and its Associated Impact on Church Interior Design: The Twentieth Century Stained Glass of Christ Church

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[17] Christ Church Cathedral, "Christ Church Cathedral," 3.

The Gradual Return to Rome-Inspired Liturgical Conventions in the Episcopalian Denomination and its Associated Impact on Church Interior Design: The Twentieth Century Stained Glass of Christ Church

In the publication *Christ Church Cathedral: The Third Century Begins*, William Harper Forman Jr. describes the twentieth century liturgical evolution of Christ Church, writing,

> The Very Rev. William H. Nes, who replaced Cummins as Dean in 1927, was to have a profound influence on Christ Church Cathedral's liturgical practices… Under Dean Nes, the Cathedral was gradually transformed from a Low to High Church. Nes carefully prepared the congregation for the change, explaining the symbolism and history behind the new practices.[18]

These new practices, which according to Harper Forman included the return to more 'traditional' phrasing and Eucharistic services,[19] have consequently left their mark on the Christ Church Cathedral and Harris Memorial Chapel in a visual way. In the PBS publication "God in America: The City Guide to Sacred Spaces, New Orleans, LA," the evolution of the Episcopalian denomination and its impact on church architecture and design is very neatly described:

> As the Anglican Church in England saw a shift in culture and tradition, some churches re-embraced the original High Church traditions, which had existed prior to their break with the Vatican… These trends spread to the United States and the Episcopal Church… Now more in line with that of a "High Church" tradition, the architecture [of the Christ Church Cathedral] has been upgraded and improved to reflect that liturgy.[20]

The motifs that characterize the stained glass windows of the twentieth century that have been installed in the Christ Church Cathedral and the Harris Memorial Chapel are thus overwhelmingly demonstrative of this simultaneous liturgical and architectural transition from Low Church to High Church. The evidence of this stems from the traditional themes seen across windows and decades, and which the author has separated into three groups: Christological Windows, Saintly Windows, and Angelic Windows.

The Christological Windows are, obviously, those windows that portray common scenes from christology. In Christ Church Cathedral proper these windows are "The Transfiguration" (1950), "The Resurrection" (exact date unknown), "Peace Be Unto You" (1970), "Gethsemane" (1951), "The Woman at the Well" (1968), "The Healing at Capernaum" (1959), "The Triumphal Entry" (1961), "Christ and the Little Children" (1963), "Christ Stilling the Tempest" (1973), "The Child Jesus in the Temple" (1954), "The Nativity" (1953), "The Baptism of Our Lord" (1954), "The Calling of the Disciples" (1954), "The Sermon on the Mount" (1957), "Christ Walking Upon the Waters" (1963), and "The Feeding of the Five Thousand" (1966). In the Harris Memorial Chapel the Christological Windows are "The Ascension" (1960), "Calling of Disciples" (1970), "Marriage in Cana of Galilee" (1969), "The Flight into Egypt" (1965), "The Annunciation, The Reigning Child Jesus, The Visit to Elizabeth" (1963), "The Presentation in the Temple" (1966), "Jesus in the Carpenter Shop" (1965), "The Last Supper" (1970), "The Crucifixion" (1960), and "The Resurrection" (1960). These windows, with their stories of Christ's life and activities, harken back to the days when stained glass windows were educational tools.

The second two types of symbols and motifs used in the twentieth century stained glass of Christ Church Cathedral and Harris Memorial Chapel are similarly traditional in that they recall the stained glass themes of centuries past and were also purchased with funds from parishioners as memorials. In the Cathedral sanctuary these include the Archangel

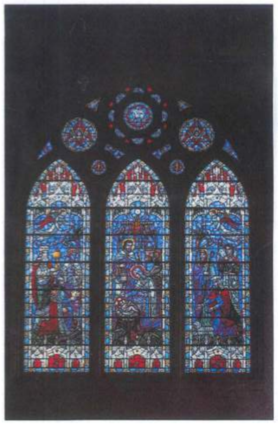

Figure 3.30. The Nativity Window, made by Burnham of Boston (1953.) Photo courtesy of Christ Church Cathedral, believed to be circa 1983.

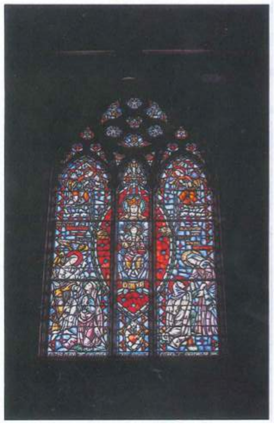

Figure 3.31. The Annunciation Window, made by Willet (1963.) Photo courtesy of Christ Church Cathedral, believed to be circa 1983.

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[18] Harper Forman Jr., *Christ Church Cathedral: The Third Century,* 8.

[19] *Ibid.,* 8-9.

[20] PBS, "God In America: The City Guide to Sacred Spaces, New Orleans, LA," 22.

Windows - “Michael” (1951), “Raphael” (1951), “Uriel” (1951), and “Gabriel” (1951) - and the Saintly Windows - “St. Joseph of Arimathea” (1961), “St. Alban” (1966), “St. Columba” (1967), “St. Augustine” (1961), “St. Dunstan” (1966), “St. Thomas A. Becket” (1968), “St. Cornelius” (1974), “St. Polycarp” (1973), “St. Martin” (1970), “St. John Chrysostom” (1970), “St. Clare of Assisi” (1971), “St. Francis of Assisi” (1963), “St. Philip” (1959), “St. Bartholomew” (1959), “St. James the Less” (1967), “St. Jude” (1972), “St. Matthias” (1971), “St. Mary” (1957), “St. Paul” (1957), “St. Peter” (1959), “St. Andrew” (1958), “St. Thomas” (1960), “St. Matthew” (1960), “St. James” (1958), and “St. John” (1958).

In Summary: Overall Signifiance

The evolution of the relationship between Christ Church’s congregation and stained glass windows, which was detailed above, is a cogent presentation of the history of the Church, its liturgy, and its congregation as they have changed throughout the decades. The existence of this visual record through a decorative detail relating to so focused a topic is only one sliver of the overall ecclesiastical and architectural history that makes the Christ Church campus worthy of the concentrated efforts of preservation professionals and advocates. Accordingly, it must be stated for the record, and noted by stakeholders, that all of the pieces of stained glass window artistry relating to both the Cathedral and the Chapel should be treated with equal reverence and care - whether the window in question was installed in 1886 or 1982. All the windows are integral to both the character and the history of the church as it has in the past, and will continue to be, transformed both socially and liturgically.

The Pegram's Battalion Memorial Belcher Mosaic Window in the Confederate Memorial Chapel, in Richmond, Virginia as a Case Study for the Rose Window of Harris Memorial Chapel

Elizabeth Shultz

With the addition of the Harris Memorial Chapel to the Christ Church complex in 1889,[1] the Rose Window, a Belcher mosaic, was installed and arguably remains one of the most unique pieces of stained glass work in the city of New Orleans. While the 1940s renovations to the Chapel mean that the Rose Window remains relatively safe from accidental damage that could be inflicted during church services or any of the activities or meetings that occur in the Chapel space, the relatively dramatic weather conditions that exist in the Gulf Coast region mean that the Rose Window is a high priority for preservation efforts. As a comparatively uncommon and complicated form of stained glass, Belcher mosaic pieces require special care and maintenance. Understanding this reality, it is important to acknowledge that the care of such a special and integral part of the historic architectural and decorative arts fabric of the city of New Orleans - in addition to Christ Church itself - inevitably requires a larger investment of time, professional opinion, and financial resources. Accordingly, the example provided by the Belcher mosaic stained glass windows of the Confederate Memorial Chapel in Richmond, Virginia provides an excellent case study from which appropriate scholars and professionals can jump to provide tailored recommendations that best suit the Rose Window of the Harris Memorial Chapel.

The Belcher mosaic stained glass window in question for the purposes of this brief case study is the Pegram's Battalion Memorial Window which is located in the Confederate Memorial Chapel in Richmond, Virginia. (image 1) The Chapel itself now on the grounds of the Virginia Museum of Fine Arts.[2] It dates to 1887 and was created to honor the confederate soldiers who served as part of an artillery battalion that was commanded by Major William J. Pegram during the Battle of Gettysburg as part of the Civil War.[3] The Confederate Memorial Chapel was built as a result of financial contributions made by Civil War veterans themselves,[4] and the Chapel was consistently and actively used for religious services until 1941, which is "when the last of the veterans died."[5] According to the 1971 National Register of Historic Places nomination form for the Confederate Memorial Chapel, after 1941 "the chapel was used less and less and only by small congregations. The frequent turn-

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[1] Christ Church Cathedral, "Christ Church Cathedral," 5.

[2] http://vmfa.museum/

[3] http://www.gettysburg.stonesentinels.com/HQ-CSA/ANV-3-Pegram.php

[4] http://www.dhr.virginia.gov/registers/Cities/Richmond/127-0224_Confederate_Memorial_Chapel_1972_Final_Nomination.pdf

[5] http://www.dhr.virginia.gov/registers/Cities/Richmond/127-0224_Confederate_Memorial_Chapel_1972_Final_Nomination.pdf

over in occupancy and the limited financial abilities of the congregations meant that it gradually fell into disrepair"[6] until 1960, when "a group of concerned citizens formed a committee to sponsor the restoration of the chapel… The citizens appealed to the governor for funds to repair [amongst other things] the sagging, cracked stained-glass windows… Money from the State was forthcoming and additional public support made restoration possible in 1960 and 1961."[7] While necessary, some of the interventions from this decade on the Belcher mosaic stained glass window would later be repaired themselves.

Although not comparable in terms of climate, the example of Belcher mosaic preservation that is seen in Richmond, Virginia provides one possible way that the the Rose Window of the Harris Memorial Chapel could possibly be addressed. The preservation team from E. S. Taylor Studio is comprised of principal conservator E. Scott Taylor and conservation technician M. L. Winger. They describe themselves as "solely dedicated to the conservation of historically and artistically significant stained glass windows,"[8] and this was hired to address long term issues of sagging, delayed maintenance, and the incorrect late twentieth century repairs that were mentioned above.[9] E. S. Taylor Studio describes the work on the Pegram's Battalion Memorial Window, writing "Treatment required the reversal of numerous deflections over the entire 3' x 7' mosaic window, the reintegration of pieces which were dislodged and laying behind the window, and the replacement of poorly matched glass from previous repairs."[10] (image 2) In addition to repairs to the actual glasswork of the Belcher mosaic, E. S. Taylor Studio also installed a program of preservation to maintain the security and safety of the Pegram's Battalion Memorial Window: "Due to the fragility of the entire window and the propensity to deflect no matter what support system is employed, overall stabilization was implemented by means of fixing the window between sheets of museum quality anti-reflective glass. Each sheet is open to air circulation with the entire window installed in an isothermal setting fixed to the interior of a mullioned window and vented to the interior."[11]

Given the current relative stability of the Rose Window in the Harris Memorial Chapel, this program of securing the window in-situ between two panes of "museum quality anti-reflective glass"[12] would be an excellent preservation solution for the Christ Church Congregation.

[Image 1, on the left: The Pegram's Battalion Memorial Window, a Belcher mosaic from 1887, from the Confederate Memorial Chapel in Richmond, Virginia. Restoration work done by E. S. Taylor Studio, and completed in 2004. Photo courtesy of E. S. Taylor Studio.]

{Image 2, above: A detail photo as a before and after comparison of the restoration of the Pegram's Battalion Memorial Window. Courtesy of E. S. Taylor Studio.]

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[6] http://www.dhr.virginia.gov/registers/Cities/Richmond/127-0224_Confederate_Memorial_Chapel_1972_Final_Nomination.pdf

[7] http://www.dhr.virginia.gov/registers/Cities/Richmond/127-0224_Confederate_Memorial_Chapel_1972_Final_Nomination.pdf

[8] http://estaylorstudio.com/439775/about-us/

[9] http://estaylorstudio.com/446812/belcher-mosaic-stained-glass-confederate-chapel/

[10] http://estaylorstudio.com/446812/belcher-mosaic-stained-glass-confederate-chapel/

[11] http://estaylorstudio.com/446812/belcher-mosaic-stained-glass-confederate-chapel/

[12] http://estaylorstudio.com/446812/belcher-mosaic-stained-glass-confederate-chapel/

Concluding Recommendations

Throughout this study of the stained glass windows of Christ Church Cathedral and Harris Memorial Chapel, it is grown increasingly apparent that the glasswork is one of the most significant character defining features of the church complex in relation to both the liturgy and social histories of the church and its congregation. Accordingly, all of the associated preservation recommendations for the treatments of these windows respect the integrity of the materials, designs, and processes of the existing windows.

Recommendations: Respecting the Dynamic Stained Glass Window History of Christ Church Cathedral and Harris Memorial Chapel

As a result of the fact that the twentieth century stained glass window histories of both the Christ Church Cathedral sanctuary and the Harris Memorial Chapel demonstrate a congregational passion for funding this form artistic expression - of the windows currently installed in both the Cathedral and the Chapel, over roughly 80% of the pieces were commissioned, designed, and installed in the second half of the twentieth century - it is socially fitting that the congregation continue to take an active role in the funding, design, and installation of new stained glass windows throughout the entirety of the church complex. In this way, the past history of the church and its congregation can be honored without stagnating. Stained glass makers and artisans who have previously had pieces installed in the Cathedral or Chapel should be contacted to design and install potential new pieces. Local stained glass artisans from the New Orleans area should also be considered for these projects. Any new work should be carefully documented through both photographs as well as a written record, all of which should be filed with both the Church and the Southeastern Architectural Archives.

Recommendations: Treatments for both the Existing In-Situ and Ex-Situ Stained Glass Windows of Christ Church Cathedral and Harris Memorial Chapel

As is in-keeping with the respect for the church's transformation over time, all of the existing in-situ stained glasses windows should continue to be used as windows in church complex. The ex-situ windows of the Cathedral and Chapel that have been removed in the past, but which are in storage on site, are recommended to be carefully restored and reinstalled somewhere on the site. These movements should be clearly documented through both written and photographic evidence that should be filed in both the Church records as well as at the Southeastern Architectural Archives. The reinstallation of these windows will significantly contribute to the visual history of the church and its parishioners, further demonstrating the liturgical evolution of the leadership and the congregation of Christ Church Cathedral.

Recommendations to Address Deterioration

The Rose Window, which is extremely valuable, should first be fully documented for both the Church and the New Orleans Historic District Landmarks Commission to preserve the design technique and knowledge of this local resource. All documentation and analysis should also be archived by the Southeastern Architectural Archives to ensure its lasting existence as a historic record for future generations of researchers.

The apse skylight and the ambulatory walkway should be regularly maintained to avoid any water intrusions in order to protect the plaster, paint, and windows located in those areas.

Many windows are also in need of reglazing to best continue their uses as protective barriers from the elements. This work should be carried out particularly in the tower, and while these windows are less significant, they still contribute to the overall character of the Christ Church Cathedral.

In conjunction with the reglazing work that is recommendation, where appropriate, it is necessary for the protective storm window system to be regulated and updated as necessary based on the recommendations of retained protective window system specialists.

The pros and cons of protective glazing systems should be carefully weighed by looking to other case studies from churches throughout southeastern region of the United States. Due to the similar climate and humidity levels, other successes in this area may lead to the best possible solutions to the issued faced by Christ Church. It should be noted that European systems, while addressing entirely techniques of stained glass and climates, it appears as though they have had numerous successes with these systems and processes on a level more advanced than what is currently found in the United States. Technological advances in protective glazing systems should therefore be carefully monitored and studied to possibly be integrated into the Christ Church master maintenance in the coming decades of the twenty-first century.

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Roofing

Christine Carlo and Cody Ellis

Slate Shingles of Cathedral Roof. Photo by Cody Ellis, 2015.

Introduction

Per the original design there are seven individual roof structures to consider; the cruciform-gabled roof over the main cathedral, the gable roof over the chapel, the half conical, high pitch slant roof over the rear apse, the low-pitch roofs that cover the side-aisles of the cathedral, the hipped roof that covers the current location of the organ, the flat roof that covers the “red room”, and the large spire that tops the tower (Figure 4.0). From henceforth these separate roof structures will be referred to as: the cathedral roof, the chapel roof, the apse roof, the side-aisle roofs, the organ roof, the red room roof, and the spire respectively. One major note that should be considered when reading the roofs portion of this report; first hand analyses and documentation of the roof structures was not conducted. The condition analyses of the roofs was conducted by visual observation that could be gather from the tower, the ground, and the interior of the buildings. Historical documents and the narratives of Dimitri Roby were used throughout the production of this document. From here forth, the authors will site any of the presented information that was gather without first hand documentation.

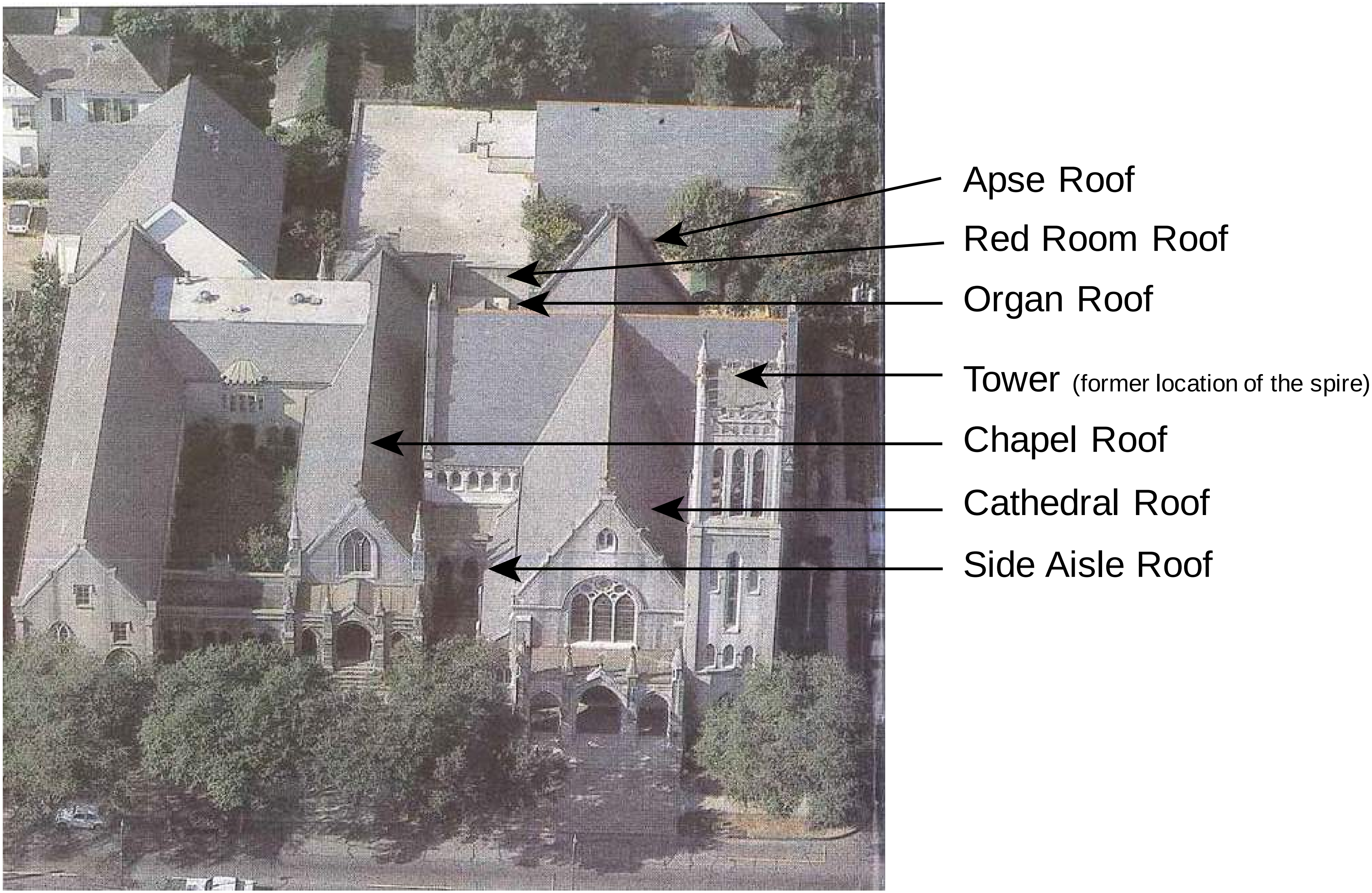

Figure 4.0: Arial view of Christ Church Cathedral.
Photo courtesy of Betsy Swanson.

The Cathedral Roof

The largest roof of the complex is by far the cathedral roof, which consists of two gable roofs that intersect to form a crucifix shape in plan. The main gable roof above the nave runs 106 ft. from the front entrance of the cathedral to the apse.[1] The secondary gable roof spans a distance of 80 ft. between the transepts.[2] The cathedral roof is approximately 36 ft. in width above the nave, with an exterior slope of 60 degrees, and rises 64 ft. above the ground at its highest point. Based on documentation conducted by Dimitri Roby the roof uses a rod truss system, which contains heavy timber members that can be subdivided into principle rafters (that run separately from the masonry wall up to an apex), a horizontal beam (that ties the primary rafters together), and struts (that tie the beam to the primary rafters) (Figure 4.1). The trusses are spaced 12 ft. apart and connected by purlins with metal fasteners (Figure 4.2). Common rafters are then run perpendicular to the purlins and are sheeted with wooden tongue and groove boards (Figure 4.1). Slate shingles are used on top of the sheathing as the main roofing material, along with terracotta at the peaks, and metal flashing in the valleys of the gable intersection (Figure 4.3). Brick parapet walls cap the ends of gable roofs with an alternating extension of approximately 2 ft. above the roof line (Figure 4.4). An interior wooden ceiling structure is attached

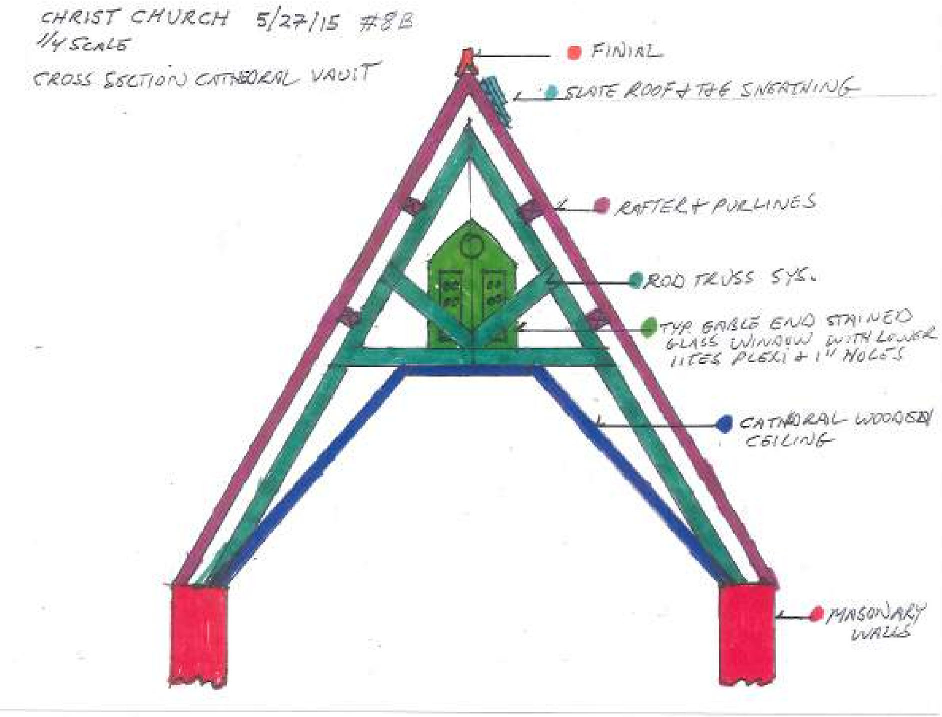

Figure 4.1: Diagram of the cathedral roof structure. Courtesy of Dimitri Roby, 2014.

Figure 4.2: Image from the interior of the cathedral roof. Courtesy of Dimitri Roby, 2014.

Figure 4.3: Ridge condition of the cathedral roof. Photo by Cody Ellis, 2015.

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[1] Samuel Wilson, "The Buildings of Christ Church," (New Orleans: Louisiana Landmarks Society) 1997. P. 48

[2] Ibid

Figure 4.4: Parapet wall at the front of the cathedral. Photo by Cody Ellis, 2015.

Figure 4.6: Entry hatch of the cathedral roof.
Photo by Cody Ellis, 2015.

Figure 4.5: Cathedral ceiling. Photo by Cody Ellis, 2015.

below the trusses and creates a vault space within the roof (Figure 4.1). The ceiling itself consists of exposed medium sized decorative wooden purlins that run between the trusses with wide wooden boards running between the rafters (Figure 4.5). The fore mentioned space above the ceiling is accessible from a trap door located on the south-east slope of the roof via the adjacent window located on the second story of the tower (Figure 4.6). This space was not accessible to the authors at the time of this report. According to a Daily-Picayune article from April 10th, 1887 a large ventilator was located in the vault.[3] A large cupola can also be seen in the perspective drawings of Freret and Wolf that date from 1959 (Figure 4.7). It is likely this aperture related to the ventilation of the space, but as of today no remnants of their existence remain. (See "Environmental Conditioning" section for further discussion of the original ventilation.)

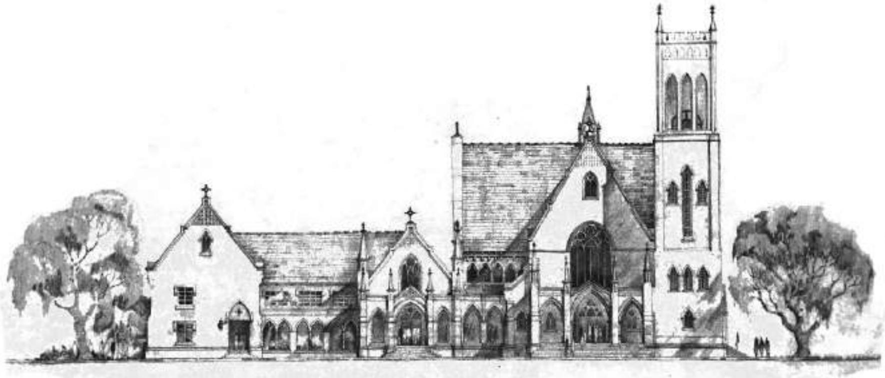

Figure 4.7: Front elevation by Freret and Wolf, ca. 1959. Freret and Wolf Office Records, Collection 40, Folder 151, Southeastern Architectural Archive, Special Collections Division, Tulane University Libraires.

The Chapel Roof

The chapel roof is constructed in a less complex gable style than the cathedral roof and runs approximately 95 ft. from the front entrance, closest towards St Charles Street, to the alter, closer towards Carondelet Street. The roof spans approximately 25 ft. and uses a hammer beam truss structure (Figure 4.8).[4] The trusses are spaced approximately 12 ft. apart and it is likely that comparable rafter, purlin, and sheathing configurations are used as the cathedral, however, first hand observations of the internal structure was not conducted. The ceiling structure contains decorative

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[3] Ibid

[4] Wilson. P. 50.

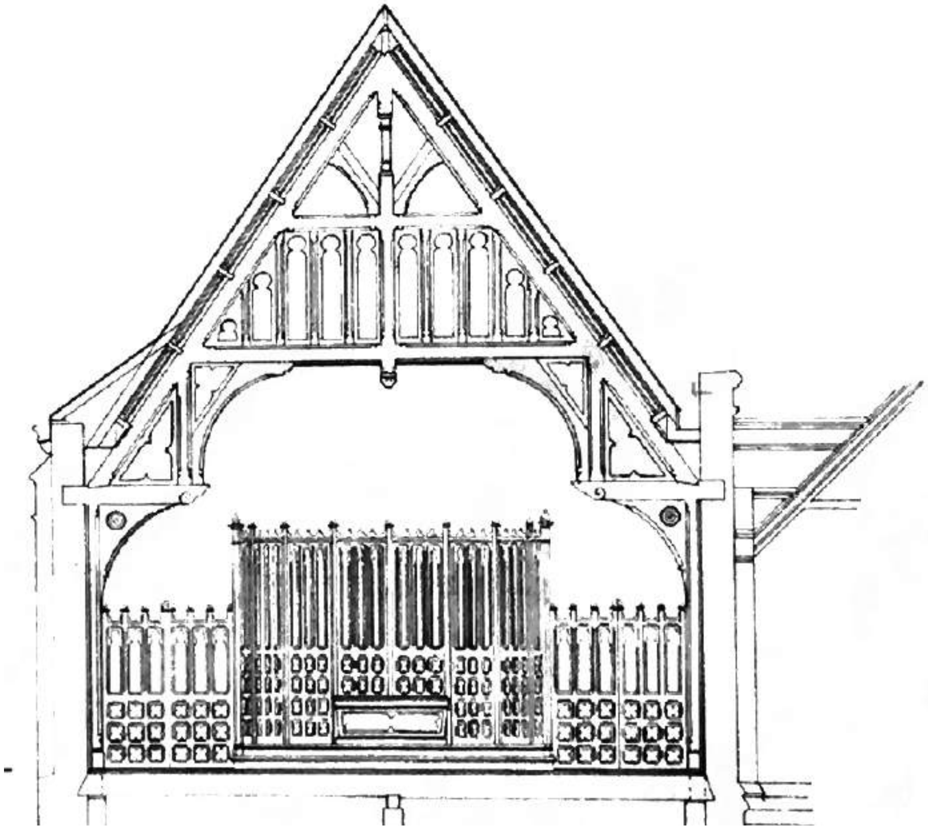

Figure 4.8: Section of chapel by Thomas Sully, ca. 1888. Thomas Sully Office records, Collection 8, Folder 26, Southeastern Architectural Archive, Special Collections Division, Tulane University Librairies.

Figure 4.9: Chapel ceiling. Photo by Cody Ellis, 2015.

purlins that run between the trusses, comparable to the cathedral ceiling. Unlike the cathedral ceiling, the smaller tongue and groove boards run parallel to the purlins instead of perpendicular (Figure 4.9). The chapel roof utilizes identical slate roofing and terracotta ridge caps as the cathedral roof. The ends of the gables are capped with brick parapet walls that rise approximate 2 ft. above the roof line in the same fashion as the cathedral roof. It is unknown if passive ventilation techniques were used within the roof structure upon its initial construction.

Figure 4.10: Apse roof. Courtesy of Dimitri Roby, 2014.

The Apse Roof

The roof above the half domed apse utilizes a half conical gabled roof structure, which rests against the parapet wall that caps the end of the cathedral's gabled roof (Figure 4.10). The roof is approximately 34 ft. at its base and rises to a point, about 10 ft. above the apse wall. At the apex of the roof there is a skylight that opens to the apse below. The roof is covered in the same slate tiles as the cathedral roof and the sheeting and sub structure is unknown. However, considering it was built simultaneously to the cathedral roof it is likely that the materiality and construction techniques are similar. The interior of the apse contains a plastered ceiling that is painted. The skylight that penetrates the roof can be seen directly next to the parapet wall.

The Side-Aisle Roofs

Below the clearstories that run on either side of the nave are two side aisles. The side-aisle on the southwest (upriver) side of the building

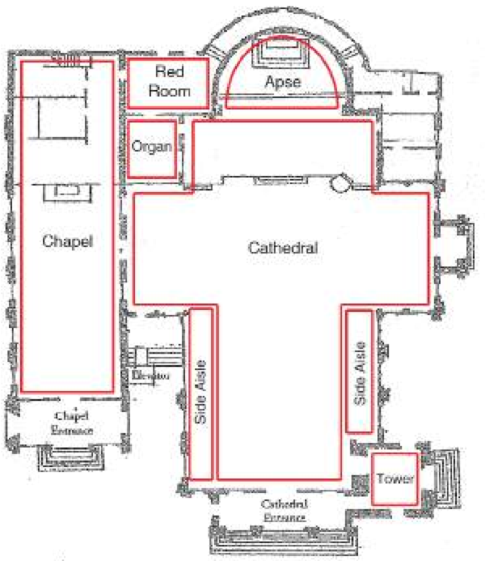

Figure 4.11: Plan of church, cathedral, and adjoined structure. Diagram by Cody Ellis, 2015.

runs between the north transept and the cathedral entrance (measuring 50 ft. long) and the side-aisle on the northeast (downriver) side of the building runs between the south transept and the tower (measuring 35 ft. long). The side-aisles measure approximate 8 ft. in width, are covered with small roofs that pitch away from the nave, and rise approximately a story from the church floor, directly below the clearstory windows. The roof contains a pitch of approximately 45 degrees and is likely to be constructed of a comparable rafter, purine, and sheathing configurations as the cathedral roof, considering they were constructed simultaneously by the same builder (first hand analyses of the structure were not made). The ceiling of the side-aisles are sheeted with wood members, in a similar fashion as the chapel ceiling, and run perpendicular to the roof members.

The Organ Roof

The organ roof is located between the north transept, the chapel, the red room, and the choir (Figure 4.11). The roof line starts two stories above the ground level of the church, at the same relative height as the cathedral and chapel roofs. The hip roof has a much smaller pitch than the cathedral or chapel roofs (approximately 30 degrees), but is sheeted with the same slate as the other two. Simple terracotta tiles cover the ridges of the roof and gable oh hip is utilized at the apex to accommodate for a vent (Figure 4.12). The sheeting and sub structure of the organ roof is unknown, however, considering it was built simultaneously to the cathedral roof it is likely that the materiality and construction techniques are comparable.

Figure 4.12: Organ roof. Photo by Cody Ellis, 2015.

The Red Room Roof

The roof above the red room differs from the others of the original buildings due to its flat design. Although the roof is "flat" it does have a slight pitch that drops away from the building towards the current mechanical area. It is likely that the original roofing material was not the current tar coating, but as of this report the original material is unknown.

Spire

The tower structure of the church was originally topped with a spire that reached 135 ft. in height.[5] The spire contained a steep pitch, square pyramidal roof that was topped with a crocket adorned cap and cross (Figure 4.13). The totality of the structure rose approximately 41 ft. above the tower. Due to the absences of the original architectural drawings it is hard to determine the original structure and materiality of the spire. However, considering it was constructed at the same time as the cathedral it likely that similar construction techniques and material choices were made. The spire was destroyed by a hurricane in 1915.[6] Following the destruction of the spire the top of the tower was then sheathed with a copper roof to protect it from the elements.[7]

Figure 4.13: Photograph of Christ Church Cathedral. Courtesy of Louisiana Digital Library,

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[5] Wilson. P. 48.

[6] "Churches Suffer Heavily From Fury of Storm." Times-Picayune, October 1, 1915. Accessed February 4, 2015.

[7] "Lightning Strikes Christ Church." Times-Picayune, June 26, 1964. Accessed February 4, 2015.

History of Change/Interventions

1885 – Building designed by New York architect L.B. Valk.
3/10/1886 – Ground was broken for the CCC on Ash Wednesday by builder B.M. Harrod.[8]
4/10/1887 – First service held in Cathedral.
6/6/1889 – Chapel was consecrated.[9]
7/24/1912 – Fire damages rectory building, located towards Carondelet Street from the main cathedral. No damage is reported in the cathedral or chapel.[10]
9/26/1915 – Spire destroyed by hurricane.[11]
6/26/1964 – Lighting strikes finial atop the belfry. Finial falls from tower through the roof of the church entrance breaking the wooden beams and the ceiling.[12]
8/28-29/2005 – Roof sustains damage during Hurricane Katrina.[13]

Current Conditions

Overall, the seven individual roof structures discussed in this report are in good condition. The most notable changes are those that affect the inherent passive ventilations systems of the original design and thus compromise the buildings ability to expel moist air. This section will discuss the notable building components of the roof structures and how they are currently performing.

Figure 4.14: Slate shingles on cathedral roof. Photo by Cody Ellis, 2015.

Shingles
Based on information gathered through firsthand conversations with Dimitri Roby and visual comparison to known examples, the original shingles of cathedral, chapel, side hall, and apse roofs are likely Pennsylvania blue slate (Figure 4.14). These shingles were fixed to a wood sheathing without any sort of impermeable vapor barrier in between. These shingles were crafted of quality slate and fastened in a manner that allowed moisture that is trapped within the roof space to slowly dissipate upwards (Figure 4.15). As the sketch demonstrates, a combination of flashing and slate shingles protect from precipitation, but the lack of an impermeable substrate allows moist air from below to escape because of construction tolerances that allow for air movement.

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[8] Wilson. P. 43.
[9] Wilson. P. 50.
[10] "Not Incendiary." Times-Picayune, July 21, 1912. Accessed February 4, 2015.
[11] Wilson. P. 45.
[12] "Lightning Strikes Christ Church." Times-Picayune, June 26, 1964. Accessed February 4, 2015.
[13] David, Duplantier. "City Guide to Sacred Spaces – New Orleans, LA." PBS. Accessed March 24, 2015. https://www.pbs.org/godinamerica/art/nola_cityguide.pdf.

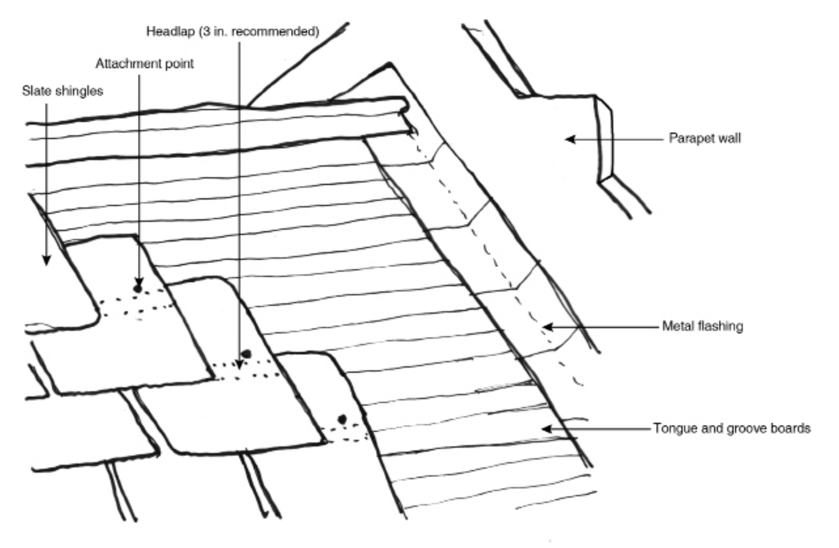

Figure 4.15: Typical slate shingle roof construction. Diagram by Cody Ellis, 2015.

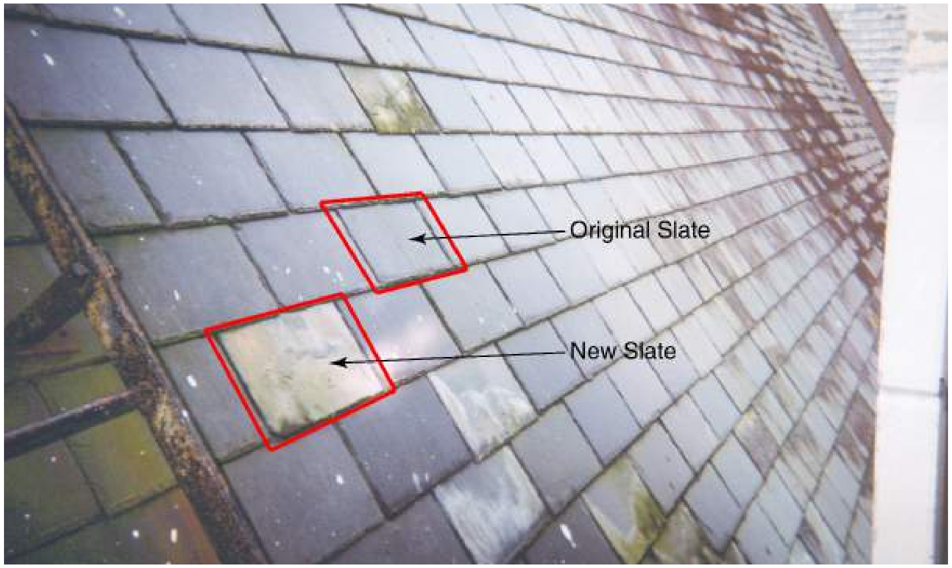

Figure 4.16: New vs old slate shingles. Photo courtesy of Dimitri Roby, 2014.

Figure 4.17: Broken shingles. Courtesy of Dimitri Roby, 2014.

Replacement shingles are made lower quality slate that have deteriorated much faster than the original slate that was used (Figure 4.16). When replacement slates were needed, new slates were inserted in a manner that compromised the rest of the roofing materials. When roof pitches were low enough to walk on they often were, thus causing other shingles to crack or break under the weight of contractors (Figure 4.17). When roof pitches were too steep to walk on walk boards were used, which were adhered using nails. In order for these nails to support the weight of the walk boards and contractors they had to be driven through the shingles into the wooded sheathing. This process also caused the destruction of shingles. This damage was often remedied through the use of spot coating tar, which initially may prevent leaks, but causes major issues for future maintenance of the roof.[14]

Flashing

The metal flashing used for the ridges of the roof and areas next to the parapet walls seems to be in good condition based on the narratives from Dimitri Roby, binocular observations from the tower and visual observation form the street. Additional visual observation of the roof was conducted during periods of moderate rainfall and no notable failures or pooling of water was observed. One negative change to the metal flashing has occurred in the areas that runs between the shingles and parapet walls. The tar coating that has been applied to the tops of the parapets had also be applied down over the metal flashing (Figure 4.18).

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[14] Tower, Liam. “To Tar Or Not To Tar - That Is the Question.” Traditional Roofing Magazine. December 1, 2008. Accessed March 19, 2015. http://www.traditionalroofing.com/TR7_tar.html.

Figure 4.18: Tarred flashing by parapets.
Courtesy of Dimitri Roby, 2014.

Figure 4.19: Damaged gutters. Photo by Cody Ellis, 2015.

This tactic may quickly waterproof the area, but does not allow for the simple, continual maintainance that slate roofs require.[14]

Gutters and Downspouts

The gutters and downspouts around the roof edges are one of the major issues associated with the roof structures. The proximity of vegetation and lack of general maintenance have allowed the gutters to become clogged and develop leaks (Figure 4.19). These leaks result in precipitation being deposited against the building and much closer to the foundation then the original rainwater diversion system called for (see drainage system section for more information). The depositing of moisture close to the building also leads to further moisture issues within the masonry foundation (see masonry section on page ? for more information).

Finials and Ridge Caps

Overall condition of the finials and ridge caps are good. Upon visual inspection only one broken tile can be found (Figure 4.20). Beyond general maintenance this aspect of the roof system is in good working order. See architectural appurtenances section for more information.

Figure 4.20: Damaged ridge cap. Photo by Cody Ellis, 2015.

Interior Wooden Structure

Based on the documentation gathered by Dimitri Roby, the interior wooden structure of the cathedral appears to be in good shape. One of the only issues resulted from the puncturing of the wooded sheathing by contractors, as mentioned in the previous section regarding the slate shingles. During his documentation of the cathedral roof vault Dimitri Roby observed the heads of 10 C and 16 C nails protruding through the sheathing in a manner that compromises the original design of the building envelope (Figure 4.21). From the images supplied by Dimitri Roby no signs of fungal activity, insects, or other notable signs of deterioration can be observed. Once again, first hand analysis of the area was not conducted.

Figure 4.21: Nails protruding through sheathing.
Courtesy of Dimitri Roby, 2014.

Parapets

Another issue within the roof structure are the parapet walls. When the tops of the parapets were coated with tar (Figure 4.22), existing moisture

Figure 4.22: Tarred parapets.
Photo by Cody Ellis, 2015.

issues related to rising damp were compounded. The tar coating does a great job of protecting the top of the brick walls from precipitation, but a less aggressive alternative would be advisable. Moister that becomes trapped beneath the tar can lead to deterioration of the masonry walls (see masonry section for more information) as well as the finishes (see finishes section for more information). Based on images gathered by Dimitri Roby no major mold or other moisture related issues can be observed within the roof structure. However, the combination of a tight building envelope without proper ventilation creates an ideal breeding ground for future moisture related deterioration.

Ventilation

The creation of a tight building envelope was accomplished through two major interventions. One: the introduction of non-permeable coatings (i.e. tar and incompatible plasters/paints) and two: the removal of passive ventilation systems. Based on documentation gathered by Samuel Wilson, Jr. from a Daily Picayune article on April, 10 1887 the original design of the cathedral roof included "…ventilators in the walls, and a large one in the vault through which the warm air from the interior may readily escape into the tower."[15] The ability to exhaust hot air form the building not only made the interior space more comfortable for the inhabitants, but also removed moist air that produces condensation. Condensation, and more so moisture, is the major cause of deterioration within older buildings. Today there is a small ventilation system within the cathedral roof, however its comparability to the original ventilation cupola is questionable. It is likely that original system would have been better at expelling the moisture from the building compared to the new existing system.

The hipped roof of the building that contains the organ has a vent opening that faces towards the courtyard, which in the past was used to remove hot air from the building. Today this opening has been sealed over, and thus compromises the building ability to shed moisture (Figure 4.12). Two smaller vent opening can be seen on the apse roof, and appear to be functional. Based on visual observation and narratives of Dimitri Roby the skylight at the top of the apse does not appear to be operable (Figure 4.23). Because the passive ventilation measure were either reduced, which is the case in the cathedral room, or covered, which is the case in the organ roof, moisture is allowed to linger. This issue is compounded through the introduction of mechanical cooling systems that lead to greater levels of condensation (refer to environmental conditioning section for more information). Although no major issues within the roof have occurred thus far due to the reduction of air flow, if these passive ventilation systems were reinstated it would significantly improve the restoration efforts. They would allow the building to more thoroughly dry out and increase the longevity of the churches building components.

Figure 4.23: Apse roof.
Photo by Cody Ellis, 2015.

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[15] Wilson. P. 48.

Comparable Case Studies

Following Hurricane Katrina, the Vieux Carre Commission held a conference to address the need for quick and long lasting solutions to the damaged historic slate roofs throughout the city.[16] The conference examined several buildings in Charleston, South Carolina for their responses to basic maintenance and disaster repair. These four examples provide insight to the long term effects of possible solutions for Christ Church.

St. Michael's Church - circa 1751

71 Broad Street
Charleston, SC [Figure 4.24]

It is estimated that the original slate roof was added to the church during the 1750s.[17] Some of the original slate shingles still remain after the 250 years of use proving just how durable quality slate can be. Throughout its history, the roof to St. Michael's has needed to be repaired a number of times. It was severely damaged throughout the Civil War, and was repaired multiple times. It then had to be repaired after the great earthquake of 1886, and again after a tornado in the 1930s. This repair was comprehensive; the slate was rearranged with the added new slate to give the roof a mottled appearance. The most recent repair was following Hurricane Hugo. All of the remaining good slate was moved to the visible portico roof, while new slate was laid across the rest.[18]

Figure 4.24: St. Michaels Church 2012
Source Brian Stansberry, "St-michaels-episcopal-charleston-sc3" July 30, 2012, Accessed March 4, 2015.

Cathedral Church of St. Luke and St. Paul - 1814

126 Coming St,
Charleston, SC

The current roof of the Cathedral is an artificial slate known as Supra-Slate.[19] The original Cathedral roof was documented as being slate. Sometime prior to the hurricane all the slate was replaced with asbestos shingles. The reason or time frame for this repair are unknown. In 1989, Hurricane Hugo severely damaged the roof.[20] Unlike the slate roof of St. Michael's Church that was able to mostly withstand the hurricane, the shingles on the Cathedral Church were completely removed. Only the bare trusses were left standing. It was then that the artificial slate was installed. The choice was made because at the time Supra-Slate cost about 30 percent less than a traditional slate roof and came with a 40-year guarantee.[21] Over time the slate faded to a uniform silver color. Care has been taken to minimize damage because the aged material cannot be matched in color. After about 25 years some damage to the roof can be seen, (Figure 4.25) but overall the material has performed as expected.

Figure 4.25: Cathedral Church of St. Luke and St. Paul
Source: Google Maps, Accessed March 5, 2015.

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[16] John Leeke, http://www.historichomeworks.com/hhw/library/slateimitators/slateimitators.htm

[17] Ibid.

[18] Ibid.

[19] Ibid.

[20] Ibid.

[21] Penny Singer, "Asbestos Free Slate That Isn't Quite Slate," (New York Times) May 1, 1994, Accessed March 4, 2015, http://www.nytimes.com/1994/05/01/nyregion/asbestos-free-slate-that-isn-t-quite-slate.html

Figure 4.26: Roof of 21 Legare Street 2014
Source: Google Maps, Accessed March 5, 2015.

21 Legare Street - c. 1840
Charleston, SC
Following Hurricane Hugo, the slate roof required major repairs. In an effort to save money, the owner replaced the slate over the main house with asphalt shingles. This was deemed appropriate because the new shingles were not visible from the public right-of-way. The visible slate was replaced by what was reported as being Chinese slate, and was tested as having a high iron content.[22] Similarly to the replacement shingles of Christ Church, this slate deteriorated severely in just a few years. As of 2014, the slate is still displaying severe signs of delamination while the shingle roof appears to be in good repair.[23](Figure 4.26)

Grace Church - 1846
98 Wentworth St, Charleston, SC
Grace Church exemplifies the possibilities of good slate and installation. The original purple slate roof lasted until the earthquake of 1886. Repairs following the earthquake mixed in blue slate, much like St. Michael's. Subsequent repairs in 1887 and 1989 used Buckingham slate only to replace broken tiles. Following Hurricane Hugo in 1991, the entire church roof was replaced in Welch Royal Purple slate. (Figure 4.27) The new roof is still in perfect condition.[24]

Recommendations

As seen in the case studies, slate roofs can easily last for more than a century. Unfortunately, the roofs covering the nave, chapel, and even later additions to the church have been compromised due to poor repairs and maintenance. Given the current delamination of a large portion of the slate, as well as, indications of moisture damage in the vault, an eventual complete restoration of the roof is recommended.

Slate roof failures can be linked directly to moisture content in and around the slate. All slate naturally delaminates as it weathers, the speed of which is determined by its mineral impurities.[25] As the laminations come apart, the slate will begin to absorb moisture which will increase the deterioration of the tile. Dampness within the tiles can in turn cause rot in the substrate and structural members of the roof. Poor ventilation will allow the substrate to continue to hold moisture against the slate tiles causing more delamination. It is this cycle that will continue to cause problems if only parts of the roof are repaired. Fortunately, the complete restoration can be delayed by following some basic maintenance practices and addressing smaller issues.

Figure 4.27: Grace Church
Source: "Grace Episcopal Church," (Palmetto Carriage) Accessed March 5, 2015

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[22] John Leeke, ibid.

[23] Ibid.

[24] Ibid.

[25] Jeffrey S. Levine, "Preservation Brief 29: The Repair, Replacement and Maintenance of Historic Slate Roofs," (Technical Preservation Services) Accessed February 27, 2015, http://www.nps.gov/tps/how-to-preserve/briefs/29-slate-roofs.htm

Basic Recommendations

Good continued maintenance practices


Figure 4.28: How to step on a slate roof
Source: "How the Nu-lok Roofing System Works" Accessed March 4, 2015.

A strong attempt should be made to limit the traffic on the roofs. If for some reason access to a small portion the slate roof is unavaoidable, it is best to wear soft soled shoes and step on the lower-middle portion of the exposed slate tiles.[26](Figure 4.28) This will help to minimize the pressure around the nail hole and prevent cracking. The best practice for extensive movement on slate roofs is the use of ladders and ridge hooks.(Figure 4.29) The ladder allows for the weight of the workman to be distributed over a large area. Since ridge hooks are also used in the maintenance of tile roofs, this method should be used for any area with the simple terracotta ridge cap.[27] The decorative terracotta finials pose a problem when accessing the main roof over the nave. When looking to gain access, it is best to keep in mind that the goal is to spread out weight over a large area. Jacks and planks (Figure 4.30) should only be used when replacing entire areas of slate. When used incorrectly, they will leave uncovered nail holes, which will then leak.

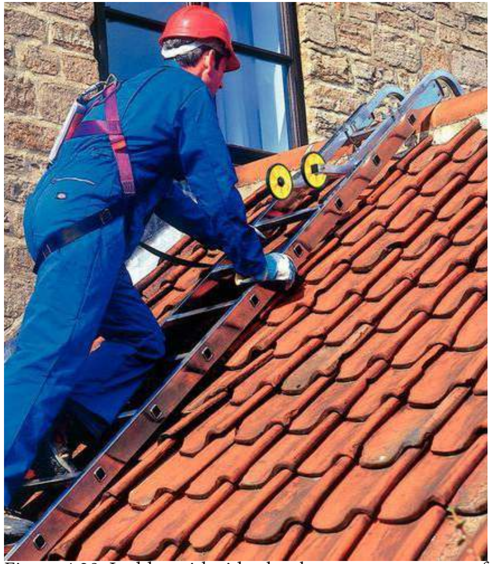
Figure 4.29: Ladder with ridge hooks on a terracotta roof
Source: "Roof Ladder 21 ft." (MW Hire Group) Accessed March 4, 2015.

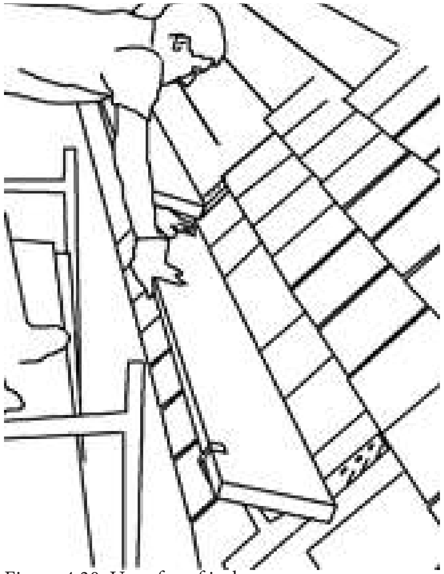
Figure 4.30: Use of roof jacks
Source: http://www.traditionalroofing.com/TR2-Install%20Hint.html

Foot traffic on the flat roofs should also be avoided. Walking on flat roofs compresses the underlayment and places stress on the exterior membrane. Overtime this can lead to low spots and cracks that collect water. When working from a flat roof, it is best to lay plywood over the surface to distribute the weight and stress over a larger area. It is important to clean the gutters on the flat roofs since the low slope allows for build up of dirt and plant material (Figure 4.31). The build up of material will hold moisture against what is an already vulnerable location for water penetration.


Figure 4.31: Current build up on flat roof overlooking courtyard
Photo Christine Carlo, 2015

Consistent documentation should be used so changes over time will be evident. Inspections should be done at regular intervals[28]. It is recommended that a slate roof be checked annually, and flat roofs be checked tri-annually; roofs should also be checked after large storm events for damage or standing water. All cracked, misaligned, missing and

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[26] Ibid

[27] Anne E. Grimmer and Paul K. Williams, "Preservation Brief 30: The Preservation and Repair of Historic Clay Tile Roofs," (Technical Preservation Services) Accessed March 4, 2015, http://www.nps.gov/tps/how-to-preserve/briefs/30-clay-tile-roofs.htm#hip

[28] Jeffrey S. Levine, ibid.

Figure 4.32: Areas of damage to a slate roof
Source: http://0.tqn.com/w/experts/Roofing-1598/2010/10/Roof-Shot_1.jpg

delaminating slates and cracks or dents in the asphalt membrane should be noted. (Figure 4.32) To protect the roof, it is recommended that these inspections take place from the ground or a cherry picker. The use of the high points in the church, especially the tower, are recommended rather than accessing the adjacent flat roofs. Water stains, rot, and other moisture indications in the structure should also be recorded during inspections. Leaks should be noted and repaired in a timely manner.

Figure 4.33: Current water damage in vault
Photo courtesy of Dimitri Roby, 2014.

Every five to seven years an inspection should be conducted by a professional contractor experienced in historic slate roofs.[29]

Slowing the deterioration of the slate roof

Due to the large scale deterioration of tiles on the roof it is not economical to replace them individually. Once 20% or more of the slate needs replacing, it is less expensive to replace the entire roof.[30] The best recommendation is still to do a full scale renovation. Until the time comes for renovation, the goal should be to slow deterioration. Missing and severely damaged tiles should be replaced to protect the substrate. Areas above detected moisture damage in the vault should be inspected and replaced as needed.(Figure 4.33) The goal of these repairs should be to minimize water damage to maintain the integrity of the structure. Proper technique should be used when replacing slate tiles. Friction fit copper pieces or alternate hooks should be used to cover the nail hole in the new tile. These will prevent water from penetrating the new hole.[31] The application of roofing mastic or sealants should be avoided as they deteriorate over time allowing water to enter. Examples of sealants can already be seen across the cathedral roof.(Figure 4.34)

Figure 4.34: Existing crack with sealant on slate tile
Photo courtesy of Dimitri Roby, 2014.

Slowing the deterioration of the flat roofs

With proper installation and maintenance, a built up asphalt roof can last between ten and twenty years. It is important to remove all debris seasonally. This is especially important for areas that have tree overhangs as they are likely to catch more material. Blistering and or mushy areas are signs of water having gotten into the membrane. These areas must

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[29] Ibid.

[30] Ibid.

[31] Ibid.


Figure 4.35: Current wear of reflective paint on roof
Photo courtesy of Christine Carlo, 2015

be cut out and replaced.[32] The current reflective paint on the roofs is great at preventing ultraviolet light from breaking down the chemicals in the roof. Several areas, though, are showing signs of wear (Figure 4.35). After replacing any water damaged areas, a fresh coat of paint would help to extend the life of the current roofs.[33] It is also important to check all the flashing. Heavily tarred areas can mask small cracks around the flashing that will allow water penetration. (Figure 4.36) Removal of excess tar and proper replacement of any damaged flashing will guarantee the quality of these important seals.


Figure 4.36: Built up tar edge around flat roof
Photo courtesy of Cody Ellis, 2015

Replacement of broken ridge cap

The ridge caps protect the ridge from the fierce weather conditions in New Orleans. On the north ridge, directly by the parapet there is a broken tile (Figure 4.37). Paint directly below this ridge on the interior of the nave is beginning to peel indicating a moisture problem. Not being able to determine if this has been caused from falling moisture or rising damp, it is recommended to replace the cap as soon as possible. During repair, other caps should be checked for damage and adherence to the ridge (see the decorative appurtenances section for more information).


Figure 4.37: Broken finial on north ridge
Photo courtesy of Cody Ellis, 2015

Ventilation

Good ventilation is imperative in fighting rising damp. We were unable to visit the vault, but Dimitri Roby details the condition of the ventilation systems very thoroughly in his letters to the church. [34] Ultimately, ventilation along the roof line needs to be increased. The current fan system is helping but there are several other simple options to help address this problem. The first would be to add lovers to the existing window allowing for natural ventilation much like the missing cupola would have. The second would be to add to the current roof vents during the replacement of slate tiles. There are many new options for roof vents that blend into a slate roof. (Figure 4.38) As tiles and their substrate


Figure 4.38: Low profile slate roof vent
Source: http://www.glidevale.com/2012-07_compact_inline_vent.html

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[32] "Maintaining a Flat Roof," United Roofing, December 30, 2010, Accessed March, 24, 2015, https://stormdamagerepairmn.wordpress.com/2010/12/30/maintaining-a-flat-roof/

[33] Ibid.

[34] Dimitri Roby, "Christ Church Cathedral and Chapel," July 16, 2014.

Figure 4.39: Tar covered parapits over chapel
Photo courtesy of Cody Ellis, 2015

need replaced, it could be a better option to just replace the area with a vent.

Recommendations for securing the future value of the church:

Address the tar covered parapets on exterior walls

Tar was most likely applied to the parapets as a first response to moisture found in the walls. (Figure 4.39) This has been problematic because overtime the tar has run down the faces of the walls creating unsightly black streaks. The solution would be to remove the exterior layer of tar and stucco and replace the stucco. If rain penetration is still a concern, a discrete flashing detail can be added, similar to one used for protection of brick walls (Figure 4.37).

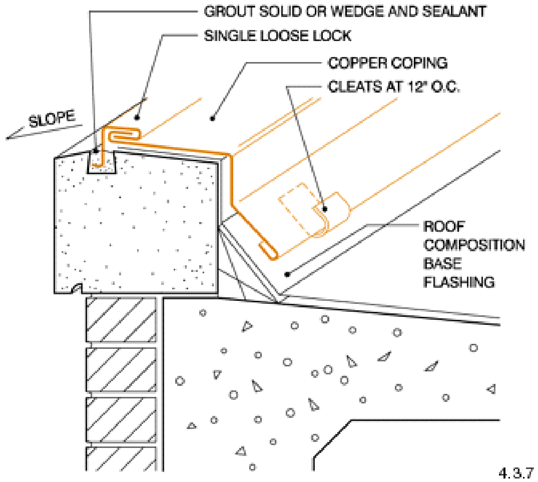

Figure 4.40: Flashing detail
Source: http://www.copper.org/applications/architecture/arch_dhb/arch-details/flashings_copings/images/28.gif

Restoration or replacement of all slate roof

The current state of the slate roof indicates that repairs will most likely be necessary in five to ten years. Monitoring the dampness in the cathedral vault should give a better indication of immediacy of the repairs. If there is no new water damage is indicated and efforts are made to better ventilate the spaces, the roof may be able to last several more years. If monitoring reveals new water damage or mold growth the safest course of action would be to replace within the five years. Standing water or large leaks should be dealt with immediately. It is important to note that much of the original tile does still seem to be in good condition and could be reused to cut down on the costs of replacement.

Carefully remove all finial and slate. With proper removal, the original slate can be reused. Replace any damaged tongue and groove sheathing. It is important that the sheathing is replaced in kind and not with plywood or other sheathing materials. Dense sheathing with carry the vibrations from nailing and break nearby slate tiles. Gaps within the tongue and groove also provide additional ventilation for the roof. Tiles that have been salvaged should be used in the most visible public areas first. Since both the chapel and cathedral roofs are visible, it may be best to mix old and new tiles to give a uniform appearance, much like they did at St. Michael's Church in Charleston. Alternatively, the cathedral may receive a completely new roof to cut back on maintenance because it is hard to access. The reused tile could then be applied to the chapel roof first and to other slated areas as volume allows.

The Slate Roofing Contractors Association of North America is a good resource for finding slate roof contractors. There are four companies within Louisiana that are endorsed by the Association [35]:

Durable Slate Company
New Orleans, LA
www.durablerestoration.com

Guaranty Sheet Metal Works, Inc.
Kenner, LA
www.guarantysheetmetalworks.com

The Roof Doctors, Inc.
Baton Rouge, LA

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[35] Slate Roofing Contractors Association of North America, Inc., Accessed February 4, 2015, http://www.slateroofers.org/

CC&W Enterprises, Inc.
Baton Rouge, LA
ccwenterprises.com

Figure 4.41: Application of sealant at seams of an EPDM roof
Source: http://www.epdmroofs.org/what-is-epdm

Replacement of flat roof coverings

While tar and paper roofs can be good roofs, they do have a limited lifespan. While the roofs are currently in acceptable condition, it will be important to monitor them for indications that they need replaced. Soft, mushy spots, as stated before, can be replaced without replacing the entire roof. However, if there are many spots that need replaced, it will be more economical to simply replace the entire roof. Another indicator for replacement is "alligatoring".[36] If the membrane becomes cracked or scaly, it is time for a new layer of asphalt to be applied. If these areas are coupled with soft spots, or if light can be detected through the cracks, the entire roof will need replaced. Since the flat roofs are unseen, it is not necessary to replace them with the original covering. A sheet metal roof, either flat or standing seam would be a good option, as they have a longer lifespan and will withstand New Orleans weather conditions. A second option would be a more durable synthetic membrane such as EPDM. EPDM or ethylene propylene diene terpolymer, is a durable rubber roofing membrane.[37] EPDM roofs can come with up to a 30 year warranty and can be designed to withstand the extreme weather it will face in New Orleans. Both the sheet metal roof and EPDM roof are available in a white finish which has been shown to reduce heat gain and cooling costs.

Removal or grounding of current lighting rods

It is important to remember that the roof does contain several lighting rods. While they are not a necessity, it is extremely important that they remain grounded. Contractors need to be made aware that the lines are still live and must be maintained or completely removed.

Figure 4.42: Existing lighting rods on the cathedral roof
Photo courtesy of Cody Ellis, 2015

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[36] "Maintaining a Flat Roof," ibid.

[37] "What is EPDM?" ERA, EPDM Roofing Association, Accessed April 7, 2015, http://www.epdmroofs.org/what-is-epdm.

Decorative Exterior Appurtenances

Laura Stokley

Figure 5.1 : Terracotta cresting, finials, and decorations on Christ Church Cathedral. Photo by Laura Stokley, 2015.

Introduction

Terracotta can be any fired clay product. The name terracotta comes from Italian and literally means, “baked earth.”[1] Although art historians generally apply the term to most ceramics, terracotta in the architectural sense is typically red, unglazed, and fired at very high temperatures for strength and durability. Terracotta is usually a dark reddish color, but can range from a lighter ochre or orange to a deep brown earthen color depending on the type of clay, additives, and firing process. The benefits of terracotta are its strength, lightness, versatility, durability, and inexpensive production.[2]

Most cultures around the world have some form of terracotta incorporated into their architectural traditions. In ancient times it was most commonly used architecturally for bricks, roofing tiles, and decorative elements. The Greeks used terracotta as early as 3000 BCE and its use spread throughout the old world. The Romans used terracotta for a multitude of purposes, but their advancements in concrete made terracotta less common. After the fall of the Roman Empire and up until the 14th century, terracotta fell out of common architectural use. In the late 15th century it reappeared in Italy and Germany as architectural decoration.[3]

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[1] Weaver, Martin E., and F. G. Matero. “Architectural Ceramics.” InConserving Buildings: A Manual of Techniques and Materials, 109-32. New York: Wiley, 1997.

[2] “Terra-cotta | Pottery.” Encyclopedia Britannica Online. Accessed February 06, 2015. http://www.britannica.com/EBchecked/topic/588111/terra-cotta.

[3] “Terra-cotta | Pottery.” Encyclopedia Britannica Online. Accessed February 06, 2015. http://www.britannica.com/EBchecked/topic/588111/

Figure 5.2 : Christ Church Cathedral by George Francois Mugnier. George Francois Mugnier Collection, Lousisana State Museum, Louisiana Digital Library http://cdm16313.contentdm.oclc.org/cdm/singleitem/collection/GFM/id/809/rec/4.

Unglazed terracotta became popular in America as a building material in the 1870's. One of the first and most prominent distributers was the Northwestern Terra Cotta Company (1878–1956) headquartered in Chicago.[4] Following the 1871 Chicago fire terracotta became more popular in the city for its lightweight and fire-proof qualities. Other late 1800s manufacturers and large distributers of roofing and building materials also began producing and selling terracotta building elements.

Terracotta production is a complex, time-consuming process that requires skill and craftsmanship. First the clay is selected, impurities are removed, and fillers are mixed in. When grog, ground previously fired terracotta, is added the finished product is typically stronger and reduces shrinkage in the kiln. Once the clay and additives are mixed thoroughly and all impurities are removed, the moist clay is packed into a negative mould made of plaster. When packing the clay one must be sure to fill all the small and large spaces and make sure there are absolutely no air bubbles. Bubbles or gaps could cause the piece to explode in the kiln. There is a certain amount of shrinkage as the clay dries, so after about three days the piece should come right out of its plaster mould. Then the finishing/tooling process smoothes out any imperfections and creates a fireskin, a concentration of fine particles on the surface which give the piece extra protection. Any holes needed for screws or fasteners are added at this time as well. Then begins a second drying process which can last anywhere from a few days to several months. A slip coat, a coating of very fine clay particles, can then be applied giving added protection and a more uniform appearance to the piece. The terracotta is then carefully placed in a kiln and baked at temperatures around 1500° - 2000°F.

A downfall of unglazed terracotta is the difficulty of keeping it clean. It has the ability to attract grime and collect dirt and soot. This was particularly problematic in the heavily polluted air of the Victorian era (1837-1901). Following the popularization of electricity and other modern advancements, soot became less of a threat, but was replaced by moss and other bio growth which can take root in the porous surfaces of terracotta and cause or exacerbate cracks as well as obscuring the design of the object. Typically the slip coat protects the terracotta and keeps

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[4] Wilson, Mark R. "Northwestern Terra Cotta Co." Northwestern Terra Cotta Co. Accessed February 18, 2015. http://www.encyclopedia.chicagohistory.org/pages/2797.html.

plants from finding footholds, but over time this can be worn away and expose the rougher interior mix. Trees and bio growth are possibly the biggest threat to terracotta work of any kind. They can split brick and rip ornaments from their fasteners.

Water penetration and freeze-thaw cycles are a huge threat to terracotta.[5] In climates like New Orleans where the temperature rarely drops below freezing, this is less of an immediate concern, although it could cause damage in rare freezing weather.

Building Documentation

Christ Church Cathedral, in its current state, was constructed in three main phases. The first phase was Lawrence B. Valk's 1886 cathedral; second, Thomas Sully's chapel was added in 1889; and third was the 1959 expansion project by Freret and Wolf. All three phases of the design feature pitched slate roofs with terracotta cresting, finials, and ornaments. The original cathedral features a tower with terracotta gargoyles and more elaborate cresting than the later additions. There are decorative chimney pots on the cathedral as well. The chapel uses terracotta cresting tiles and decorative finials of a different shape and design, but of similar style to those on the cathedral. Both the cathedral and the chapel feature a terracotta cross on the apex of the front façade. The original cathedral also included a steeply pointed roof on the tower and a ventilation cupola at the center of the roof where the four wings of the cathedral meet. Both had elaborated decorative elements atop them, and both have since been removed (Fig5.2).

The current condition of the decorative terracotta on Christ Church Cathedral is fairly good. Some bio growth is present as well as staining from bird droppings, but most pieces are fully intact and showing minimal signs of weathering. A few pieces are in rough shape, but still intact and easily distinguishable.

The four terracotta finials on the cathedral tower (Fig5.5-5.6) are

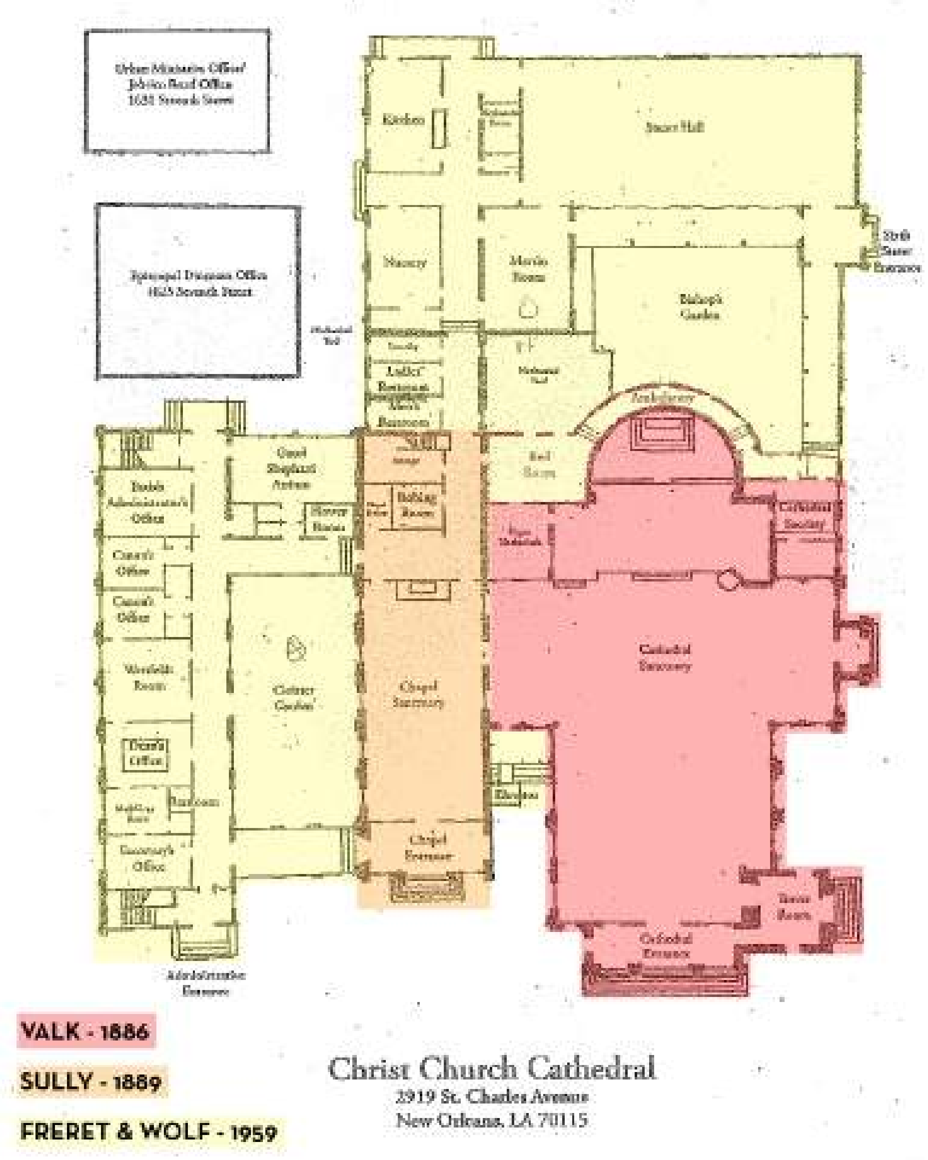

Figure 5.3 : Floor plan and phases of construction. Graphic by Laura Stokley, 2015

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[5] "Cleaning Historic Ceramic Tile and Terra Cotta." Iowa State Historic Preservation Office. Accessed February 28, 2015. http://www.iowahistory.org/historic-preservation/technical-assistance/assets/CeramicTerraCotta.pdf.

Figure 5.4 : Roof plan and key to terracotta elements including all three types of ridge tiles. Graphic by Laura Stokley, 2015; Aerial photograph from Google maps

in relatively fair shape, but one of them shows serious signs of wear and the other three show less serious, but visible weathering. The design appears to have a clover motif. All four of them are hosting small lightning rods, which appear to be made of copper. These four points are the highest parts of not just the cathedral, but the surrounding neighborhood as well. These little spikes can be seen in several photos strapped to a number of finials, chimney tops, and on some of the ridge tiles. Attached to each rod is a conducting wire, which draws any lightning that may strike down to the ground to minimize damage to the building.

The cathedral has finials adorning its front and side entrances as well. These have a Romanesque style byzantine leaf motif culminating in a bud at the top (Fig.5.7-5.10). The chapel has similarly designed finials adorning its front entrance as well, but they are clearly not made from the same mould (Fig.5.11-5.13). The chapels finials have the same motif, but are rounder where the cathedral's are more boxy. The chapel's finials are also taller and more slender. The chapel finials are in good shape and

Figure 5.5-5.6 : Tower Finials: in poor condition on the left and fair condition on the right. Photos by Laura Stokley, 2015

seem firmly secured, however one of the finials on the chapel is visibly crooked (Fig5.13). All of the entrance finials have a visible layer of dirt and grime, but none have any apparent cracks or chips. They all seem fully intact and unblemished.


Figure 5.7 : Cathedral side entrance finials. Photo by Laura Stokley, 2015


Figure 5.13 : Crooked chapel finial. Photo by Laura Stokley, 2015


Figure 5.8-5.12 : The three on the left are from the cathedral. The two on the right are from the chapel. Note the slight differences in shape. Photos by Laura Stokley, 2015

The cross on top of the cathedral has a lightning rod attached to it presumably because it is one of the highest points on the building. This cross also has some slight cracking at its base and dark discoloration on the shaft just above the base (Fig5.16). The cross on the chapel is in great shape except it has some plants growing from its base (Fig5.14-5.15).

The cathedral tower has eight terracotta gargoyles, two on each of its four faces. All of the gargoyles are intact and show very little sign of weathering. The main problem is bio growth on all of the gargoyles and several ferns growing out of the connection between the terracotta and the face of the tower. Some of the gargoyles have staining from bird droppings as well (Fig5.17-5.20).

Figure 5.14-5.16 : left, chapel cross; right, cathedral cross. Photo by Laura Stokley, 2015

Figure 5.17-5.20 : Tower gargoyles showing bio growth, ferns and staining. Photo by Laura Stokley, 2015

Christ Church Cathedral features three types of ridge tiles. The ridge tiles on the cathedral are more ornate and have a more sophisticated interlocking system than the ones used by Sully or Freret and Wolf. They fit together so that the connections are flush and the face of the ridge is continuous (Fig5.24). The later ridge tiles have a bulge where one overlaps another and a variety of mortars and tar-like binders can be seen at the connection sites, especially on the Freret and Wolf addition (Fig5.34-5.36). Interestingly, Sully's drawings show tiles matching those on the cathedral, however a different tile was used (Fig5.21). And in 1959 when Freret and Wolf designed their addition the drawings show ridge tiles matching those on the chapel (Fig5.22). The drawings even note that the tiles should match those of the existing chapel. And once again, a different, less ornate tile was used. One of the ridge tiles on the cathedral is significantly damaged, and a few others are chipped and cracking, but most are intact (Fig5.27). The rest of the ridge tiles on the building appear to be in good shape. The cathedrals tiles are also strung together with a fine wire not visible from the street. This is likely part of the lightening protection system, but may serve the subsidiary function of physical anchoring as well.

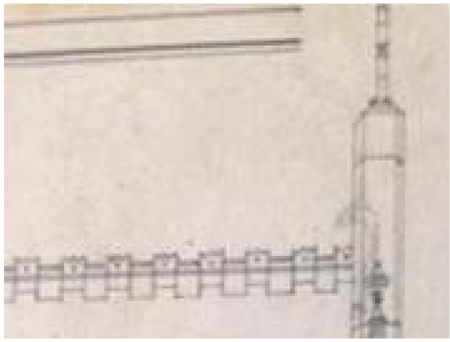

Figure 5.21 : Ridge tiles in Sully, Thomas Office Records. Collection 8. Folder 26, Southeastern Architectural Archive, Special Collections Division, Tulane University Libraries. Photo by Laura Stokley.

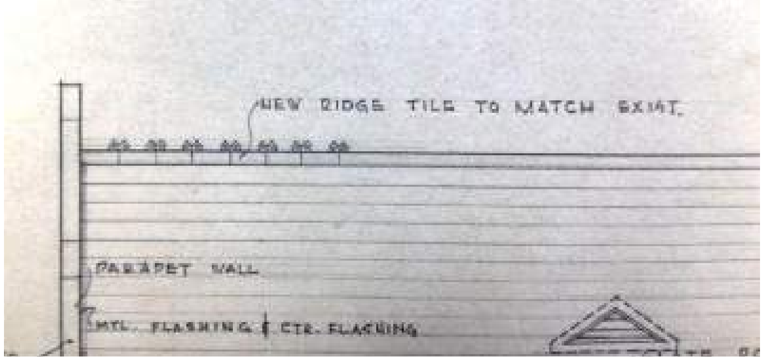

Figure 5.22 : Ridge tiles in Drawings from Freret and Wolf Office Records. Collection 40, Folder 151, Southeastern Architectural Archive, Special Collections Division, Tulane University Libraries. Photo by Laura Stokley, 2015.

Figure 5.34-5.36 : Ridge tiles on the chapel; mortars and connections noted. Photo by Laura Stokley, 2015

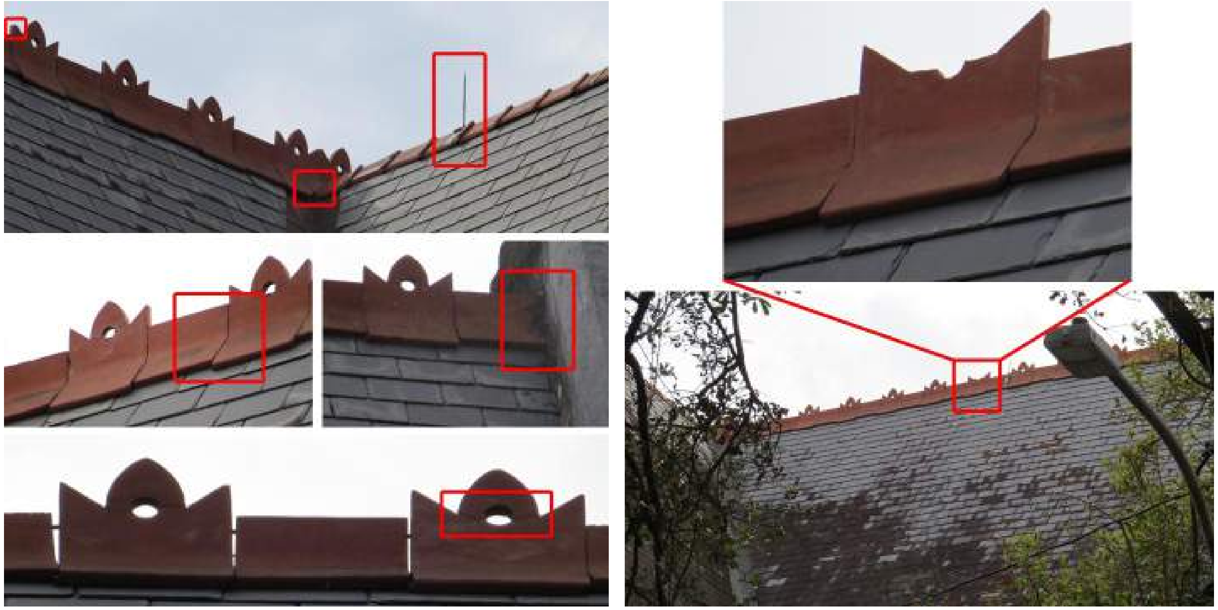

Figure 5.23-5.33 : Cathedral tiles with lightning rods, mortars, connections, and wires; Broken tile also noted; images on the far right are of a fallen ridge tile currently in the Southastern Architectural Archives, Special Collections Division, Tulane University Libraries. Photos by Laura Stokley, 2015.

The chimney pots also have a moderate amount of dirt and grime build up as well as some biogrowth (Fig5.37 - 5.38).

Investigation and Research

The manufacturer of the terracotta ridge tiles is unknown. They do not appear in the trade catalogs at the Southeastern Architectural Archives at Tulane University (SEAA) or those of The Historic New Orleans Collection (THNOC), nor have they been found in any online catalogs from the Association for Preservation Technology International (APT) Building Technology Heritage Library, Avery Architectural Library, the Library of Congress, etc. As noted earlier, the ridge tiles used in each phase of the construction are all different. Some of them could have been custom made or perhaps purchased from different manufacturers. It is also possible that the church officials requested different styles during each phase of construction for cost or aesthetic reasons.

The chimney tops on the cathedral match those produced by Moorhead Clay Works of Philadelphia and pictured in their 1877 catalog, found in the online Building Technology Heritage Library (Fig5.42).[1]

In 1889 when Thomas Sully designed the matching chapel he incorporated terracotta cresting on the roof just like the Cathedral. In his office's drawings for the chapel the ridge tiles are clearly the same style as those on the cathedral, however all of the historic photos show the current style of tile. The tiles used on the chapel differed slightly from, yet matched the rhythm and spacing of the terracotta cresting on the main cathedral. Why a different style is used is unclear.

He most likely purchased these terracotta elements from a local distributer such as F. Codman Ford, or from Richard J. Downey, NewOrleans' terracotta distributers at the time.

Soards' City Directory from 1888 has the first listing specifically for terracotta salesmen. The only one listed is Tupper Bros. on Union Street.[2] Tupper Bros. is also listed in the 1887 Soards' City Directory, but is listed under "Builders' Materials." This indicates that there certainly

Figure 5.37-5.38 : Clay chimney tops on the cathedral. Photos by Laura Stokley, 2015

Figure 5.39-5.41 : Ridge tiles on the Freret and Wolf addition, also found on some parts of the Cathedral. Photos by Laura Stokley, 2015

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[1] Moorhead Clay Works Illustrated Catalogue of Builders Materials Made of Terra Cotta or Vitrified Clay. Philadelphia: Moorhead Clay Works, 1877.

[2] Soards' New Orleans City Directory, for 1888. New Orleans: Soards Directory, 1888.

were distributers in the city prior to the inclusion of terracotta as a separate category in the directory. The 1887 directory also lists F. Codman Ford on Baronne Street under “Building Specialties.”[3] He continues to be listed in the 1888 and 1889 directories. In 1894, Sully published a book of photographs entitled *New Orleans Through a Camera*. In the back of this book he also features advertisements for the craftsmen, consultants, and distributers with whom he typically worked.

One advertisement features J.C. Ewart & Company from Akron, Ohio and states “the firm is an extensive manufacturer of terra cotta cresting, finials, and hip rolls for trimming slate roofs.”[4] They identify Ford as their New Orleans distributer since c.1884. Another advertisement is for the Building Specialties Company in New Orleans, of which Ford is listed as the president. This advertisement lists the Northwestern Terra Cotta Company, and Akron Roofing Tile Works.

Richard J. Downey is first listed in 1886 and continues to appear in the directories for 1887, 1888, and 1889.[5] There is also an advertisement for “R.J. Downey, Slate Roofer” in the back of Sully’s 1894 publication of architectural photos. The advertisement mentions “Terra cotta and English ridge and hip tiles.”[6] J. Hannah & Company is also listed as a New Orleans terracotta retailer in Sully’s 1894 publication, however, the company is not listed in any of the city directories from 1885-1889 so it is unlikely that they provided the material for either the cathedral or the chapel projects.

A Northwestern Terra Cotta Company catalog c.1900 highlights several projects in New Orleans by Sully using their products which suggests that this company may have provided terracotta work for Sully’s 1889 addition, if not the original 1886 construction as well.[7] The Northwestern Terra Cotta Company’s last factory in Denver closed in 1956. By 1959 there were only a handful of companies mass producing terracotta building tiles and decorations. So in 1959, when Freret and Wolf designed their addition and specified new ridge tiles to match those of existing chapel, it was unlikely that identical tiles would be easily found. This may be why a simpler tile was used, or it may have been a design decision made during construction.

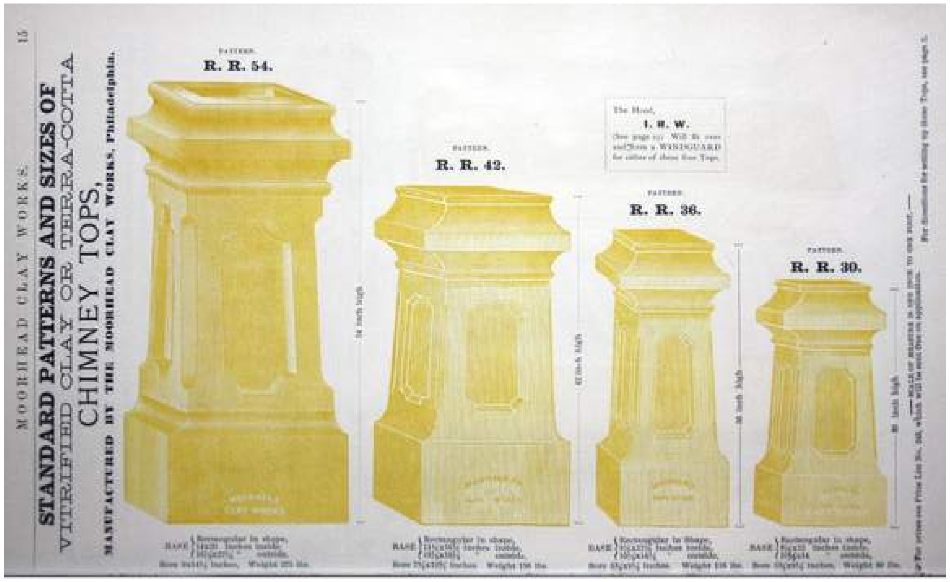

Figure 5.42 : From Moorhead Clay Works Illustrated Catalogue of Builders Materials Made of Terra Cotta or Vitrified Clay. Philadelphia: Moorhead Clay Works, 1877.

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[3] Soards’ New Orleans City Directory, for 1887. New Orleans: Soards Directory, 1887.

[4] Sully, Thomas. New Orleans Through a Camera. New Orleans, 1894.

[5] Soards’ New Orleans City Directory, for 1886. New Orleans: Soards Directory, 1886.
Soards’ New Orleans City Directory, for 1887. New Orleans: Soards Directory, 1887.
Soards’ New Orleans City Directory, for 1888. New Orleans: Soards Directory, 1888.
Soards’ New Orleans City Directory, for 1889. New Orleans: Soards Directory, 1889.

[6] Sully, Thomas. New Orleans Through a Camera. New Orleans, 1894.

[7] The Northwestern Terra Cotta Co., Chicago. Catalogue. Chicago, C. 1900.

Recommendations

General recommendations for terracotta:

- Sandblasting, chemical treatments, etc. should not be used to clean terracotta elements. Cleaning methods should always use the gentlest means possible
- Original pieces should be preserved as much as possible, repaired whenever possible, and replaced only when absolutely necessary.
- All plant material which is currently growing on terracotta elements should be removed in the most delicate way possible and any cracks left behind should be repaired.
- Cleaning method for unglazed terracotta: Slightly soiled areas can be cleaned with warm water and scrubbed with a soft bristle brush. Heavier soiled areas may be cleaned with steam or diluted solutions of muriatic or oxalic acid with a final water rinse; however, a conservator should evaluate the soiling and determine the safest and most effective treatment before any cleaning of this degree is executed.[1]

Recommendations for Christ Church Cathedral:

- All plants should be gently removed from the terracotta decorations, particularly from the gargoyles and crosses. It is best to remove vegetation after it has been killed so that the roots will more easily let go of the building fabric. Herbicides should never be sprayed directly on building surfaces, but rather applied directly onto the leaves of the plant.
- The crooked finial on the chapel should be inspected up close to check its stability and evaluate the potential for straightening it. This is an aesthetic measure and should only be attempted if one is sure that it will not damage the terracotta piece.
- All terracotta pieces should be gently cleaned. Many chemical solutions are available to do this cleaning, but only the gentlest of methods should be attempted and only by professionals familiar with terracotta work. As with any cleaning, small areas must be tested first and results documented.
- Intervention in the deteriorating tower finials is not recommended at this time, as long as they are stable. Regular maintenance and care should help extend their life span, but they may ultimately need to be replaced.
- The stability of the decorative appurtenances should be checked whenever access provides the opportunity. This is both a matter of public safety and of preventing destruction of elements through falls. Some elements may be assessed during routine maintenance such as gutter cleaning, while evaluation of higher fixtures should be scheduled as part of roof and lightening protection inspections.

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[1] “Cleaning Historic Ceramic Tile and Terra Cotta.” Iowa State Historic Preservation Office. Accessed February 28, 2015. http://www.iowahistory.org/historic-preservation/technical-assistance/assets/CeramicTerraCotta.pdf.

Glossary Appendix

Cresting: a decorative coping, balustrade, etc., usually designed to give an interesting skyline.

Efflorescence: the migration of water-soluble salts via capillary action to the face of the brick resulting in a white and powdery surface

Exterior: all outside surfaces of any building

Facade: the front wall of a building

Finial: a relatively small, ornamental, terminal feature at the top of a gable, pinnacle, etc.

Gargoyle: a grotesquely carved figure of a human or animal, often acting as a spout with open mouth, projecting from the gutter of a building for throwing rain water clear of a building.

Repointing: the process of removing deteriorated mortar from the joints of a masonry wall and replacing it with new mortar.

Ridge Tiles: a decorative or semicircular or curved tile used in making a roof ridge (a type of cresting).

Shingles: a wall or roof covering consisting of small overlapping pieces, square or patterned

Terracotta: a hard unglazed brownish-red earthenware, or the clay from which it is made (from Italian, literally: baked earth)

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Drainage Systems

Trudy Andrzejewski, Nathan Lott

Figure # 6.1: A section of K gutter on the lower level of the Nave roof. Photo by Trudy Andrzejewski, 2015

Introduction

A drainage system is comprised of various elements including gutters, leader heads, downspouts, and buried drain pipes that lead to subterranean catch basins and pipes. The purpose of the drainage system is to collect rainwater from the roof and hardscapes like courtyards and direct water away from the building. Controlling where rainwater is directed after leaving expansive roofing systems like that seen at Christ Church Cathedral, is an important component to mitigating the effects of water and moisture damage. Intact, functioning and manageable drainage systems are key to the preservation of the entire Cathedral campus.

Original Design/Composition:

Christ Church Cathedral was designed to shed rainwater via an integrated system with multiple components of differing materials: from the slate roofing tiles, the first point of contact for most raindrops, water flows into metal flashing (possibly lead) at the roof joints and into copper gutters, affixed by metal nails (likely iron). It flows into copper downspouts then falls into terracotta drains, which carry the water through subterranean terracotta pipes either to the property's edge, where it enters the city's curb-and-gutter stormwater system, or which weep into the property's soil (these weeping drains are also known as French drains). When rain falls directly on the windows, walls and buttresses those surfaces also act as part of the building's integrated system for shedding water--hence the sloped shelves at points where buttresses widen. Moisture should run down the building envelop to gravel or soil below or evaporate directly from the exterior wall. The sandstone-paved surfaces of the building's courtyards slope toward catch basins connected to the subterranean system. Lastly, the landscaped grounds themselves absorb rainwater.

Drainage System Components

Type	Material
Roofing	Slate
Flashing	Lead*
Gutters	Copper
Fasteners	Iron*
Exterior walls	Stucco
Windows	Glass and wood
Pavers	Sandstone*
Grates	Steel*
Subterranean pipes	Terracotta
New connections	Plastic and PVC

*speculative pending materials analysis

Given the complexity of the system outlined above, one might expect drainage systems to merit standalone architectural drawings and detailed specifications for the builder, but that is rarely the case. We lack, for example, a comprehensive map of the subterranean pipes that receive water from downspouts and gutters at many points on the building. We can, however, reference drawings completed in 1959 by architects Freret & Wolf to better understand some of the Cathedral's drainage systems. Freret and Wolf's office records are maintained at the Southeastern Architectural Archives at Tulane University and include renovations to Christ Church Cathedral as well as plans for the New Parish House and other building additions.

Complexity aside--at Christ Church Cathedral, the gutters and downspouts stretch several hundred feet in total--exterior drainage has typically been a secondary consideration for architects and their clients. Systems were designed not to be noticed. Inherently sacrificial, they were expected to be replaced when damaged by hurricanes or rust. While we do not have the original plans for the cathedral, we do have plans for a midcentury addition by Freret and Wolf that include only minimal details about the gutters and downspouts to be installed, as seen in the image above. We can also infer from the plans that some alterations to the existing drainage system were required.

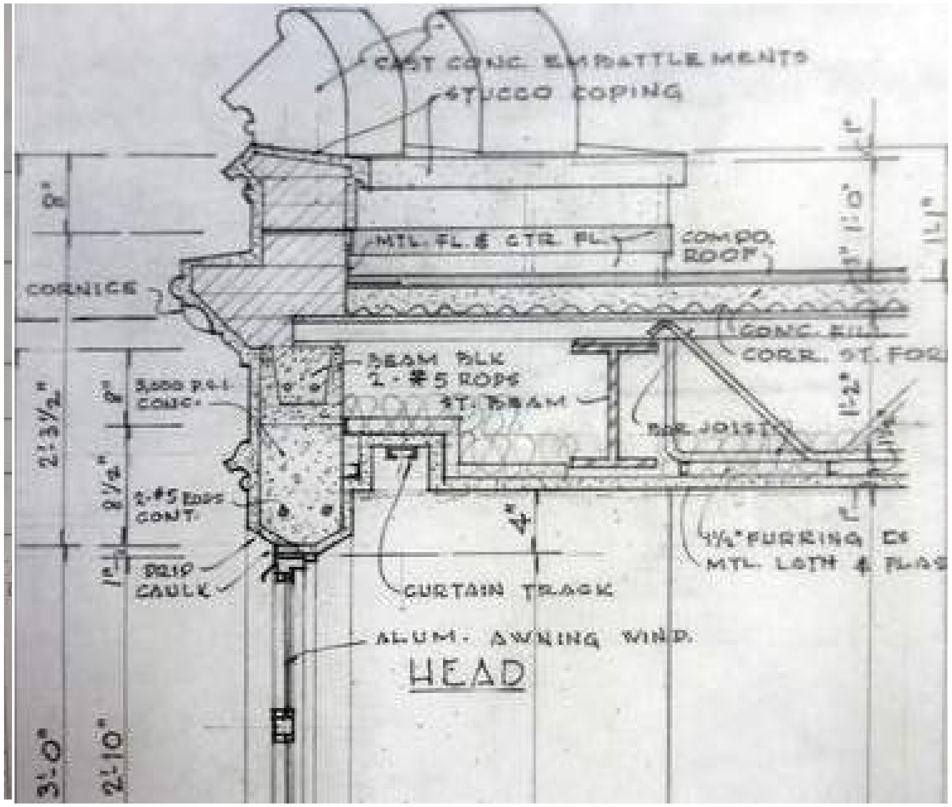

Figure # 6.2: Freret & Wolf's drawings depict a gutter system for the New Parish House in 1959. Freret and Wolf Office Records, Collection 40, Folder 151, Southeastern Architectural Archive, Special Collections Division, Tulane University Librairies. Photo by Laura Blokker, 2015

The conventional view holds that gutters, downspouts and drains are not truly part of a building but merely something affixed to it. The positive facet of this mildly dismissive view is that these components can be modified when they fail without raising the hackles of preservationists and building owners (provided the alterations hew to the cardinal rule of remaining out-of-sight whenever possible). Today, building conservationists maintain that despite the sacrificial character of drainage elements,

Figure # 6.3: On this aerial view of the church, gutters and downspouts are mapped in red, missing downspouts in yellow. Photo by Google Earth, Edits by Nathan Lott, 2015

the replacement systems should be in-kind and restorationists should utilize materials that are sensitive and fitting with the historic building fabric surrounding it.

Analysis:

Comprehending the design, functionality and maintenance needs of the drainage system is key to understanding the preservation needs and priorities of Christ Church Cathedral. Moisture is penetrating the building envelope and damaging the masonry and plaster. Excess moisture elevates the risk of wood decay and may attract termites. There are many ways moisture can accumulate within a building (rising damp, condensation, leaks, etc.), and it is naive to expect that improved rainwater discharge will alleviate the problem entirely. However, securing the building envelop from rainwater is a logical and relatively affordable starting point--particularly given the absence of visible leaks in the roofing or around windows. Inspections conducted during storms by a conservation consultant, Dimitri Roby, found no major attic or window leaks. (Roby's inspection, however, also proved the prevalence of flooding in other, lower sections of the Cathedral complex.) The historic structure's drainage system should be considered a top priority as the church raises and allocates funds for the maintenance and preservation of its campus on St. Charles Avenue and Sixth Street in New Orleans' Garden District.

Currently, several factors are contributing to poor drainage and excess moisture around the foundation of the structure. Missing gutters and downspouts do not direct rainwater to specific sections of ground, drains or catch basins that are designed to handle large, rapid amounts of water during heavy rainfall. Instead, the water is collecting anywhere it can, leading to an influx of water around the foundation where the ground remains is a state of perpetual saturation for weeks at a time. The steep-pitched roof and the slate material typically cause rainwater to shoot off from the roofline of the building. Stains on the side of the building indicate overtopping of gutters. The current gutters lack the width or flashing needed to capture this rainwater. Gutters and drains are frequently clogged, creating similar issues of overtopping. Based off the intentional directing of downspouts beneath grade-level through fitted concrete holes, it is probable that subterranean drainage systems are tied to the municipal storm sewer system. Alternately, they may be tethered to French drains that leach water into the soil down grade, further from the building. Investigating this subterranean network is of primary importance. Even when water does reach the subterranean pipes, it may encounter blockages from leaf litter or collapsed pipes or it may leak through cracked pipes into the soil too close to the foundation.

The location and manifestation of moisture damage within the building strongly suggests a problem of rising damp in the Cathedral Sacristy, Ambulatory, and Red Room, a trio of small rooms added near the apse. These additions and the subsequent construction of a flat-roofed wing that fully enclosed the adjacent Bishop's Garden substantially altered the building's drainage system. Rather than discharging onto soil, the gutters and down-

Figure # 6.4: On this aerial view of the church, gutters and downspouts are mapped in red. Photo by Google Earth, Edits by Nathan Lott, 2015

spouts on the Carondelet Street-side of the cathedral now discharge into an elevated, hardscaped courtyard and must drain toward Sixth Street via a network of subterranean pipes. One particularly worrisome outdoor area, the walled Mechanical Yard, sits below the level of the courtyard and is insufficiently linked to the subterranean system.

The extent of excess moisture within the building is not limited to one section, however. Following significant rainfall events, water pools on flat roofs and in the crawl space below the church. This has been observed and documented by building conservationist Dimitri Roby. Biogrowth (green algae) is visible on the buildings foundation in several places and along the wall of the administrative wing on the uptown side of the complex. This excess water needs to be moved away from the foundation of the building in a sensitive manner and near-term repairs should be done within six months (these include basic actions like replacing missing downspouts). Further investigations can be complete within a year (these could include video inspections of buried pipes and/or exploratory digging to assess subterranean components of the system as well as structural assessment of flat roofs). Within three years, the church can commission design and implementation of compatible contemporary additions to the drainage system, including possible green roof and/or cisterns that will redirect water before it reaches the subterranean pipes.

History of Changes/Interventions:

Additions and alterations made to a building or its grounds, as have occurred in four distinct campaigns at Christ Church Cathedral, frequently necessitate changes in the drainage system. It may no longer be possible to jettison water onto adjacent undeveloped land; downspouts may need to be reconfigured when an exterior wall becomes a party wall; subterranean pipes may need to be relocated or buried deeper to accommodate new foundations; newer structures may utilize flat roofs with interior drains. These accretions not only add complexity to the drainage system, but they can have the effect of removing portions from sight and/or access. This heightens the risk that the already sacrificial system will suffer a lack of maintenance.

At a minimum, we can infer that the drainage system components at Christ Church Cathedral date to the period of the underlying addition or more recently. In all likelihood, gutters on the Cathedral and Chapel have been significantly repaired and replaced since a hurricane felled the church spire in 1915 and hurricane Betsy required major repairs to the church in 1966. Visible elements of plastic or PVC piping can also be assumed to be recent additions. These are most evident where the Bishop's Garden discharges rainwater onto the grounds near Sixth Street.

Just as the technology for building drainage has evolved significantly since the cathedral's construction, so has the wider approach to drainage within the city of New Orleans. Massive pumping stations built in the early twentieth century nearly doubled the amount of buildable land in the metropolitan region. Storm sewers replaced open swales along the roadside; rather than breach the levee built along the Mississippi, these conduits

Figure # 6.5: Standing water in the downtown Mechanical Yard. Photo by Dimitri Roby, 2015

drain rainwater toward Lake Pontchartrain. No longer gravity-fed, open canals were covered; many of the "neutral grounds" from which crowds view Mardi Gras parades contain miles of pipe.

The city's drainage system functioned as designed, but yielded unintended consequences. Water was not allowed to collect in streams, bayous and swamps, and low-lying lands were rendered dry enough for construction and habitation. (Although localized flooding does occur when heavy rainfall exceeds the system's capacity). The repeated pulses of stormwater entering Lake Pontchartrain, however, contained many contaminants washed from lawns and roads. Because the rainwater was no longer percolating through the soil into aquifers below, the city's rate of subsidence increased. (Groundwater withdrawals for industrial purposes aggravate this phenomenon.) This leaves New Orleans sinking while the global sea level rises.

Recognizing the unsustainable nature of the current approach, the city's public, private and philanthropic sectors have collaborated to formulate a revised strategy. Pumps and pipes will continue to play a major role, however "green infrastructure" and rainwater capture will be deployed keep water out of the city's drainage system. That water will be reabsorbed into the soil, helping to slow subsidence, or used for nonpotable purposes like irrigation.

How does this wider context affect Christ Church Cathedral? It is possible that the church can become a pilot project for this new approach by installing green infrastructure (rain gardens, vegetated green roofs, bioswales, etc.) on its grounds or rainwater capture and in so doing receive financial assistance from the Sewerage and Water Board, Environmental Protection Agency or another institution. Drying the soil immediately adjacent to the church's foundation is a primary conservation goal, but it should not be assumed that directing water into the city's stormwater system is the only means of doing so.

Current Conditions:

Gutters

There are at least three distinct styles of historic gutters used on the exterior of the Christ Church Cathedral Complex. Half-round gutters are attached to the roofline that opens onto the Bishop's Garden along Sixth Street. Half-round gutters were traditionally used on buildings erected and fitted with gutter/downspout drainage systems before 1950. Their wide, open design is susceptible to catching leaves, seed pods and other debris that can block the movement of water. They are also relatively shallow compared to other gutter styles. The half-round design is historically accurate and is aesthetically compatible with the Cathedral, as it complements the complex and heavily textured pattern of the slate shingles along the roofline. They are also easily attached and hung from the roof.

K-style Gutters are also featured on the Cathedral's buildings. K-style gutters are most commonly found on residential buildings across the United States, but are also installed in a variety other building types. The curved front is meant to mimic cornice moldings, while its flat backside also allows it to be installed directly onto the building's fascia board.

Figure # 6.6: Standing water in the copper gutters on a hipped roof behind the chapel and the adjacent flat roof. Photo by Trudy Andrzejewski, 2015

Some of the Cathedral's gutters are box gutters hidden behind tall parapets or cornices. In some cases, there may also be flashing behind a parapet that directs water toward an opening and into a downspout. This appears to be the case on the Sixth Street transept entry. A box gutter at the low point between the pitched roofs of the Cathedral Sacristy and Choir discharges into a downspout in the Bishop's Garden. The gutters on the uptown side of the chapel are readily discernable in the courtyard, but those on the downtown side abutting the cathedral are difficult to discern. These appear to be integrated into the wall at the base of the roofline.

Downspouts

Downspouts connect from the gutters on the roofline. They vary in shape, typically being rectangular or circular. Downspouts control the flow of water either onto the ground at grade or into a subterranean drainage system. Some have angled, open-sided extensions that allow air to enter and exit, stabilizing flow.

In addition to understanding the composition of the downspouts, it is worth noting supplementary systems that work to ensure that downspouts are a.) functioning to their highest potential and b.) adhered to the building correctly. First, leader heads are traditional components to gutter-and-downspout drainage systems. They are large, square or rectangular boxes fit to the tops of downspouts where they connect to gutters at the roofline. The larger composition of leader heads allow them to function when heavy rainfall causes overflow in the system. They also provide air circulation, preventing a "vacuum" effect and allowing rainwater to flow through the system effectively.

Recognizing the location and method by which downspouts are adhered to the building facade is also important. In areas where metal ties adhere copper gutters and downspouts to the building, be aware that copper salts can carry through to other, weaker and "less noble" metals, corroding those fixtures and even producing a runoff, stain on the building facade. Systematically inspecting these fasteners and replacing those that have failed should be a routine step in the cathedral's multi-year maintenance plan. Doing so will prevent downspouts from becoming disconnected

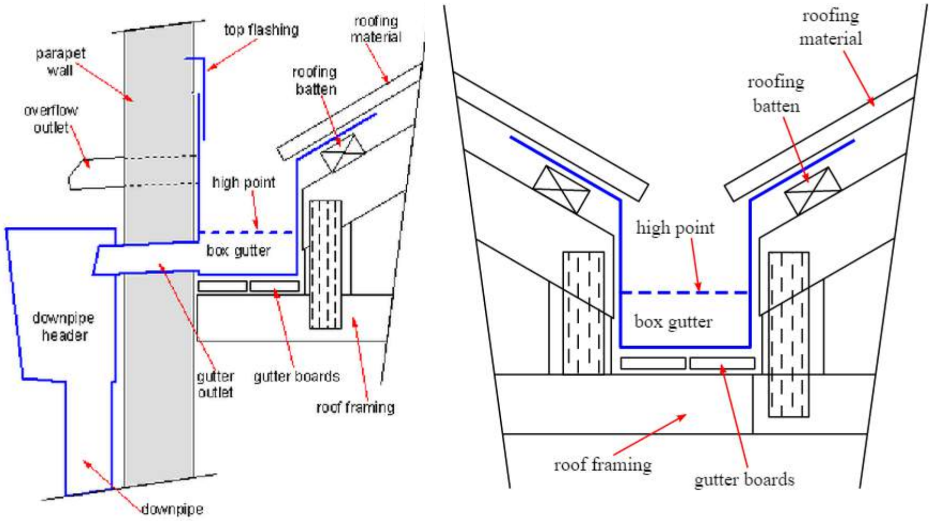

Figure # 6.7: Sectional drawings of a box gutter behind a parapet and at a valley between two roof sectio. Image courtesy of Wikimedia Commons, 2015 during severe storms. This is particularly important as dislodged gutters and downspouts can become projectiles during a hurricane which could threaten the stained glass windows.

Some downspouts are disconnected from gutter systems along the roofline (on the Sixth Street facade outside the Bishop's Garden and at the rear of the administration wing). These should be promptly repaired. There are also a number of downspouts that are disconnected from drains or subterranean pipes (on the side of the chapel nearest the cathedral, in the Bishop's Garden and elsewhere).

Drains at grade

Drains protected by a simple metal grate are commonly used to intake rainwater from paved exterior surfaces, and such is the case with the Bishop's Courtyard at Christ Church Cathedral. However, such drains are susceptible to clogging by sediment and leaf litter. This too, is the case at Christ Church. Unless and until such drains are re-designed, routine cleaning is critical to their functionality. Drains flush with the ground are sometimes found at the base of downspouts rather than pipes protruding from the ground. This is also the case in the Bishop's Garden and the courtyard between the chapel and administrative wing. When this is the case, the downspout must be sufficiently lengthy and formed so as to direct a maximum amount of water into the drain. Extensions may be needed at Christ Church. Alternately, the drains that primarily serve downspouts can be redesigned with concrete walls that extend above grade. However, before this retrofit is made, it must be shown that surrounding grade-level surfaces drain away from the building and to another grade-level drain.

Of particular concern is the lack of a functioning drain in the Mechanical Yard. What appears to be an older drain is now collecting water from the air conditioning equipment housed there and has been outfitted with a condensate pump. This is wholly inadequate during periods of substantial rainfall. Most likely, the drain was obviated when the Bishop's Garden was raised by more than a foot and new catch basins and drains installed in the sandstone flooring. If the drain is connected to the rest of the subterranean system (which is not clear), it may be too low to drain effectively and could even receive backflow during heavy rains.

Figure # 6.8: Leader heads are positioned at and fitted to the tops of downspouts, allowing water to enter from different angles and minimizing overflow. This image from the Bishop's Garden shows leader heads attached to downspouts along two tiers of roof. Photo by Trudy Andrzejewski, 2015

Subterranean Drainage

The subsurface drainage at Christ Church Cathedral is the facet of the building most in need of further investigation. Unlike all other components of the drainage system, the subterranean catch basins, terracotta pipes and French drains are hidden from view. Blockages caused by debris of collapsed tiles are possible, particularly given the age of the building. A plumbing team working to unclog drains that receive condensate from the HVAC in March, 2015, confirmed they found roots in the main sewer line along Sixth Street. Portions of the roots were removed with a sewer auger. Endoscopic video sewer line inspections are the preferred, minimally invasive means of investigating the subterranean system. One key factor to assess is how much water is being leached from pipes into the ground. This could result from French drains or from cracked pipes, but if it occurs too close to the foundation, then repairs or reconstruction

Observered Locations and Conditions of Downspouts and Drainage Hardware

- ○ Downspout connected to underground pipe
- ● Gap between downspout and underground pipe
- ☐ Downspout connected to grade drain
- ■ Gap between downspout does and grade drain
- ▲ Downspout discharges to grade
- ○ Downspout missing
- ▽ HVAC Receiving wells connected to pumps

- L Leak in Downspout
- S Screen vents on Downspout
- B Biogrowth on walls
- C Clogged drain
- X Drain Cleanout
- F Floor Drain
- ▨ Flat Roof

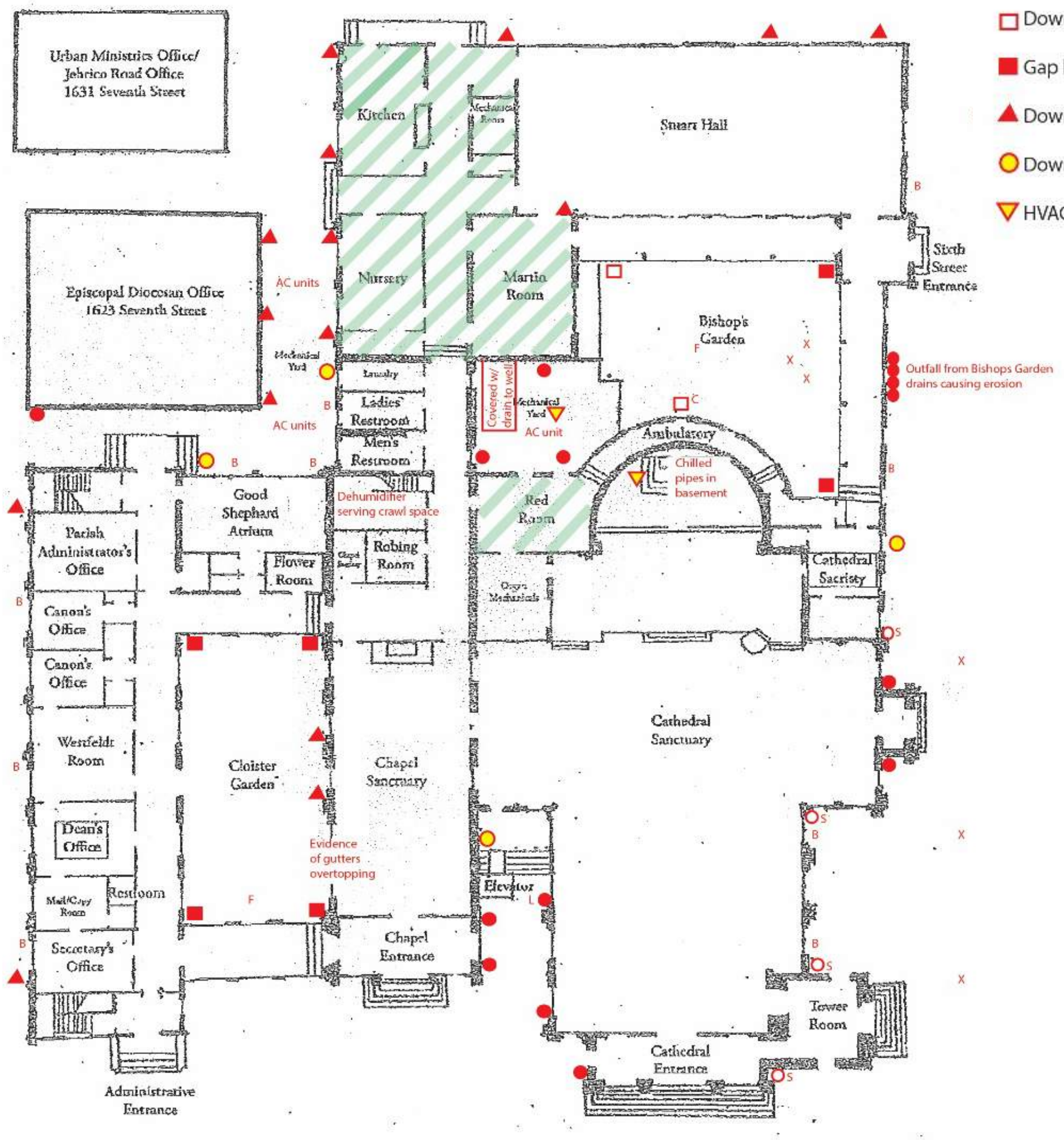

Figure # 6.9: A site map showing observed condition. Image courtesy of Christ Church Cathedral, notations by Nathan Lott, 2015 of the subsurface drainage is required. It would be a mistake to reconnect gutters and downspouts to underground pipes that funnel moisture directly to the foundation. Similarly, the discharge of subsurface drains in the Bishop's Garden directly against the exterior wall on Sixth Street is inadequate. This part of the system needs to be extended (above or below grade) to jettison water further from the building and prevent erosion.

HVAC Discharge
A substantial amount of water is being produced by the building's climate control system and discharged in three places: (1) a receiving well below the ambulatory that is linked to a sump pump apparently discharging below grade in the Bishop's Garden; (2) a receiving well in the downtown mechanical yard that is linked to a sump pump discharging into a drain at grade in the Bishop's Garden; and (3) directly into the soil between the Nursery and the Episcopal Diocesan Office next door. Sources of water in these three areas are as follows:

1. A tray serves to capture condensation from chilled water pipes below the ambulatory and direct it into the nearby receiving well, but at least one pipe is dripping outside the tray. Other PVC pipes link directly into the well.

2. Two large AC units are located in the downtown Mechanical Yard, their condensate is directed into this well via PVC pipes. A portion of the yard has been raised and enclosed with concrete block walls. The small drain inside that receives water from equipment via PVC pipes may be linked to the well outside. A dehumidifier has been placed in an interior storage space near the robing room with the goal of drying the crawl space. Water collected by this dehumidifier is presumed to be draining into the enclosed portion of the downtown Mechanical Yard via PVC pipe, but that should be verified. In addition, two downspouts discharge to this area.

3. Four AC units (three residential sized, one industrial) are located in the uptown Mechanical Yard. In addition, seven downspouts discharge at grade in this unpaved outdoor space.

Different types of air conditioners are used at Christ Church Cathedral, but each produces some water as a result of condensation. Much of the mechanical equipment is clustered near or under the ambulatory, where persistent damp has been documented. Removing this water source--to the extent practical--from beneath or beside the foundation is an important goal for the contemporary drainage system. The present configuration of PVC piping and sump pumps is confusing and apparently inadequate.

Figure # 6.10: This downspout is inadequately connected to the subterranean drain. Photo by Nathan Lott, 2015

Recommendations for Interventions:

Immediate Repairs and Investigations:
All gutters should be cleaned biannually. Developing a cleaning schedule one to two years in advance and staying on track will eliminate major issues in the future. During the first cleaning rotation, gutters should also be thoroughly inspected. The inspection should include: ensuring that the gutters are positioned tightly along the roofline and fascia, eliminating any gaps or opportunities for water to leak between the gutter and the

roofline. Gutters and downspouts should also be inspected for good soldering of joints and transitions, and checking that the materials have not corroded. Defects, wear and installation mistakes should be noted (and preferably keyed to a plan of the cathedral) so that they can be repaired. It may be most cost effective to make minor repairs immediately, while lifts and ladders are on site. More extensive repairs may be deferred in order to obtain cost estimates, select a contractor and determine the appropriate materials (see below).

All drain basins should be cleaned monthly, particularly the small drains located at grade in the Bishop's Garden. Other drains around the foundation of the building should also be cleaned regularly. These drains are susceptible to rapid buildup of soil and debris. When they are clogged, water is forced into other areas which are not equipped to retain it and can harm the building, particularly the foundation.

Reattach downspouts where there is a gap between the spout and the ground.

Relocate and/or redirect downspouts that empty onto paved areas, particularly those which are currently emptying into the Mechanical Yard, located to the rear of the Good Shepherd Atrium.

Repairs and Investigations Within 1-2 years:
The church should replace missing gutters and downspouts and repair existing drainage conduits as needed (based on the inspection conducted while cleaning). The current downspouts are being overwhelmed by the amount of water draining of the roof and through the gutters, which may cause the gutters to overflow and leak in areas where it has not been intentionally directed, i.e. off the sides of the gutters and onto the building facade. This may cause soiling to the facade, and will also damage the gutter systems.

In choosing replacement materials for the gutters, the Church should prioritize gutters and downspouts that relate to the historic fabric and material of the existing historic gutter. Copper is considered a premium material for drainage systems. The material does not require paint and its patina blends well with the slate shingles used across the roof of the Cathedral. Overall, the material is considered to be low-maintenance as it does not rust and is well suited for environments with lots of water, such as the subtropical, humid climate of New Orleans where there is a constant presence of water. However, copper can be costly and for this reason, can be susceptible to theft. The material also requires skilled laborers to install the systems, as cutting the materials and soldering joints and transitions requires experience and expertise if the installation is to be completed correctly. A second drawback is weathering causes the oxidation of copper. The material runoff then migrates to adjoining surfaces and can cause staining on areas like light-colored facades and slate shingles. This issue is not visible on Christ Church Cathedral today, but should be a consideration in the future as proper, nonintrusive cleaning methods should be used if the problem occurs in the future. (Additionally, copper is a biocide, so the runoff of the material can be beneficial and effective in preventing biogrowth staining.) Installing additional downspouts and re-

Figure # 6.11: Chicago City Hall has an extensive green roof system. Image courtesy of Tony Tiger and Wikimedia Commons, 2008.

placing missing downspouts will also be a proactive measure in preventing this issue. Lead-Coated Copper, while still costly, will not run in the same way. Runoff staining from lead coated copper is actually congruent with the coloring of light masonry walls like stucco and limestone, and thus will not discolor or stain the exterior surface of the structure.

If historic gutters and downspouts are not available and copper drainage systems are too expensive for the congregation's budget (copper is often times the most expensive materials used for gutters and downspouts today), then other materials may be considered. Aluminum, for example, is low-cost but it expands and has a short life-span. Galvanized steel is another popular, affordable material but its drawbacks also include rusting and premature failure. Replicating a copper patina may be a possibility in order to match the aesthetic of the existing systems, though on cheaper materials even the paint is likely to fail prematurely. Beyond aesthetic and historic considerations, the Church should also consider ease of use, level of maintenance required, ease of access and cost. The relationship of any alternative materials to the existing copper would have to be carefully considered to avoid galvanic corrosion of the less noble material.

During the next two years, the church should also conduct several investigations, the first being an endoscopic camera investigation of the subterranean drainage system. Using a waterproof camera known as a drain scope or sewer scope to provide visual access to the interior of pipes and conduits below ground has become a common practice within the past decade. Many plumbing companies offer the service (cameras can be purchased or rented by facilities managers, but an experienced operator is recommended). The advantage of this approach is that endoscopic cameras can help locate cracked, collapsed or inadequate pipes without digging. Thus time is not spent excavating functioning elements of the subterranean system. With the information obtained by this investigation, the church can determine what subterranean repairs are necessary and seek bids accordingly. The images obtained using an endoscopic camera may also add to the church's understanding of where French drains are used versus sewer connections and how long standing water remains in pipes following a rain event.

The church should also evaluate the feasibility of relocating HVAC equipment to flat roofs or the Cathedral Backyard. Moving the units further from the foundation; elevating them would allow for drainage in new directions without the use of sump pumps. Alternately, the church should evaluate the possibility of installing a green roof system on flat roof surfaces. A green roof will alleviate pressures on the gutters and downspouts, as well as redirect water flow and impact from the grade-level landscaping and subterranean drainage systems which may be in disrepair. A structural evaluation by an engineer will be necessary to determine if the flat-roofed portion of the building is able to carry the added weight of AC units and/or a green-roof system.

Finally, the church should conduct a feasibility analysis for the addition of one or more cisterns in the Mechanical Yards. Spatial constraints of the downtown Mechanical Yard, which is squeezed between several additions of varying ages, make it a prime candidate for rainwater capture. Rather than directing water into this space where it cannot effectively drain, the two downspouts could be connected to a close-topped cistern with an overflow mechanism. Relative to other options, this may be a low-cost alternative. However, the church would need to receive quotes from professional installers and possibly monitor flow levels from the relevant downspouts in order to make that determination. For more information on rainwater capture see "Other Considerations" below.

Repairs within 3-5 years:
Repairs to subterranean drainage as determined necessary through video investigations should be completed within three years. This may involve significant disturbance of the soil, sidewalk or garden flooring should pipe replacement be required. It may also be found that blockages in the municipal system proximal to the church's property (particularly the conduit along Sixth Street) are causing water to back up in pipes on the church grounds. In that case, it may be necessary to coordinate repairs with the Sewerage and Water Board.

Changes to landscaping should also be implemented in this time-frame and their impacts to the building assessed (see appropriate chapter). The existing landscaping includes shrubs and small trees planted close to the cathedral's foundation, collecting and retaining water in the root systems too close to the historic foundation and producing leaf litter directly above gutters and drains. Instead, plants should be located closer to the sidewalk and property line, moving water away from the foundation of the building. This would also reduce soiling on the exterior facades of the Cathedral. In the Bishop's Garden, potted plants can replace those currently lining the exterior walls, thereby retaining the verdant character.

In addition, a complete renovation of the Cloister Garden would serve to reduce the drainage burden currently resulting from the area's raised grade and solid surface pavers that do not allow rainwater to penetrate, forcing it to run-off into crawl space below the chapel during very high-volume rain events.. A new rain management garden, which is proposed and discussed in-depth in the Landscape section, can offer drainage benefits and also protect the building foundation.

Within five years' time, it is reasonable to implement a sophisticated rainwater retention system such as a green roof and/or cistern. If this can be done in tandem with the relocation of HVAC units, that may be the most effective strategy. For example, placing AC units on the roof and cisterns in the Mechanical Yards. Design for these solutions must be based on the outcomes of feasibility studies described above. The roof may bear a lighter green roof system and not the AC units. A rainwater capture professional may suggest alternate locations for cisterns and rerouting of downspouts accordingly. The goal of alleviating the excessive combination of rainwater and AC condensation in the downtown Mechanical Yard should drive the design of the system. If the church does not address excess moisture accumulation within this timeframe, significant masonry damage will likely result.

Other Considerations:

Wooden cisterns, like open canals, were once a common sight in Louisiana. However, they were largely abandoned as unsanitary. Contemporary methods of rainwater capture need not be unsightly or unsanitary but may require a paradigm shift for property owners. Here are some additional considerations related to rainwater capture recommendations above:

A feasibility analysis for a green roof begins with a structural analysis of the roof. An engineer's assessment of the roof's load-carrying capacity will determine if a green roof is an option and help inform the selection of an appropriate system. Lightweight systems include those that use modular trays filled with gravel and sedums; heavier systems may include pervious pavers and large planting container, effectively creating rooftop gardens. Another approach, sometimes called a blue roof, contains no plants at all but simply a reservoir for the storage of rainwater beneath permeable pavers placed atop the watertight roof. The reservoir can be used to hold water for irrigation or designed to release water slowly following a rain event--thus not overwhelming the onsite drainage system. Because such systems have not been widely deployed on the Gulf Coast, part of the feasibility analysis should include tracking of pilot projects in New Orleans and nearby jurisdictions. The risk of heavy rainfall, high-wind hurricanes and the potential for mosquito breeding in standing water are particularly salient concerns in New Orleans. A unique part of the feasibility analysis for Christ Church Cathedral should be tracking a pilot project at Rabouin International High School with three types of green roof. The project is being funded by the New Orleans Sewerage and Water Board and may be indicative of future cost-sharing available for similar green infrastructure projects (http://www.swbno.org/work_green-infrastructure_projects.asp).

Like its smaller cousin, the rain barrel, a contemporary system is covered and outfitted with an overflow mechanism. It may be in-ground or above-ground, clad in metal, wood or plastic. The church should evaluate--either in tandem with the green roof or independently--the feasibility of placing a cistern in the mechanical yards. This is largely a matter of spatial constraints and the potential to relocate air-conditioning apparatus. If space is sufficient, a cistern could be installed to accept rainfall from downspouts that currently discharge into the mechanical yards and cause significant flooding during heavy rain. The sole drain in the downtown yard is either poorly functioning, overwhelmed by volume, or both. Created by surrounding mid-twentieth-century additions, the downtown Mechanical Yard was left more than a foot below the grade of the adjacent Bishop's Garden. A cistern installed in this walled yard need not be visible from the garden; like rooftop retention it could serve to provide irrigation and/or discharge at low-flow times. A cistern in the uptown mechanical yard would be visible from the Nursery and Good Shepard room but no less attractive than the AC units and equipment currently found there. Currently seven downspouts discharging directly into the soil in this small space (three from the Episcopal Diocesan Office), keeping the ground in a state of semi-saturation and exacerbating biogrowth on the walls. If the church so chose, it could install conventional rain barrels on each of these downspouts as a pilot project in rainwater capture. These would needed to be emptied on a routine basis (each with its own spigot), so maintenance staffing is as much a factor as upfront cost (typically $100 per rain barrel).

Comparable Case Studies:

Butler, K. et al. Rain Catchment and Adaptive Reuse: The Historic Seaholm Power Plant. Austin: University of Texas, 2006.

The conversion of this historic power plant campus in Texas into a mixed-use live, work and community space involves an extensive landscaping plan that addresses progressive rain catchment and stormwater management opportunities, while preserving the historic fabric of the buildings and property. The extensive surface areas of two of the buildings' roofs will be adapted to provide rain catchment and storage, and will be used to supply all landscape irrigation and additional water demands. Large underground tanks will also be utilized as cistern storage, reducing pressures on the municipal runoff control systems.

Fair Street Christian Church (Springfield, OH), Durable Restoration Company. http://www.durablerestoration.com/portfolio-fair-street.html

In 2005, the Fair Street Christian Church in Ohio completed a structural stabilization and restoration of its 19th century church. New copper gutters and downspouts were installed on the historic property, who's steep and multi-tiered slate roofs are comparable to that of Christ Church Cathedral. All elements were hand soldered, waterproofed and carefully installed. This brief case study provides an overview of the scope of work that may be considered by Christ Church Cathedral.

Holmes, Nicole and Robert Rock. "Landscape as Sponge: Re-engineering a Historic Campus to Absorb the Rain." Phoenix: American Society of Landscape Architects, 2012.

While different in scale, the iterative development at Princeton University is not unlike that at Christ Church Cathedral. As the school grew, it placed buildings on more and more of its total site. This altered stormwater runoff patterns and volumes as well as the esthetics of the campus. In 2008, the university integrated stormwater management into its campus master plan for the first time. Subsequent buildings and renovations used and integrated design process marrying architecture and landscape architecture. Technologies such as engineered soils, green roofs and rain gardens emphasized rainwater absorption over traditional piped drainage. The work was conducted by Michael Van Valkenburgh Associates and Nitsch Engineering.

Weaver, Martin E. "A Masonry Deterioration Case Study: Holy Trinity American Church, Hawkesbury, Ontario." Bulletin of the Association for Preservation Technology. Vol. 1, No. 1(1978).

This case study discusses moisture problems as first evidenced by the deterioration of interior plaster work at Holy Trinity Anglican Church in Ontario. The study tracks the investigation process for determining the source of the moisture and tracking moisture content in the walls through tools such as moisture meters and surface temperature thermometers. While the Landscaping Section will detail this case study more in depth, there are clear connections between the raise in grade that has greatly impacted drainage at the base of the foundation wall. Dropping the grade to its original height will help to alleviate drainage issues, increase ventilation in the basement spaces as was originally intended, and reduce condensation and biological growth around the foundation and interior basement walls.

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Landscape and Grade

Amanda Keith

Figure 1: George F. Mugnier, , Christ Church, glass plate negative, 1887, Louisiana Digital Library, accessed Feb 5, 2015, http://cdm16313.contentdm.oclc.org/cdm/singleitem/collection/GFM/id/809/rec/4.

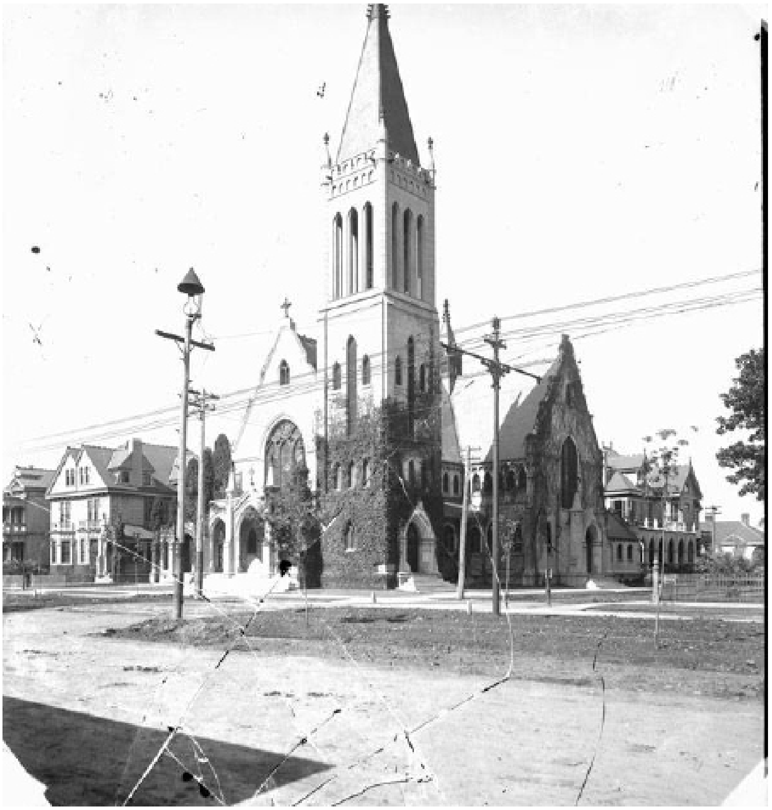

Figure 7.2: Georges Mugnier photograph, 1896 courtesy of Christ Church Cathedral Collection

Introduction

Landscaping and grade play an important role in the character of any historic building as well as to its overall health. In looking at landscaping from a preservation point of view, one must balance maintaining the character of an historic landscape with choosing plantings and a grade system that work well with the historic fabric of the building. Inappropriate plantings and grade changes over time can contribute to the introduction of moisture into the masonry walls and foundations of buildings leading to structural damage and damage to interior finishes. This section will focus on the landscaping surrounding the exterior of the Christ Church Cathedral on its St. Charles Avenue and Sixth Street facades, which are the facades that include the original Cathedral and Chapel buildings, as well as the Cloister Garden and the Bishop's Garden. The background of landscaping and grade changes at the Cathedral from 1886 to the present will be reviewed, and an assessment of current conditions of landscaping and grade on the site made. The section will then analyze problems and possible issues that may arise due to current landscape conditions. Finally it will offer some recommendations for treatment of preservation issues related to the landscape and grade at the Christ Church Cathedral.

Background and History

As outlined in the Architectural History Timeline, the Christ Church Cathedral on St Charles Avenue and Sixth Street was completed in 1887. The attached Chapel was finished in 1889. While the original plans for the Cathedral cannot be located, there is early photographic evidence of the exterior of the building from the around the turn of the 20th century, shortly after it was first completed. In an early photograph by

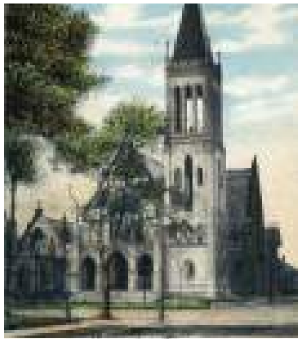

Figure 7.3: Postcard. 1907. Aleman Estate Collection, Louisiana and Special Collection Department, Earl K. Long Library, University of New Orleans.

George Francois Mugnier, dated to 1887, the building is depicted without any landscaping (Fig 7.1).[1] Another Mugnier photograph from 1896 (Fig. 7.2) taken from St Charles Ave and looking in the uptown direction towards the Cathedral, shows growth of vines on the façade of the chapel and on the tower.[2] An illustrated postcard from 1907 (Fig.7.3) depicts the Cathedral with minimal landscaping, really only a groundcover of some type of grass, however this image also shows that by 1907, vines were beginning to grow on the Sixth St façade as well as the chapel façade and some of the finials of the chapel roof.[3] By the time of the photograph taken between 1915 and 1922 from St Charles Ave (Fig. 7.4), the front of the chapel is nearly obscured by the vines growing across the entire façade, creeping onto the roof, and covering the terra-cotta finals.[4]

Figure 7.4: Christ Church Cathedral c 1915-1922, Christ Church Cathedral Collection

Figure 7.5: 1930s photograph of Christ Church Cathedral front façade, State Library of Louisiana.

Figure 7.6: Christ Church Cathedral 1966, taken from the neutral ground at Sixth St and St Charles Ave. Charles L. Franck, photographer. The Historic New Orleans Collection, acc. no. 1994.94.2.1000.

A photograph of the St Charles façade dating to the 1930s (Fig.7.5) shows the vines, though by this time they seemed to have been cut back somewhat, as the top of the chapel façade is visible in this photograph.[5] A later photograph (Figs. 7.6) dated to 1966 shows the building with only a small amount of vines growing on the Sixth St façade.[6]

The church has in its vault a watercolor illustration dated from 1942 by Richard Koch, architect and William S. Wiedorn, landscape architect (Fig. 7.8) that shows the plans for landscaping done on the property at the time.[7] This map shows where various plants and trees were placed and what species were planted. It predates the additions of the administration building and the rear additions, so it does not include the current Cloister Garden or Bishop's Garden, but aside from those differences, the plan shape for the landscaping is remarkably intact. It is possible that this was not the first landscaping done at the site because the plans reference moving some existing plants and trees to different places onsite, however it is likely that this was the first major professional landscaping plan for the Cathedral at this site. Unfortunately without any additional documentation of original site plans it is difficult to know exactly what was planted and if it was done with any type of planning.

The Koch and Wiedorn illustration has a key that shows what plants were chosen. Plants are then labeled on the drawings along with information about the size and number planted in any given area. This

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[1] George F. Mugnier, , Christ Church, glass plate negative, 1887, Louisiana Digital Library

[2] George Mugnier, 1896, CCC photo

[3] Louisiana Digital library photo

[4] Christ Church Cathedral photo

[5] Louisiana Digital library photo

[6] Louisiana Digital library photo

[7] Koch and Wiedorn illustration, Christ Church Cathedral private collection

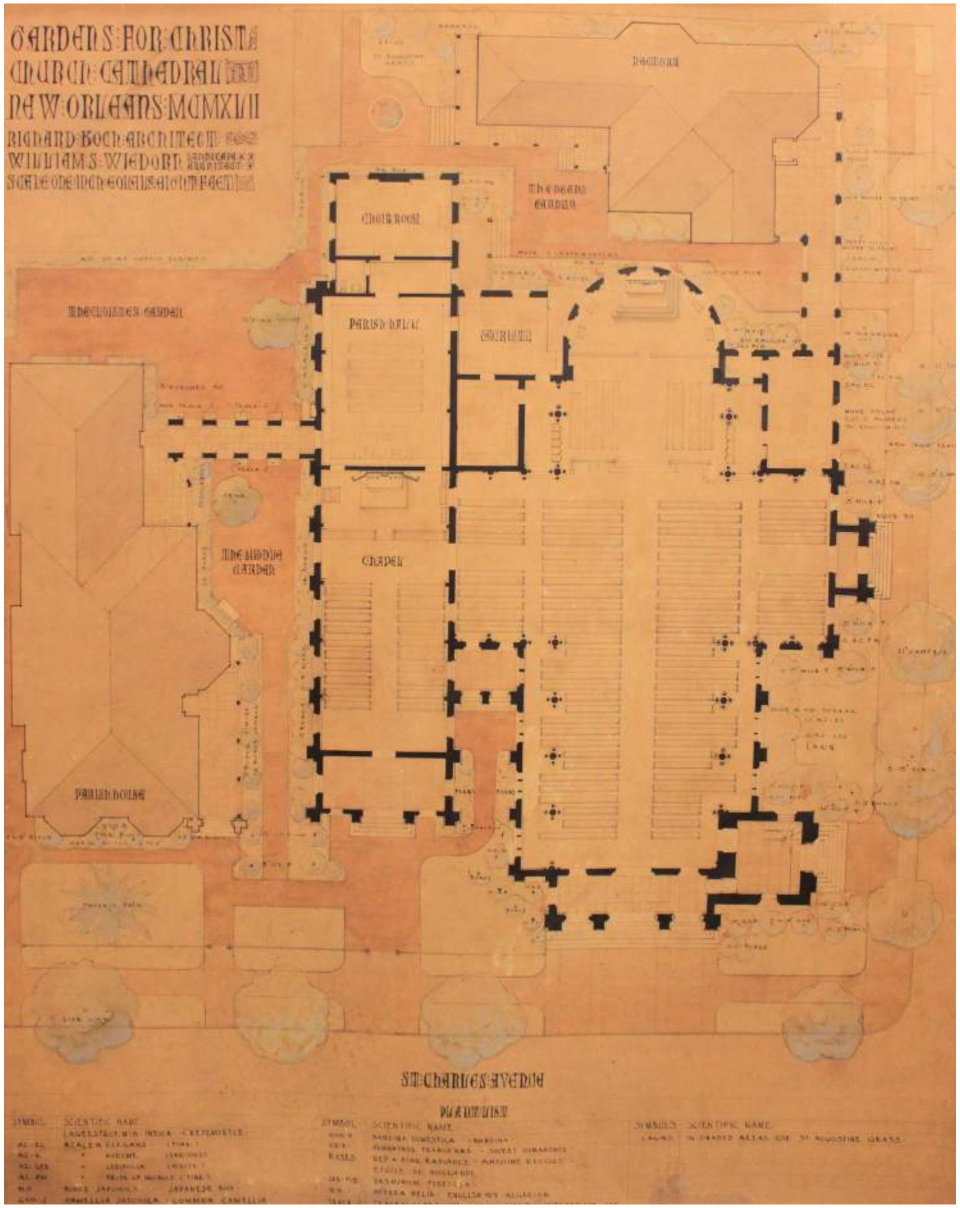

Figure 7.8: Richard Koch/William Wiedorn illustration for landscaping plans 1942, Christ Church Cathedral collection

is the first evidence of live oaks planted along St Charles Ave in this location. Previous photographs showed no trees or palm trees. For the front façade of the Cathedral, sweet osmanthus (osmanthus frangrans), also known as sweet olive trees were chosen as well as Japanese boxwood (buxus japonica), a hedge-like shrub.

Ferns and Japanese boxwood were planted along the side of the buildings between the Cathedral and the chapel, called the Middle Garden in this drawing. In this small garden between the chapel and the parish house, now the location of the Cloister Garden, they planted more sweet osmanthus and Japanese boxwood along the wall of the chapel and the edge of a patio of the parish house. The illustration shows a walkway that was most likely covered between the chapel and the parish house, and this was covered in Confederate jasmine (tracheluspermum jasminoids), a flowering, vine-like creeping plant. The garden also shows a pear tree, planted away from the walkway and shrubbery labeled as "pedocarpus". There is no key for this plant, but it may actually be podocarpus, a tropical and sub-tropical evergreen plant used as garden trees or hedges. Though not native to the United States, the plant could flourish in the sub-tropical New Orleans climate and may have been introduced.[8] In what was originally known as the Cloister Garden, but is now part of the 1960s addition to the church, there are azaleas (rhododendron Tsutsuji) planted around the edges and a black locust tree, planted notably away from the foundation of the building.

Plantings around the rear portion of the Cathedral, then known as the Dean's Garden and now the site of the ambulatory, include crepe myrtles (lagerstroemia indica), azaleas, Japanese box, English ivy (hedera helix), and jasmine (jasminus pubescens). It is interesting to note here that the church was trying to grow climbing plants purposely on the walls of the building rather than the vine inundation being some kind of local vine or invasive species. The growth of vines to cover the building was much in keeping with the Gothic Revival tradition and was especially seen on Gothic revival college campuses in the United States. The tradition of vine covered Gothic ruins however, started in England as the Revival style became popular. At the time it was considered fashionable to have a vine covered gothic ruin on one's property, and if one did not exist, then it was built and vines and shrubbery quickly planted to create the ruinous effect.[9]

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[8] "Podocarpus", Wikipedia Internet Encyclopedia, accessed Feb 25, 2015, http://en.wikipedia.org/wiki/Podocarpus.

[9] "Louisiana Architecture: A Handbook on Styles, Gothic Revival", accessed Mar 20, 2015, http://www.crt.state.la.us/cultural-development/historic-preservation/louisiana-architecture-handbook-on-styles/gothic-revival/index.

Finally around the exterior of the Sixth St façade, there are more crepe myrtle and sweet osmanthus trees as well as azaleas, and banana shrub (michellia fuscata). It seems that some flowering trees were chosen along Sixth St such as Tulip and Camphor. Additionally, they placed 50 English ivy plants along the exterior wall of what is now the Sacristy. The plan does not indicate what types of vines were planted along the St Charles Avenue elevation. However, a photo from around 1915 shows leaves that look like English Ivy along with what appears to be Cat's Claw vine, the invasive species that covers so many buildings in New Orleans. (Fig.7.7)

Figure 7.7: Vines covering the chapel. Undated. Visual Materials Collection, Southeastern Architectural Archive, Special Collections Division, Tulane University Librairies.

A photo from 1966 (Fig. 7.6) show a landscaping plan that had changed little over time, with the exception of the removal of ivy on the building. It is not known why the church chose to remove the ivy and other creeping vines from the façade of the chapel and the finials, but it is possible that the creeping vines were causing issues with the masonry, as they are known to do.

It should be noted that the Koch and Wiedorn landscape plan, though created in 1942, was much in keeping with the overall landscaping patterns of the Garden district of the late 19th century. After 1860 many homes in the neighborhood featured lawns that created "lush green vistas" in addition to native subtropical flowering plants.[10] Another aspect that would have been easily recognized by 19th centur residents was the choice of wonderfully fragrant plants such as sweet olive trees and jasmine. These plants were often chosen in earlier times to help mask the smells of sewers that frequently backed up and other unpleasant odors of the early suburb.[11]

Figure 7.9: current view of Christ Church Cathedral from neutral ground at St Charles and Sxth, photo by Amanda Keith

Figure 7.10: Landscaping at front elevation between Cathedral and Chapel, photo by Amanda Keith, 2015

Current Conditions

The landscaping for the Cathedral as it stands now consists of plantings around the perimeter of the Cathedral and Chapel as well as two interior courtyard spaces, the Cloister Garden and the Bishop's Garden that feature paved patio space as well as plantings. The grade in both interior courtyard spaces has been raised over the years so that it is just over a foot above its original level. This is detrimental to the building spe-

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[10] Jim Frasier, "The Garden District of New Orleans", University Press of Mississippi, 2012, 73.

[11] Ibid, 25-26.

cifically in the Cloister Garden, where grade was raised to a degree in which it covered the original ventilation system, allowing excess moisture to collect in the walls. In the Bishop's Garden, the raised grade is mostly an issue in the bed of plantings that rests against the exterior wall of the ambulatory, where it is also causing problems of excess moisture in the masonry wall.

While the original exterior landscaping retains the same general plan shape and placement (Fig. 7.9), some of the plantings have been changed over the years. Along the front façade of the Cathedral, the landscaping is fairly sparse with some azaleas and palms planted along the front of the building flanking the main entry stairs.(Fig. 7.10) Grade in front of the Cathedral slopes down away from the building. The general plan view shows a landscaping scheme that is generally the same as the 1942 plan, with the key difference being the number and types of plants. It seems that even in the early landscape plans, plants were planted very close to or against the foundation of the building.


Figure 7.12: "Sacrificial" spot for wheelchair ramp, no landscaping, photo by Amanda Keith, 2015


Figure 7.13: The Cloister Garden, view towards St Charles Ave, photo by Amanda Keith 2015


Figures 7.14 & 7.15: Exposed vents covered by a foot of soil during grade changes over time, photo by Amanda Keith, 2015

The former entrance between the chapel and the Cathedral now serves as a sacrificial spot in terms of landscaping as that entrance has been converted to the wheelchair accessible entrance for the building.(Fig. 7.12) Where there were once ferns planted is now a metal ramp with no landscaping in this area. Camellias have replaced sweet olive trees in flanking the entrance to the chapel.


Figure 7.16: Bas relief fountain in Cloister Garden, photo by Amanda Keith,

The current Cloister Garden (Fig. 7.13) is a courtyard space that sits where the former Middle Garden was located between the chapel and the administration building. It is enclosed on its other two sides by a covered open-air walkway on the front façade and a totally enclosed walkway in the rear that connects the administration building with the chapel. The Cloister Garden features a raised grade patio paved with large flagstones. Japanese boxwood flanks the outer perimeter of this garden space. There are also lily turf (liriope muscari) plants in areas of the landscaping that jut out into the larger rectangular space. A small dogwood tree is planted in the corner as well as camellia bushes. In the center of the garden placed on the wall of the chapel is a bas-relief fountain designed for the church in 1962 by Angela Gregory.[12](Fig. 7.16) The fountain does not currently work, but the church would like to have it repaired and for it to remain in the garden. Recently, during investigations by Dimitri Roby, some soil test units were excavated along the chapel wall and the ventilation openings were once again exposed after being covered


Figure 7.17: Bishop's Garden, photo by Amanda Keith 2015


Figure 7.18: Drain clogged with plant matter in bed against ambulatory, Bishop's Garden, photo by Amanda Keith, 2015

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[12] Times Picayune, April 4, 1987

Figure 7.19-11: An angel fountain sits in the Bishop's Garden
Figure 7.19-2: One planter does not touch any buildings walls
photos by Amanda Keith, 2015

over the years due to the grade change in this space (Fig.7.14 & 7.15).[13] A profile of the soil in the beds against this wall reveals that plant roots from the Japanese box growing in this area are touching the wall. Plantings this close to the foundation of a building can cause issues by drawing moisture to the foundation and holding it there.

Figure 7.20: Grade change from Mechanical Yard to Bishop's Garden of 18 inches, photo by Amanda Keith, 2015

The Bishop's Garden (Fig. 7.17) is a small, irregularly shaped courtyard that is bounded by the ambulatory wall, a gate enclosing the outdoor mechanical space and access to the basement of the Cathedral, the wall a meeting room of the addition, the recreation room of the addition, and a covered memorial wall and walkway on the external Sixth St side of the building. The space is paved with concrete pavers. There is a bed of three crepe myrtle trees, banana shrub, lily turf, and cast iron plant (aspidistra elatior) planted against the ambulatory wall. This bed has two large drains, which empty the downspouts coming off the roof in this area that are partially clogged with plant matter.(Fig. 18) According to Dimitri Roby, these drains were totally covered by soil and plant matter when he began his conditions assessment of the church and grounds.[14] There is another bed running against the wall of the mechanical space and the meeting room that features four small trees and lily turf groundcover. A small angel fountain and some plants in containers sit on the edge of this bed. (Fig. 7.19-1) Finally there is a bed in the corner where the walkway to the recreation room meets the walkway in front of the memorials. This bed does not sit against the foundation of any building and is planted with a sago palm and lily turf.(Fig. 7.19-2) Four planter boxes sit along the walkway side of this bed facing the glass wall of the recreation room.

Figure 7.21: Sixth St elevation of Cathedal, photo by Amanda Keith, 2015

Figure 7.22: Cast iron plants have replaced azaleas along the Sixth St elevation, phoyo by Amanda Keith, 2015

The grade in the Bishop's Garden has been raised dramatically (Fig. 7.20). Entering the mechanical space, there is a difference of almost 18 inches between the original ground level and the present level of the patio in this courtyard. The raise in grade in this area was likely made in order to bring it to the level of the entry of the recreation room.

Figure 7.23: AT&T cell tower along Sixth St elevation, photo by Amanda Keith, 2015

On the exterior wall of the Sixth Street façade, while there is a general similarity in plan shape of the landscaping, many of the plant types have been altered over the years.(Fig. 7.21) There are fewer trees and shrubs planted along this section, ivy and other climbing plants have been removed, and azaleas, once the most common plant found in this area have been largely replaced by cast iron plants planted up to the foundation.(Fig. 7.22) In the area between the tower entryway and the side entryway, an AT&T cell tower system has

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[13] Personal Interview with Dmitri Roby

[14] Ibid

been installed, strictly limiting access to landscaping in this section. (Fig. 7.23)

Analysis of Conditions

An assessment of the current conditions shows a landscaping scheme that is not well thought out in terms of its effects on the building fabric. Though in some cases landscaping plans are the same as or similar to historic landscaping plans, it is safe to say the landscape does not retain its historical integrity due to changes made in grade and plant type. In the newer courtyards, grade has been raised to the detriment of the building walls. Around the building, plants and trees have been placed too close to the foundation, and roots may be holding excess moisture against the masonry. Additionally, termites use the roots of plants as highways straight into a building.

The interior of the church has displayed problems of deterioration of masonry and interior finishes due to excess moisture. These issues are discussed in detail in the masonry and interior finishes sections of this report. It is likely that a combination of insufficient drainage and poor landscape planning is contributing to the moisture, causing problems to the building structure and interior. The drainage issues are also be discussed in a separate section.

Two current conditions of the landscape plans at the Cathedral that are leading to excess moisture are the placement of plants and trees too close to the foundation and the raise in grade in the interior courtyard gardens. The landscaping of this building has been planted far too close to the foundation of the building since at least 1942 when the Koch and Wiedorn plan was made, and this has likely always been the situation. It is obvious in hindsight, from the choice to let vines inundate the facades of the building that plantings were chosen for aesthetic purposes rather than with any thought to the building. Modern preservation standards suggest planting all plants at least a foot from the building.[15] Another source goes into further detail, suggesting that plants must be placed "at least half their mature width plus one foot away…".[16] Additionally, trees and shrubs with a mature height over six feet should be planted so the edge of their canopy is at least five feet away from the building and shorter shrubs should have at least three feet of clearance. This allows roots to grow without damaging buildings with the introduction of moisture or pests such as termites and to allow airflow between foliage and the building surfaces. Any mulch or ground cover must be at least a foot from the foundation of the building.[17] In the case of Christ Church, all shrubs, groundcover, and trees are planted right up to the foundation or walls of the building.

Martin Weaver's case study for the Holy Trinity Anglican church in Hawkesbury, Ontario echoes the situation at Christ Church Cathedral almost exactly. Issues of rising damp in the masonry walls at both churches are leading to plaster bubbling and cracking of the walls on the interior. Just as with Holy Trinity, it was discovered that sub-floor ventilation units, used to keep condensation from building up inside the building had been buried beneath dirt due to grade changes over time.[18] In the case of Holy Trinity, which exists in an entirely different climate and did not have an existing damp course as in Christ Church Cathedral, recommendation were given to create an impermeable layer to move rain away from the foundation of the building. While the case study of Holy Trinity can be followed for guidelines on treatment, the specific climate and building history of Christ Church requires an adjusted set of recommendations to deal with what are, essentially the same problems.

The grade change in the Bishop's Garden is less of a problem for the historic building fabric because that area does not touch any part of the original building. However, the plant bed next to the wall of the ambulatory is contributing to excess moisture and deterioration of masonry in that part of the building. The combination of having 18 inches of damp soil that does not drain properly and large tree roots planted against the brick wall is wreaking havoc on the ambulatory and is obvious from the condition of the plaster on the interior of that section of the church.

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[15] Sharon C.Park, AIA, "Preservation Brief 39: Holding the Line: Controlling Unwanted Moisture in Hsitoric Buildings", Technical Preservation Services, National Park Service website, accessed Mar 1, 2015, http://www.nps.gov/tps/hohttp://www.nps.gov/tps/how-to-preserve/briefs/39-control-unwanted-moisture.htm.

[16] "Alabama Smart Yards", accessed Feb 25, 2015 http://www.aces.edu/pubs/docs/A/ANR-1359/ANR-1359.pdf.

[17] "Foundation Plantings", Clemson Coorperative Extension, accessed Feb 25, 2015, http://www.clemson.edu/extension/hgic/plants/other/landscaping/hgic1702.html.

[18] Martin E. Weaver, "A Masonry Deterioration Case Study: Holy Trinity Anglican Church, Hawkesbury, Ontario", Bulletin of the Association for Preservation Technology, Vol. 10, No. 1(1978) pp. 10-19. Accessed Feb 19, 2015, www.jstor.org .

Recommendations

The following recommendations are suggestions that may help alleviate excess moisture being drawn into or held against the foundation due to landscaping. Minor interventions will be discussed first followed by larger scale interventions and long-term strategies.

A. While many of the plants in place at the church are known to be "thirsty" species, ones that draw in a lot of surrounding moisture, they are planted too close to the foundation of the building. It is recommended that all plants around the exterior be moved to at least one foot away from the foundation, using the specifications from the analysis portion of this document. Plants, bushes, and short shrubs must be half their mature width plus one foot away from building walls or foundation and trees must be five feet past their canopy. Any groundcover must be at least one foot away.

B. Reintroduction of azalea hedges around exterior facades as seen in the 1942 illustration would help to draw moisture from the walls. Native azaleas are woody shrubs known to draw in moisture.[19] They also maintain the historic character of the landscape. These hedges must be planted within the parameters stated above for distance from the building. If space is an issue, dwarf azaleas may be considered as well. Additionally, in keeping with the Koch and Wiedorn design, a fragrance garden could be planned, using some of the existing sweet olive trees and bringing back Confederate Jasmine, this time vining on trellises to prevent any damage to building fabric.

C. Replacement of the plant beds in the Cloister Garden and the Bishop's Garden with container plants would help to solve the issue of plants being too close to the foundation. This would help to alleviate issues with moisture and the threat of insect invasion through root systems planted near foundations. Removal of trees that are too close to the building will prevent the threat of future disturbance to the masonry from growth of roots underground. A smaller scale tree known for moisture absorption, such as a Dogwood could be planted in the bed that does not currently touch any of the building walls.[20]

D. It is important that all vents remain exposed in the Cloister Garden. In order to do this, units excavated by Dmitri Roby should be shored with brick "window wells" so that these vents remain free to allow movement of air.[21]

E. A more extreme intervention to mitigate this situation would be to lower the grade in the Cloister Garden. This is something the Cathedral may want to consider as a long term plan as it would require removal of the paving stones, the slab of cement under the paving stones, seen in the Wold and Freret designs from 1959, current plantings, and a good deal of soil. Hopefully, by lowering grade, it would bring the soil level back down to below the "damp course" of slate installed in the original masonry walls, allowing this slate to do its job of preventing moisture from wicking up into the masonry.[22] This plan would ultimately result in a sunken courtyard, but may be a successful strategy for solving issues of drainage in this garden. Because it is open air, installation of a rain garden in the center of the space may be an innovative plan to draw moisture away from the walls of both the chapel and the administration building while maintaining a peaceful garden atmosphere for quiet contemplation and prayer.

F. While a return to original grade is not recommended in the Bishop's Garden, it is imperative that the bed against the ambulatory wall be removed and excavated so necessary repairs can be made to this wall. Once repairs are made, proper drainage of the roof into catch basins in this courtyard must be maintained, but soil and plants should not be returned to this bed.

G. A rooftop garden or green roof could be installed on one of the flat roofs of the 1959 addition in order to take some of the pressure off roof drainage. The building would have to be structurally sound enough to support the weight of a roof garden, and it would have to be implemented

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[19] Alissa Pond Mentzer, "Thirsty Plants That Will Draw Water Away from the Foundation", eHow website, accessed Feb 27, 2015, http://www.ehow.com/info_12161551_thirsty-plants-draw-water-away-foundation.html

[20] Ibid

[21] Dmitri Roby, "Christ Church Cathedral Narrative", May 6, 2014

[22] Ibid

correctly in order to prevent leaking into the building. A roof top garden would have the benefit of providing a greenscape for the church site while delaying runoff from the roof from inundating the foundations of the building.[23] One example to look to for a New Orleans rooftop garden is the Holy Cross Community Center in the Lower 9th Ward.[24]

Conclusion

Christ Church Cathedral features landscaping plans that, while not maintaining true historic integrity, contain many historic qualities, for example, use of plant types such as camellias, azaleas, and crepe myrtles. Landscaping plans have seemingly never taken into account the effects they may have on the building fabric, and thus masonry walls have had moisture and insect invasion introduced through damp soil and roots too close to foundation walls. Careful reconsideration of landscaping plans with historic building fabric in mind could result in mitigation of many of the underlying issues facing both the exterior masonry and interior finishes of the church. By moving vegetation away from the foundation and thinking about alternative landscaping methods, new solutions can be reached to maintain beautifully landscaped garden spaces and intact historic building fabric.

A reimagining of the 1942 Koch and Wiedorn plan could potentially result in a beautiful landscape scheme that honors the history of the building through both its Gothic Revival style and its Garden District setting. The idea would be to maintain a beautiful and fragrant landscape that harkens to the original design while respecting the needs of overall building health. By carefully considering choice of plantings and their-placement, the church will be able to continue to enjoy lovely and tranquil garden spaces while protecting their beautiful historic building.

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[23] Louise Lundberg, “EcoCity & Augestenborg & Augustenborg’s Botanical Garden”, The Scandinavian Green Roof Institute, accessed Mar 1, 2015, http://www.spin-project.eu/downloads/14Scandinavian_Green_Roofs_InstituteLouise_Lundberg.pdf

[24] 21. Brian R. Friedman, “Green Roofs keep houses—and cities—cooler”,Times-Picayune, Mar 6, 2014, accessed Mar 21, 2015, http://www.nola.com/homegarden/index.ssf/2014/03/green_roofs_keep_houses_--_and.html.

Environmental Conditioning

Kathryn Callander, Meredith Jacobs, and Kelly Morgan

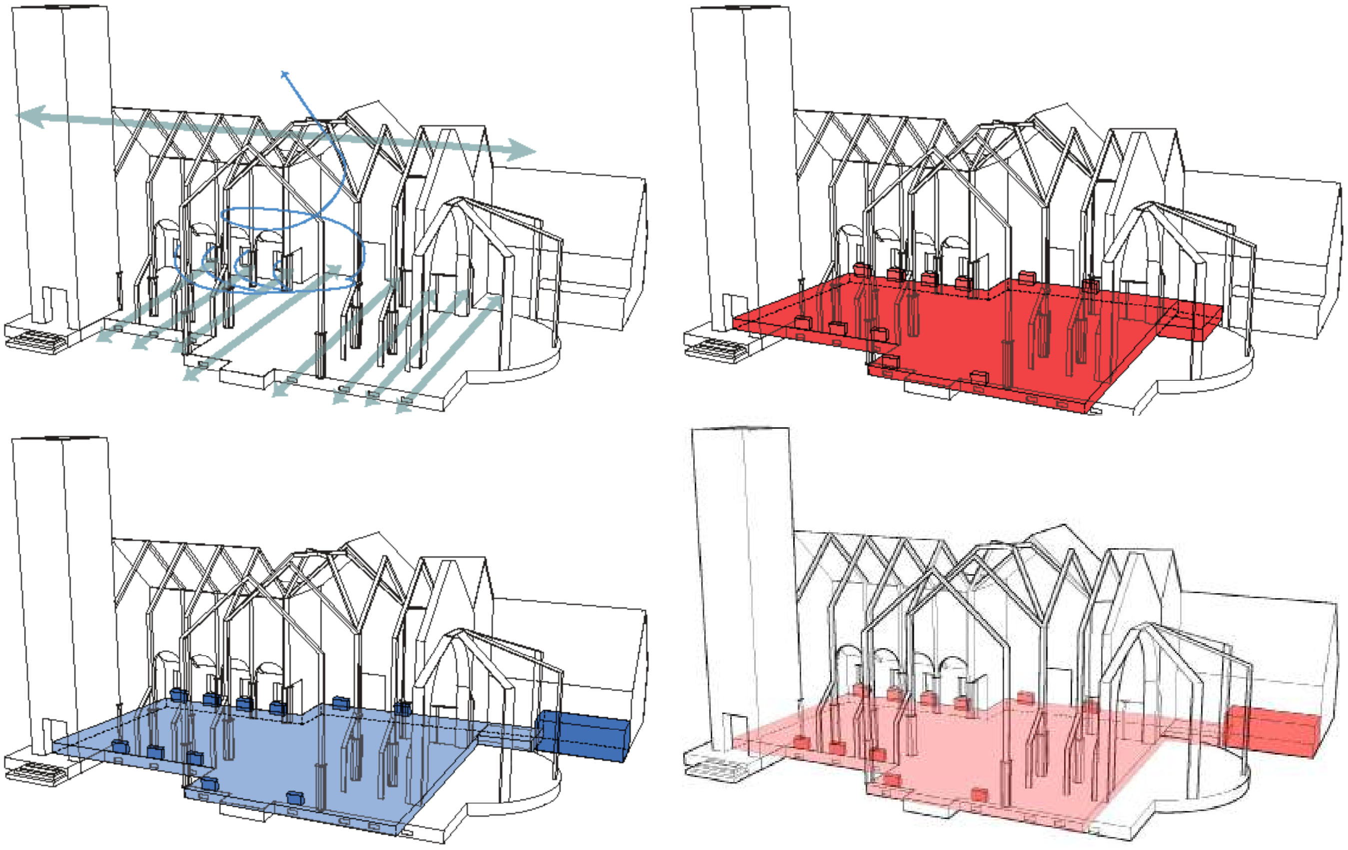

Figure 8.1: Diagrammatic Evolution of heating and cooling systems in Christ Church Cathedral, will be explain through course of the chapter. Diagrams by author.

Introduction

The environmental conditioning in a building refers to the heating and cooling systems that provide for the comfort of its inhabitants. This definition extends to active systems, such as electrical/ mechanical HVAC (heating, ventilation, and air conditioning) units, as well as passive systems that depend on natural processes for their functionality, such as opening windows for air circulation. Before the advent of climate control and air conditioning systems, the architect was charged with the task of designing a building that would not only be functional, durable, and aesthetically pleasing but that would also capitalize on existing site conditions, reconciling the need for human thermal comfort with the local microclimate. Christ Church Cathedral is no exception. The design of the building historically relied on an active system of radiators for heat during the winter as well as thermal massing and ventilation to provide for natural, passive cooling during warmer months. Following the development and widespread adoption of electrical and mechanical air conditioning systems, however, the cathedral transformed from a passively cooled, "breathable" structure to a sealed, weather tight environment. Despite the addition of an active cooling system in 1958, Christ Church Cathedral to this day struggles to maintain the ideal temperatures necessary to achieve thermal comfort in the Cathedral interior. Furthermore, the artificial cooling systems that were installed at this time also contribute to the accessory problem of moisture migration that accelerates the deterioration of historic building fabric. Therefore, in order to develop a more effective and efficient long-term solution to the environmental conditioning at Christ Church Cathedral, the development of the building's active and passive heating and cooling systems must be first explored. This report will thusly explore the design and operation of historic and existing heating and cooling systems in Christ Church Cathedral and how these systems negotiated for human thermal comfort in New Orleans' hot/humid microclimate. Conclusions will follow this analysis and recommendations will be made for an ideal environmental conditioning system that will achieve a balance between human thermal comfort, energy efficiency, and the preservation of historic building fabric and the materials and collections therein.

Human Comfort

Human comfort is a response to an array of environmental variables, including noise, lighting, odors, and so on. The perception of comfort is widely subjective and varies according to physiology, culture, and context. Because of this, human comfort is not an objective standard but varies greatly and, therefore, comfort is generally addressed in terms of a scale or general range. Like many organisms, humans are able to self-adjust to fluxes in their immediate environment to provide for comfort. [1] This includes basic physiological reflexes, behaviors, and even the modification of surroundings through design. These human behaviors often alter comfort levels by closing a drafty window when it is chilly or turning on a ceiling fan when it is warm. Both of these actions affect airflow, which is an important factor in achieving thermal comfort. When the body is not preoccupied by adjusting to the environment and energy is rather freed for productivity, general comfort is achieved. [2] Thus, a person is said to be comfortable when they are in balance with their environment.

Innate, involuntary physiological reflexes specifically provide for thermal comfort, including familiar responses such as sweating and goosebumps. Sweating utilizes evaporative cooling to lower the body's temperature when it is under thermal stress. In response to heat, the body secretes sweat from glands in a process known as perspiration. The resultant layer of sweat that forms on the skin's surface is then evaporated into the warmer surrounding air. However, energy is required for the liquid sweat to change state into a gas during evaporation. This required unit of energy is supplied by removing heat from the body, thus promoting a cooling effect that aids in regulating the body's temperature. In this way, thermal balance is maintained through evaporative heat transfer. Sweating can be compared to goosebumps, also known as the pilomotor reflex, which is in response to cold temperatures. During this reaction, the muscles at the base of body hairs contract, causing the skin to pucker and feature small bumps that resemble the skin of a plucked goose (hence the name goosebumps). These erect hairs act like a self-generated blanket, trapping air and using it as an insulating layer to warm the body. Human behaviors, such as the addition or removal of layers of clothing, can also influence comfort. Much like the pilomotor reflex, the act of putting on a sweater when it is cold out adds an insulating buffer between the surface of the skin and the surrounding cooler air, therefore warming the body. Similarly, removing clothing when it is hot out allows for the evaporative cooling effect of sweating to take place while simultaneously permitting cool, refreshing breezes to make contact with the skin. Such behaviors thus allow for a degree of personal preference and control within our environments and are responsible for the range in human comfort that often affects the environmental conditioning of a building. [3]

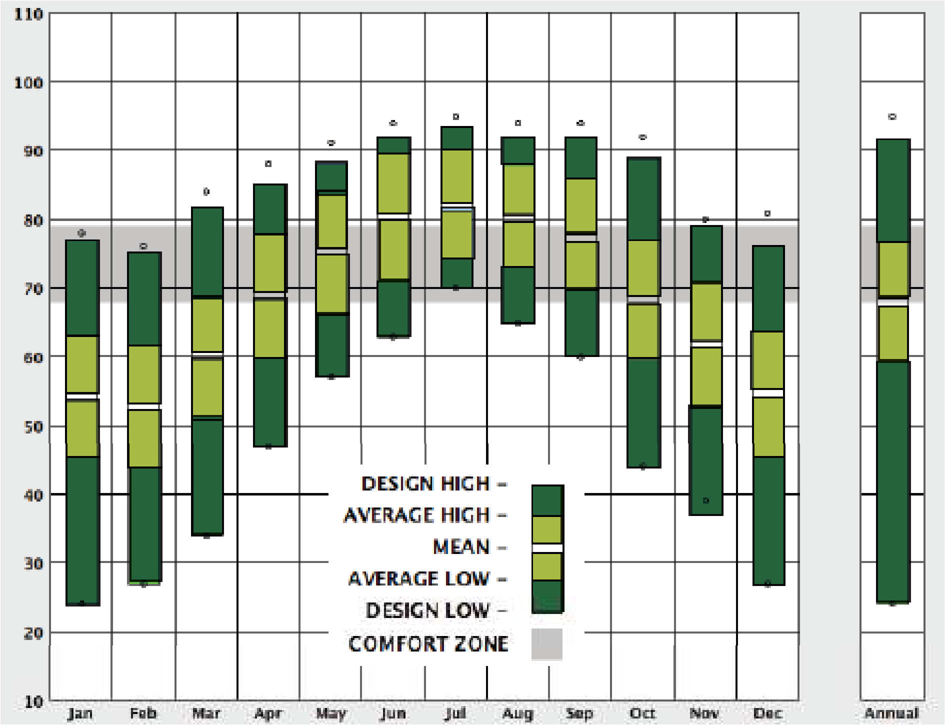

Figure 8.2: Average and median temperatures each month in New Orleans with comfort zone highlighted. Climate Consultant Software, Version 5.4, in reference to ASHRAE Standard of Comfort Model, 2005.

Thermal Comfort

Thermal comfort is defined as "the maintenance of a thermal balance between the human body and its environment" and, as can be seen by the above examples, it plays a critical role in influencing overall human comfort levels. [4] Thermal comfort, like human comfort, is largely subjective and lies within a general range of interplaying factors such as air temperature, air speed, relative humidity, physiology, clothing, and so on. Thermal comfort also largely varies according to culture as, for example, the ideal thermal temperature is said to be between 58 and 70 degrees Fahrenheit in the United Kingdom while in the warmer microclimate of the tropics it is generally 74 to 85 degrees Fahrenheit.[5] Within New Orleans, ASHRAE defines the ideal thermal temperature to be between about 67 and 81 degrees Fahrenheit, with consideration given to changes in humidity and air velocity (Figure 8.2). In warm microclimates like the tropics and New Orleans' hot/humid microclimate, keeping cool, especially during hot summer months is important. [6] In this way, New Orleans can be described as a cooling climate.

Climate

The United States is divided into four major climate zones according to general precipitation levels and temperature patterns. These zones include cold, temperate, hot/arid, and hot/humid. New Orleans occupies the hot/humid climate zone, which can be characterized by its high temperatures and heavy rainfall. With average humidity in the summer around 91% and the average summer temperature about 90 degrees Fahrenheit, prioritizing thermal comfort in this zone is clear. [7] Therefore, because shelter is the main instrument for fulfilling the requirements of human thermal comfort, a discussion of climate-responsive architecture is warranted. [8]

Climate-Responsive Architecture

Intuitively, architecture in cold climate zones relies on structures that retain heat. The opposite could be said of New Orleans architecture in the hot/humid zone, where the goal is to provide for cooling of the building interior. The different historical styles of architecture seen in New England compared to New Orleans, for example, are due in a large part to their drastically different weather and temperature patterns.[9] Interestingly, global trends between historic architecture types are often evident and are largely defined according to climate zones. [10] This is because historic architecture tends to respond to climatic, site-specific conditions like prevailing winds and topography, material availability, technology, and construction practices. [11] In this way, historic architecture is often grounded in an intimate knowledge of place and seeks to optimize opportunities at the site by working in conjunction with the site's available natural energies rather than relying on mechanical or electrical systems, thus typifying passive design. Passive design strategies use many of the same principles that were previously discussed in relation to how humans self-adapt to provide for comfort. The pilomotor reflex that generates goosebumps or the action of adding a sweater when it's chilly outside, for example, can be equated to the bioclimatic strategy of adding insulation to a building to prevent heat loss in cold climates. The traditionally lightweight, breathable structures found in hot/humid New Orleans that feature materials with low thermal loads can also be likened to a person wearing clothing that allows for evaporative cooling in hot weather, such as a lightweight cotton tank top and shorts. It is also important to note that many traditional Louisiana buildings also employed thermal mass for cooling, including *briquette-entre-poteaux* and *bousillage* walls sheltered by deep overhangs and porches. Thus, historic design is often sensitive to microclimatic conditions and utilizes passive, intuitive strategies to achieve comfort in building interiors.

The reliance on active mechanical and electrical systems for negotiating comfort in the built environment can be illustrated by the rise of the air-conditioning unit in the United States within the past century. The predecessors of modern air-conditioning units date back to the early 20th-century when, in 1906, American Willis Carrier patented a cooling device that he referred to as an "air-conditioning apparatus." [12] A mere five decades later, America's love of air-conditioning can be evidenced by the post-World War II economic boom of the 1950s, where air-conditioning units for homes were in high demand and sales were upwards of 1 million units. [13]

In the past, heating was limited to fireplaces, coal stoves, and later radiators. Cooling relied on shading devices such as overhangs and porches as well as passive design strategies that promoted ventilation and air circulation in interior spaces. The introduction of electric fans largely worked in conjunction with these passive systems, where warm air trapped in attics could more expeditiously be expelled and cooler fresh air drawn in with the assistance of an attic fan while air circulation in the building's interior dwelling spaces could be enhanced by the use of house fans. In this way, early electric fans can be described as a transitional phase between passive natural systems and the later adoption of active mechanical/ electrical HVAC units more commonly used today. Modernly, the majority of buildings are outfitted with air conditioning systems and are consequently sealed to the outside in order to maximize control of the interior environment through extensive mechanical systems, thus changing the dynamic in which we maintain thermal comfort in the built environment. This is not to negate the role of design in modern environmental conditioning, however, as the conditioning of buildings is as much reliant on the design as it is on the mechanical systems. The orientation, window size, and height of a building all affect human comfort within the structure. There is a strong history of designing buildings based on climatic needs. Hot humid climate buildings, such as those in New Orleans, struggle to offset the increased discomfort of high humidity conditions. The most effective method for cooling the human body is moving air across the skin so design is often based around passive cooling strategies that encourage airflow and allow hot air to rise and escape. This leads to high ceilings, large windows and vents to allow air to escape from steeply peaked roofs.[14] In many ways technology has lead to the demise of passive systems. Historically buildings were constructed around creating a successful passive environment within the structure. This allowed for unique designs to emerge depending on climate, most details of which were lost with the rise of temperature control and air conditioning. This is seen with the struggle to maintain human thermal comfort within Christ Church Cathedral. [15]

Thermal Comfort in Christ Church Cathedral

As Fathy et al. interestingly pointed out, while humans possess a variety of ways to adapt to changes in the surrounding environment, some of which are described above, in general, once constructed, "a man-made object can no longer adjust itself." [16] Therefore, designing with thermal comfort in mind is important for creating comfortable, habitable structures that people want to use. This concern for comfort was especially salient at Christ Church, where congregations gathered for services in the relatively confined cathedral. The uncomfortable effects of the congregation's body heat combined with the hot/humid climate were mitigated by allowances made for a ventilation system in the building's design (a topic that will be discussed more in depth later). Indeed, an article from 1887 in the Times-Picayune asserts that "[o]ne of the most perfect features of the design of the building is the provision made for ventilation." [17] Architect Lawrence B. Valk in fact had patented a ventilation system years before in 1873 "to exhaust the foul air from an audience-room or assembly-hall or church."[18] (Figure 8.3) A modified version of this system was employed in Christ Church, thus illustrating that Valk was actively engaged in perfecting ventilation in his designs and applied this savvy to the design of Christ Church Cathedral. This being said, it is important to note that although ventilation was provided for in the original design, the architecture of Christ Church is not a vernacular response to climate, but was rather a reflection of the Gothic tradition imported from Europe (detailed in the history section). Work by Geva expands on the importation of church architecture, detailing that environmental conditioning in these buildings is impacted as a result of the new climatic conditions to which they are introduced. [19] This research thus establishes a precedent for imported church architecture and provides a framework for better understanding how the environmental conditioning in Christ Church Cathedral might be affected by New Orleans' harsh summer climate.

Based on a walk-through of the church and input from its users, building and its current systems are not able to adequately provide for the thermal comfort of its users. Fan-coil console units are stationed under every window in the cathedral, featuring fans with three speeds: high, medium, and low. The system features two temperature settings, winter and summer, and this setting is switched in the middle of the year going from the cooler season to the warmer season. (Figure 8.4) The rigidity of these summer and winter settings poses an obvious problem as they are not adjustable and therefore are not responsive to daily conditions. This is specifically an area of concern in New Orleans, where seasonal changes in temperature are not as pronounced as other areas in the country and it is not uncommon to have warm, sunny days in January or February, thus warming the interior of Christ Church when it is already being warmed according to the winter fan-coil setting. On the other hand, during the summer setting, the building has a thermocline effect, where the space is cooled by the fan-coil units on the ground but the stack effect leads to warm air being trapped by the ceiling. Historically, this warm air was permitted to escape through now inoperable ventilators in the ceiling and walls (discussed in more depth later). The result of this accumulation of trapped warm air is tangible, where the warm air condenses on the walls at the thermocline during the summer and leads to moisture-related issues, posing a threat to the historic fabric. Thus, goals for the building entail promoting more stable interior temperatures year round and allowing for increased air circulation and ventilation.

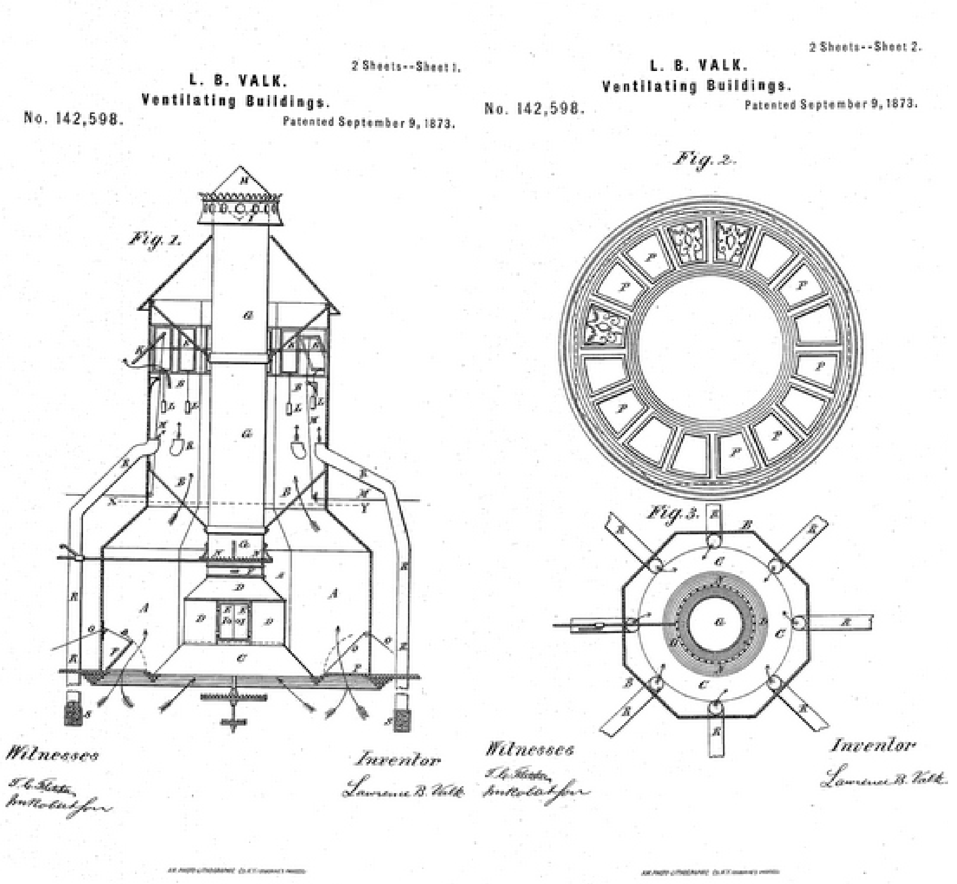

Figure 8.3: Patient Drawings of Valk's ventilation system. From "Improvement in Ventilating Buildings; US 142598." Accessed March 1, 2015. Available at: http://www.google.com.tr/patents/US142598.

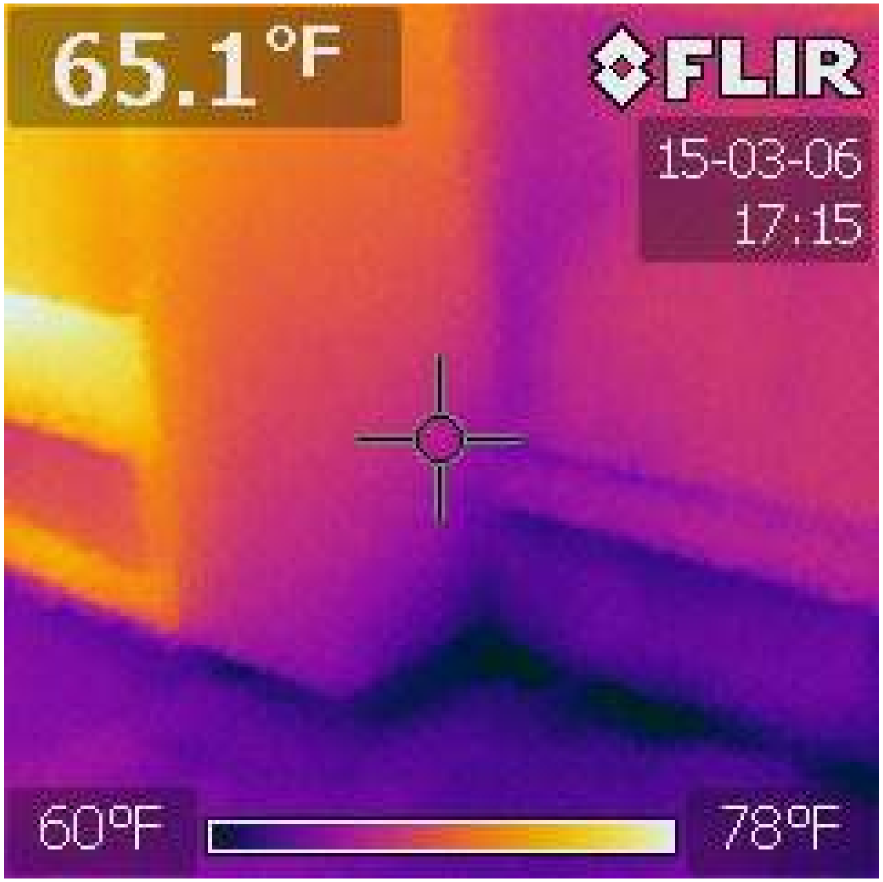

Figure 8.4: Infrared image of air compressor unit when turned to heating. Photo by author, March 2015.

Bioclimatic Chart

Four key components--solar radiation, air temperature, air velocity, and humidity--play a crucial role in providing for thermal comfort within a climate. [20] These four factors come together to determine exterior thermal comfort through the use of a bioclimatic chart (Figure 8.5). Temperature and relative humidity are plotted against one another to determine an exterior comfort zone. They are further affected by the wind conditions, still versus moving air, and the shading conditions and amount of direct sunlight. The resulting bioclimatic chart creates a bracket for human comfort in a specific environment. Once the bioclimatic chart is determined, the data can be applied to Christ Church Cathedral to determine thermal comfort in the space. [21]

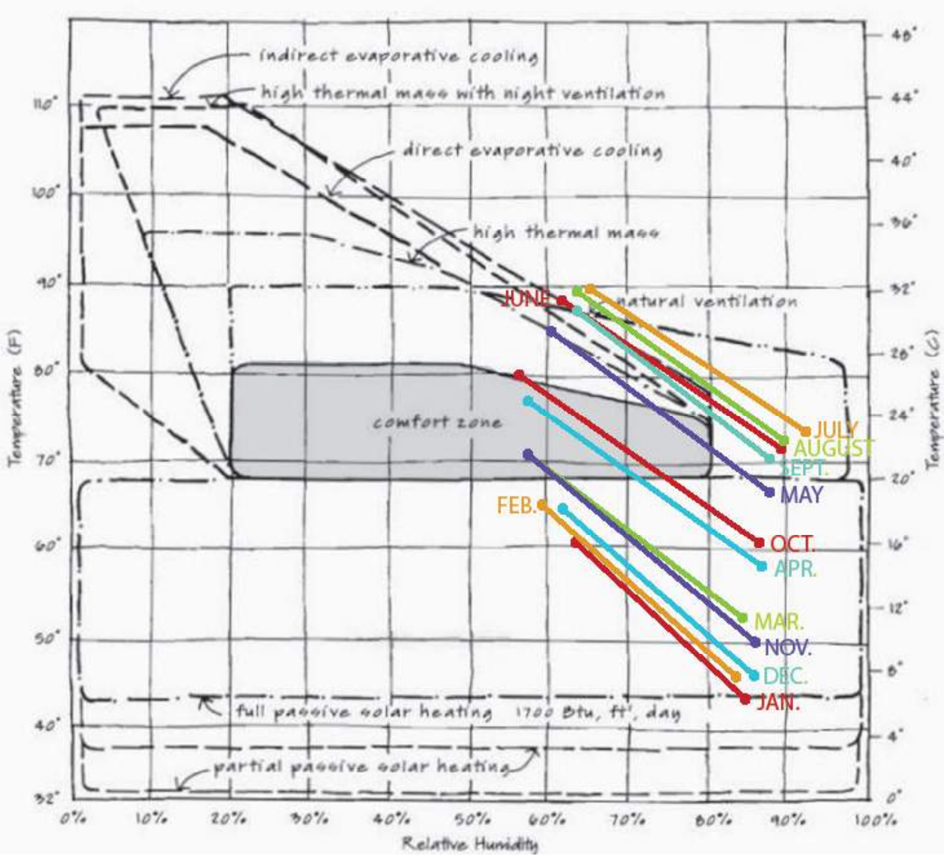

Figure 8.5: Bioclimatic chart for New Orleans. Details temperature vs. relative humidity range per month in comparison to the human comfort zone. G.Z. Brown and Mark DeKay, Sun, Wind & Light: Architectural Design Strategies, 34.

Psychometric Chart

Thermal comfort is also measured in a psychometric chart that takes into accounts absolute humidity, temperature, relative humidity, and air velocity. At this point it is important to note that when discussing humidity and thermal comfort there are two types of humidity to consider: absolute and relative humidity. Absolute humidity defines the actual amount of water vapor in the air. This number rarely changes over the course of a day and is the y axis of the psychometric chart. Relative humidity is more precise and changes with temperature. The psychometric chart thus plots absolute humidity against temperature and relative humidity against air velocity, creating zones that define standards of thermal comfort. The curving lines of the psychometric chart define the relationship between relative humidity, temperature and the possible amount of water vapor--as the air gets warmer it can hold more water. Both air velocity and radiation further affect thermal comfort, working together to define brackets for comfort based on clothing level, or CLO (Images 12 and 13). In New Orleans, CLO typically has an average of 0.5 in the summer and 1.5 in the winter. [22] (Figure 8.6)

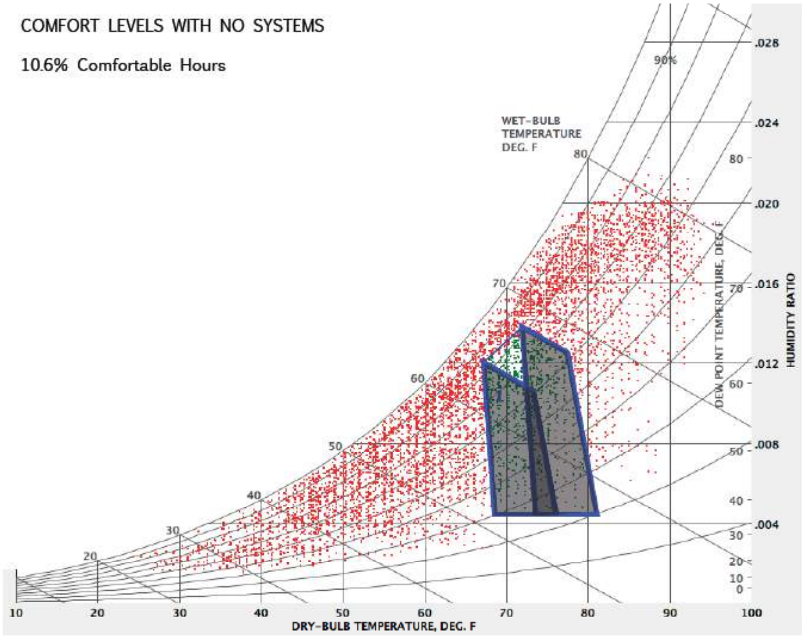

Figure 8.6: Psychrometric chart for New Orleans. Left shaded box indicates winter clothing levels, and right shaded box indicates summer clothing levels only comfortable 10.6% of the time without any passive or active cooling or heating systems. Climate Consultant Software, Version 5.4, in reference to ASHRAE Standard of Comfort Model, 2005.

The Climate Oriented Design of Christ Church Cathedral

The original design of Christ Church Cathedral exhibits clear use of bioclimatic design in its historic wall assemblies that provide for breathability as well as thermal mass, where, in combination with the original ventilation system, a certain level of thermal comfort was provided. The external wall assembly can be analyzed and documented by understanding the church's R-values. R-values define the thermal resistance of a material and depend on a solid material's resistance to conductivity (heat transfer). [23] Lower R-values in wall assemblies suggest more breathable walls, as hot air can more readily pass through them. Higher R-values on the other hand entail materials that are better insulators and thus have a higher thermal resistance. [24] After analyzing the R-values in the external wall assembly at Christ Church, the conductivity and thermal resistance of the walls were compared to the current overall energy use of the system as well as to the heating degree days (days in which heating is required in building interiors) in order to test for efficiency. With this understanding, the historic heating and cooling systems were then compared to the current systems in order to find an accurate solution for future planning of the building's environmental conditioning. (Figure 8.7 and Figure 8.8)

Calculating R-Values and Heat Resistance

The thermal resistance of the enclosed sanctuary space were calculated by adding together the respective R-values of the wall assembly (with and without windows), the floor assembly, and the roof assembly. While most of the material makeup of the church was possible to study in detail, it should be noted that some generalizations were made in order to calculate R-values. The wood in the floor and roof assemblies, for example, were assumed to be softwood because the preferred available building wood in the area at the time the church was constructed was mostly cypress and longleaf yellow pine. The external wall assembly of Christ Church Cathedral is made up of brick and cementitious stucco, and it measures approximately 23" from interior to exterior. A theoretical breakdown of

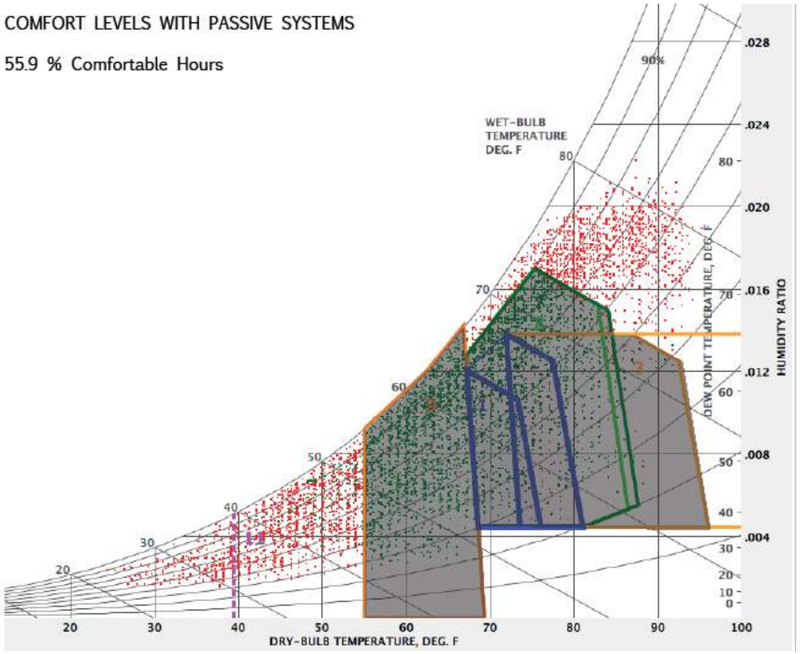

Figure 8.7: Psychrometric Chart for a passive cooling and heating system, such as the one currently available in the building, allow for comfort 55.9% of the time. Left shaded blue box winter clothing levels, right summer clothing levels.Climate Consultant Software, Version 5.4, in reference to ASHRAE Standard of Comfort Model, 2005.

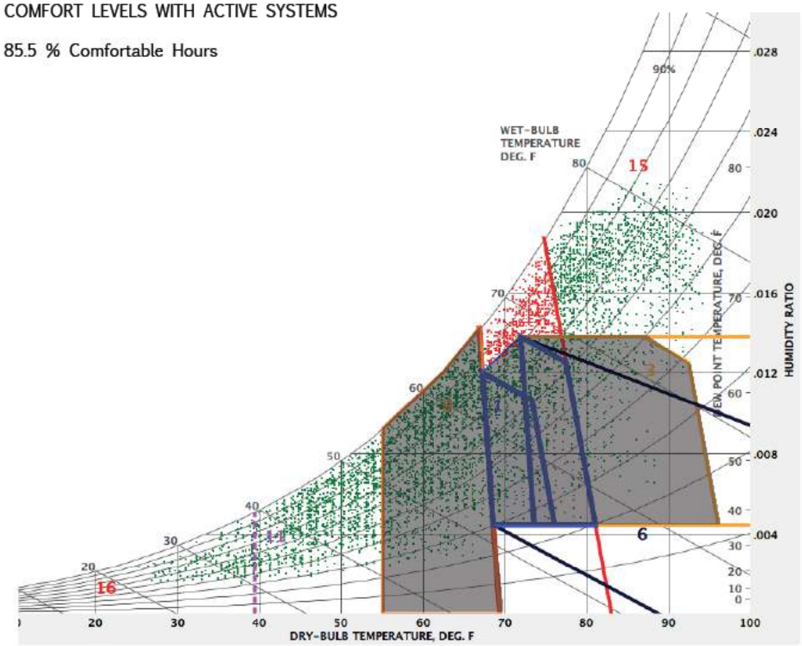

Figure 8.8: Psychrometric Chart for an active cooling and heating system, such as the one currently installed in the building, allow for comfort 85.5% of the time. Left shaded blue box winter clothing levels, right summer clothing levels. Climate Consultant Software, Version 5.4, in reference to ASHRAE Standard of Comfort Model, 2005.

the wall assembly from interior to exterior is as follows: ¾” plaster, five rows of ~4” wide bricks, and then ¾” of another layer of stucco. [25] The actual section detail of the wall is not known. Although it is unlikely, there could possibly be a layer of lath beneath the interior plaster; however, because the existence of the lath could not be verified, it was be left out of the overall R-value and heat capacity calculations. To calculate the R-value of the external wall assembly, the R-value of the individual wall components must be recorded and then added together with respect to size. Brick typically has an R-value of 0.8 per four-inch brick, and lime stucco holds an R-value of 0.2 per one-inch thickness of stucco. [26] The external wall assembly in areas without windows, then, has an R-value of roughly 7.5. There are 11 operable windows in the sanctuary that are generally stained glass with a storm shield. This assembly typically has an R-value of two. [27]

From interior to exterior, the roof is made up of a wooden ceiling, a wooden rafter and purlin system, and a tongue and groove deck and slate roof assembly, all of which enclose a rod truss system that creates the building’s structural form (Figure 8.9). [28] The ceiling is likely made up of 1.5 inch thick softwood, with an R-value of 1.41 per inch, and the slate and tongue and groove assembly contain R-values as follows: slate roofing is generally ¼” thick with an R-value of 0.1 per inch, and the tongue and groove sheathing is likely also made of softwood and is about 1.5” thick, with a resulting R-value of 2.12. The R-value for the roof is then approximately 4.27, with generalizations made in measurements, as precise measurements were not readily available for this study. The floor assembly includes softwood floor joists covered by wood at approximately 1.5” thickness. The general R-value for softwood is around 1.41 per inch, meaning that the floor has an estimated R-value of 2.12.

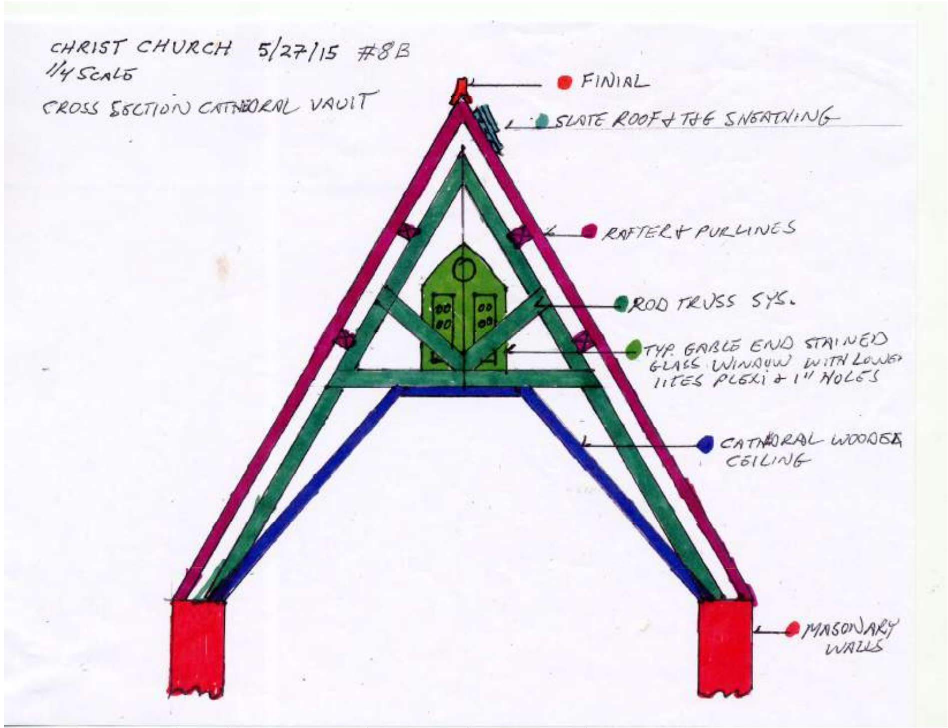

Figure 8.9: Section through Sanctuary Vault. Drawing by Dimitri Roby.

The information about the materials of the sanctuary and their respective R-values were then put into an equation to calculate the UA (also known as the U-value), which describes the building envelope’s conductivity. Christ Church Cathedral has a rough floor area of 3,450 square feet, and its walls range in height from 30 feet to 50 feet. The different surface areas of the walls were then multiplied with the floor, roof, and windows by the inverse of their respective R-values. Christ Church Cathedral’s overall UA is therefore 5,672 Btu/hF. This number can then be compared to the relationship between the building’s current energy use relative to the change in temperature (ΔT) from exterior to interior. The building’s total energy use for heating or cooling can be found by multiplying its total UA by the average change in temperature from exterior to interior. Data loggers were placed inside the cathedral for this purpose, and they logged the change in temperature both inside and outside of the church over a two month period from February to March of 2015 (Figure 8.10). From this data, it can be concluded that Christ Church Cathedral underwent a rough average change of about 15 degrees Fahrenheit over this two month period, as exterior temperatures averaged 59 degrees Fahrenheit and interior temperatures averaged 72 degrees Fahrenheit. When this 15 degrees Fahrenheit change in temperature is multiplied by the cathedral’s total UA of 5,672 Btu/hF, it can be concluded that the cathedral envelope conducts roughly 85,080 Btu of heat energy per hour, or 85 kBtu of energy per hour. After multiplying this number by the amount of time that passed during the temperature change, 24 hrs, the resulting number represents the energy conduction through the envelope necessary to maintain comfort. This number can then be plotted with the building's average change in temperature to find the energy signature of the building. When compared to New Orleans' average heating degree days--the amount of daily heat required in the city of New Orleans (1,280 degrees Fahrenheit per day)--the annual heat demand for Christ Church Cathedral relevant to New Orleans can be found.

While the breathability of a wall must be understood in order to achieve thermal comfort, thermal mass is equally important, especially in hotter climates. [29] Thermal mass has much to do with the density and heat capacity of a material or object and its ability to absorb and then re-radiate heat. If a material has much thermal mass, heat transfer is reduced and there is therefore less energy involved in heating and cooling a building. High levels of thermal mass are most effective during seasons that have high fluctuations in temperature throughout the day, as the building can collect and store heat in the warm afternoon and then release it at night when it is cooler. Likewise, natural ventilation can cool mass during the night and then the mass can absorb the heat during the afternoon. When outdoor temperatures reach their peak, then indoor temperatures can remain cool because the heat has not yet penetrated the mass. In New Orleans' hot/humid climate, thermal mass can be used to collect and then store heat from the sun or heat provided by mechanical systems to allow heat transfer when temperatures are not at peak levels. [30] To study the thermal mass of Christ Church Cathedral, data loggers were placed throughout the church that logged temperature changes from exterior to interior as well as relative humidity (Figure 8.11). Infrared photos were also taken of the walls of the church after a high fluctuation in exterior temperature to portray how the thermal mass of the building envelope absorbs and holds heat. When the infrared photos were taken, the outside temperature had recently changed from around 75 degrees Fahrenheit to a low of around 35 degrees Fahrenheit. In the infrared photos, a full spectrum of the thermal mass is visible with the highest thermal mass evident in the walls and lowest thermal mass in the roof edges and windows (Figure 8.12).

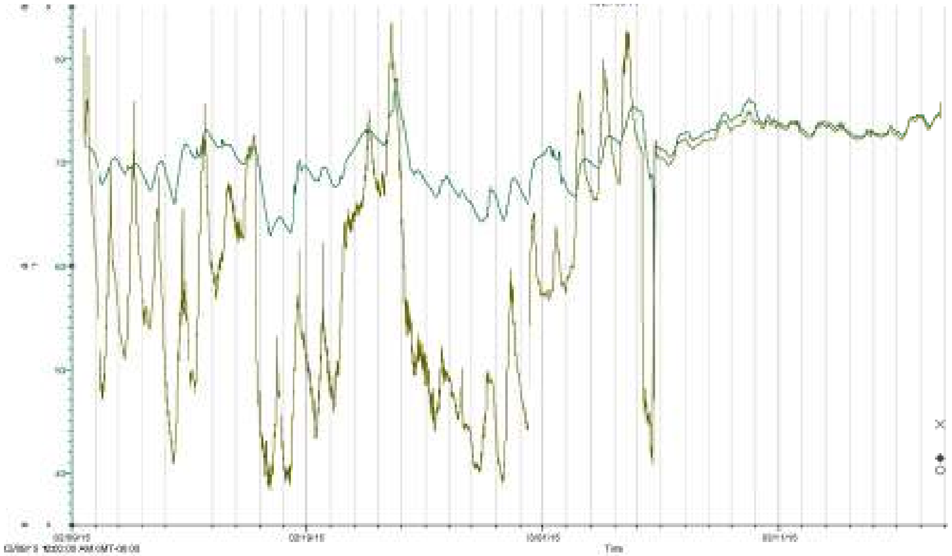

Figure 8.10: Graph mapping interior vs. exterior temperature over a period of one month, olive green being exterior temperature, forest green being interior temperature. Graph formatted by author, derived from data taken from data loggers and organized by HOBO software, 2015.

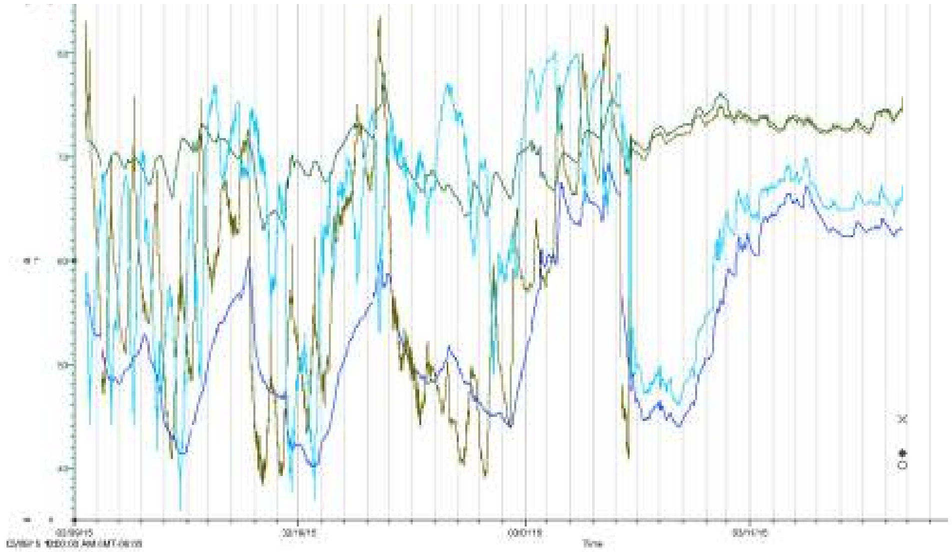

Figure 8.11: Graph mapping interior vs. exterior temperature and relative humidity over a period of one month, olive green being exterior temperature, forest green being interior temperature, dark blue as interior relative humidity and light blue as exterior relative humidity. Graph formatted by author, derived from data taken from data loggers and organized by HOBO software, 2015.

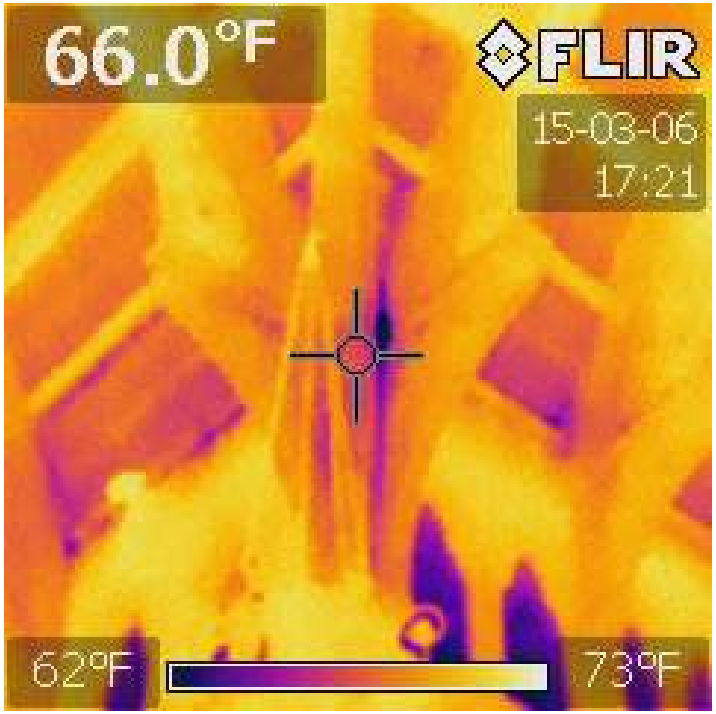

Figure 8.12: Infrared photo of church ceiling showing heat absorption in wooden rafters because of thermal mass. Photograph by author, March 2015.

Environmental Conditioning Systems

Beyond the specifics of its construction, environmental conditioning also affects a building's comfort levels and includes passive and active systems. As previously stated, a passive system relies upon natural energies at the site as well as adaptive behaviors by inhabitants, such as putting on a sweater when it gets cold or closing a window. Passive systems as such do not typically allow for total thermal control on the building interior. This can be compared to active systems, electrical/ mechanical systems that ideally allows for full control of internal environmental conditions. Active systems are dependent upon importing energy into the building in order to convert the temperature, and can thus be described as artificial heating/cooling strategies. Although active systems are not ideal due to concerns with energy consumption, they have become the standard in which developed nations deal with extreme weather conditions such as the hot/humid climate found in New Orleans. [31]

Passive Conditioning Systems

Christ Church Cathedral was originally cooled with a passive system that involved stack ventilation. The church was built on piers with a four foot crawlspace beneath its floor assembly with vents positioned in the foundation walls to provide for airflow. [32] Above this crawlspace, the interior of the sanctuary contained vents in the walls as well as operable windows to bring in air which would then exit the building through a passive cupola located directly above the transept (Figure 8.13). This was supplemented by a large ventilated area within the vault of the roof from which air would escape through gable end stained glass windows, later altered with the edition of one-inch holes to improve ventilation (Figure 8.14). [33] The writings of Samuel Wilson on the history of the church are of note here, as they include an excerpt from the Times Picayune after construction of the church that mention ventilation in the walls:

"There are ventilators in the walls and a large one in the vault through which the warm air from the interior may readily escape into the tower." [34]

From this description, it has been interpreted that there are pipes located

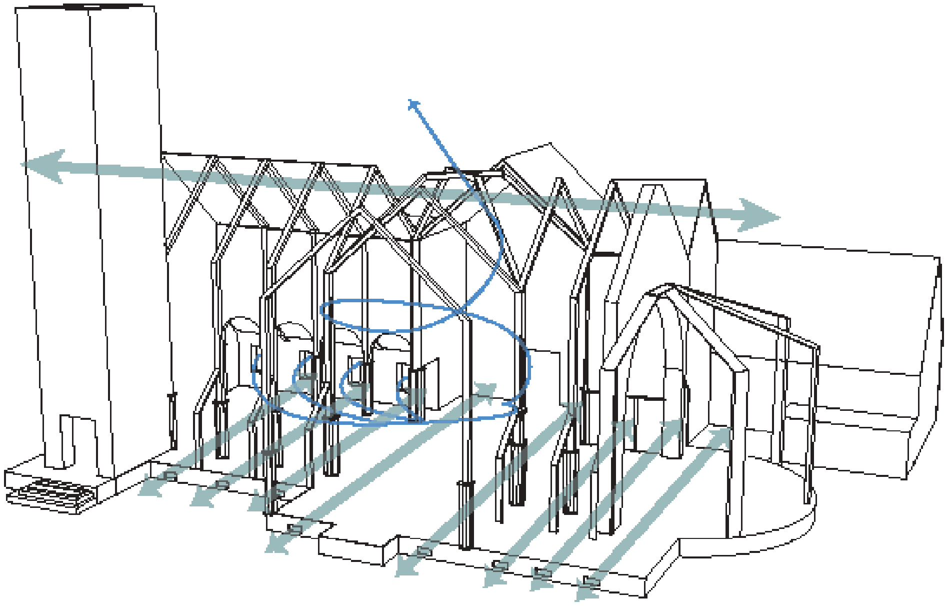

Figure 8.13: Original passive stacked ventilation of Christ Church Cathedral Cathedral sanctuary. Diagram by author.

Figure 8.14: Interior of vault. Photo by Dimitri Roby

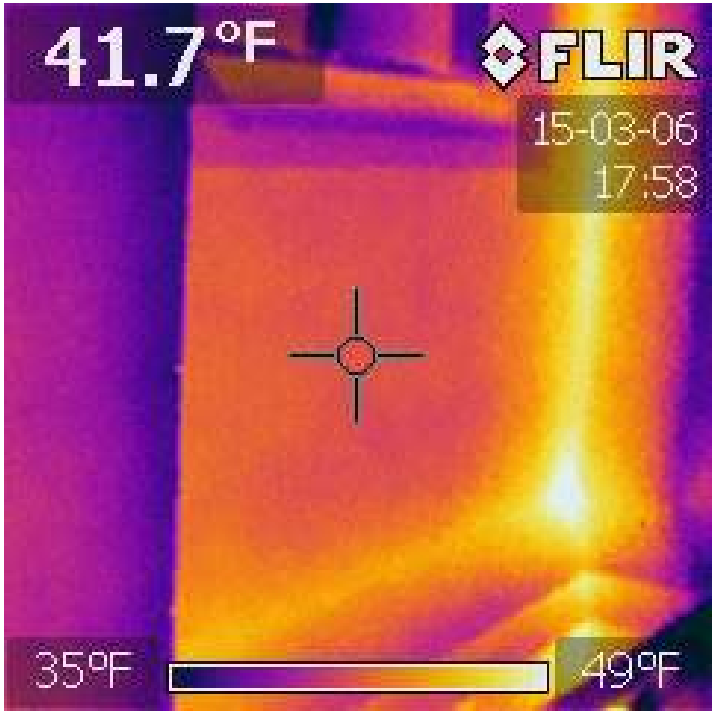

Figure 8.15: Infrared photos taken of the exterior walls did not show evidence of any "ventilators" referenced by the Times Picayune article. Colder areas along the bottom of the walls, however, suggest some sort of lower wall vents. Photograph by author, March 2015.

within the wall assemblies that provide ventilation within the actual walls of the church. The article could, however, simply be referencing the lower wall vents that brought fresh air and breezes into the building interior. Although infrared pictures taken of the walls of the church do not entirely validate either claim, they most support the idea of lower wall vents (Figure 8.15).

The chapel within Christ Church Cathedral was an addition to the original structure and was completed in 1886. [35] Operable windows located along its eastern and western walls allowed for its own cross ventilation system. This system was separate from the sanctuary and remains separate today. It is important to note that the structure of the chapel has significantly changed over time as a second floor was added behind the altar, therefore undoubtedly altering the dynamics of air movement through the building as this space is no longer open.

Existing Active Cooling System

As cooling systems evolved over time, buildings that originally relied on ventilation alone for cooling were manipulated to include new systems, and in this way new standards of comfort were thus developed. The original method of cooling Christ Church Cathedral and other buildings may therefore not be considered effective according to current standards. While ventilation initially provided air flow through buildings to make them more comfortable, it did not actually cool the air. [36] The creation of the cooling fan revolutionized this operation by drawing outdoor air into buildings and providing a positive pressure. The later introduction of exhaust fans drew air from a space and out of a building. Out of this context electrical/ mechanical cooling systems evolved, and eventually the International Mechanical Code and ASHRAE ventilation standards stated that "commercial, institutional, and industrial buildings must be mechanically ventilated when occupied." [37] After this development, windows were oftentimes sealed in old buildings and the historic allowances for ventilation were thus overridden by new mechanical systems that solely provided heating and cooling. [38] Along this trajectory, Christ Church Cathedral's original passive system was replaced with an active system in 1958, and the same system is still in use today. The major parts of this active system function to provide for both heating and cooling of the building interior, where in console fan-coil units air is fanned over coils that then enters the church through air compressors (Figure 8.15, Figure 8.16). [39] The air compressors are Marlo C3J units with two row hot water heating coils and four row DX coils. The air compressors are connected to a water chilling machine with all equipment concealed beneath the apse floors. The old heating system provided the pipework for the new mechanical system in the sanctuary, but other parts of the building, such as the chapel, had to have new spaces provided for major mechanical components, as its systems were originally separate from the sanctuary. The large components for the chapel are now found in the choir room upstairs that is situated above the entrance to the chapel from within the building (Figure 8.15, Figure 8.16). After this active system was introduced, the windows were eventually covered by storm windows and the latches at the bottom were permanently closed to outdoor air, thus rendering them inoperable within their original capacity to provide for ventilation. Thus, after 1958, cooling relied solely on the new mechanical HVAC system, where correspondence from the Freret & Wolf architectural offices identified that the system was installed with the understanding that "it would not be first rate," rather, it "must operate several hours in advance of services."[40] The new system was not well received even in the years immediately following its installation where, for example, in 1962, a representative of the church wrote that "the air conditioning system proved to be wholly inadequate to the needs" and that "the church was much too warm and much too humid." [41, 42] It is interesting to note that the inefficiency of the new active cooling system may be in part be attributed to the fact that while two ice accumulators were recommended for installation, only one was installed due to financial constraints. [43] Records of the church do not indicate any major changes to the air handlers of the new system, although correspondence does make mention of some recommendations for the proper use of the air conditioning system in order to deliver its optimal performance. [44] (Figure 8.17)

As compared to the original system of ventilation around which the church was built, the active system requires much more maintenance. Likewise, as the system was installed in separate locations corresponding to separate parts of the building, there lacks a central operation area and therefore multiple systems must be operated and maintained at the same time. This situation is not unique to Christ Church Cathedral, as many old buildings that were manipulated to add new mechanical systems face this issue. [45]

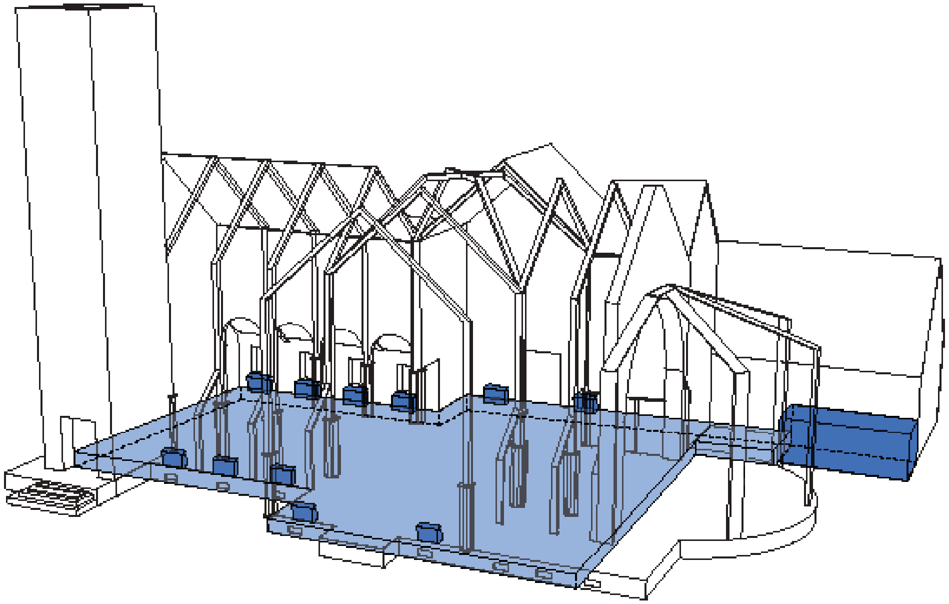

Figure 8.16: Current active cooling system of Christ Church Cathedral sanctuary. Diagram by author.

Figure 8.17: Current active cooling system. Photo by Dimitri Roby.

The Past and Existing Active Heating System

Christ Church Cathedral was originally outfitted with an active heating system that was incorporated into its original design. This system included a Fitzgibbons brand coal-fired boiler in the basement of the church (Figure 8.18). The boiler warmed a tank of water and captured the steam that was generated in pipes that were then diverted under the floor of the cathedral to steam radiator units under each of the windows, in the location that the current fan-coil console units sit today (Figure 8.19, Figure 8.20). The historic Fitzgibbons coal-fired boiler was replaced with a new unit located behind the apse in the mechanical yard in past decade. Unlike the Fitzgibbons boiler that relied on steam, the new electric boiler generates heated water that is distributed by pipes to the fan-coil console units installed in 1958 under each window in the cathedral, replacing the earlier radiator units. Air is fanned over the coils in the fan-coil units and enters the cathedral through Marlo C3J model air compressors. These fan-coil units are also used for the active cooling system. It should be noted that whereas the cathedral relies on piped heating, the chapel features a different system that utilizes on forced air.

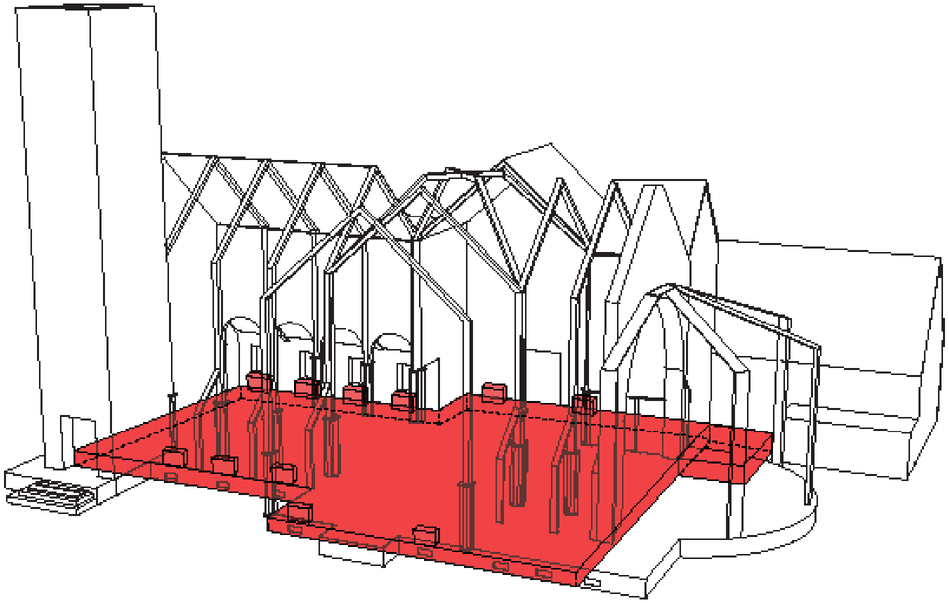

Figure 8.19: Original active heating system of Christ Church Cathedral sanctuary. Diagram by author.

Figure 8.18: Fitzgibbons boiler of Christ Church Cathedral, part of the original active heating system. Photo by author.

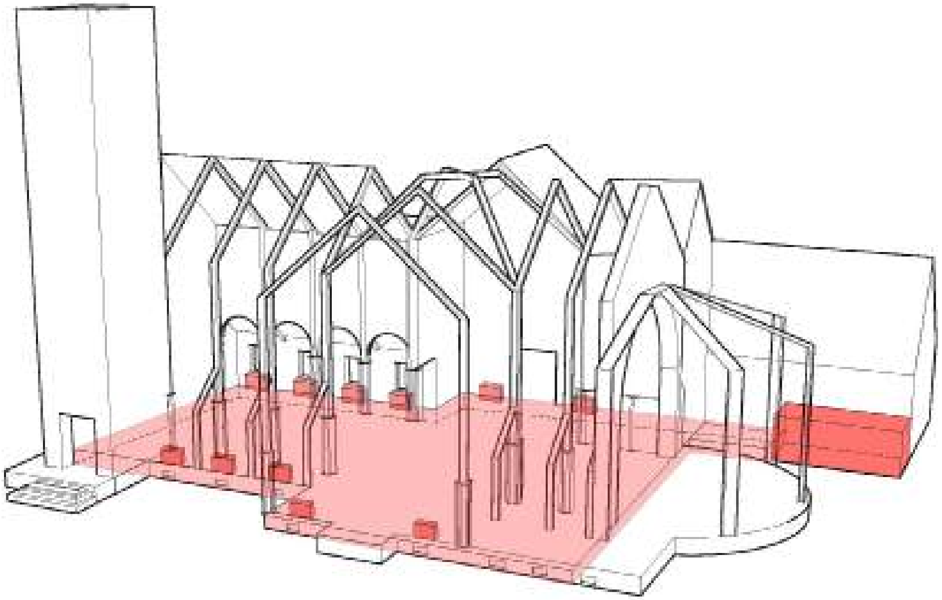

Figure 8.20: Current active heating system of Christ Church Cathedral sanctuary. Diagram by author.

Conclusion and Recommendations

The current active heating/cooling systems only feature two settings—winter and summer--where the rigidity of this system is cumbersome and does not allow for sufficient control of the building's thermal conditioning. As previously explained, the installation of the active cooling system in 1958 disallowed historic passive ventilation strategies in an attempt to weathertight the building envelope, thus leading to a host of issues within the church. In this way, in addition to not adequately providing for thermal comfort, accessory problems such as a pronounced thermocline during summer months due to the entrapment of hot air as well as an accumulation of water in the crawlspace resulting from air conditioning units threaten the building's historic fabric and the materials and collections contained therein. Therefore, recommendations will be made for an ideal, cost-effective environmental conditioning system solution that will achieve a balance between human thermal comfort, energy efficiency, and the preservation of historic fabric. The recommendations are intended to positively impact building performance and comfort by employing strategies that are realistic, achievable, and economically feasible. Guiding preservation principles, including doing interventions which are not visually obtrusive, doing the smallest intervention possible, and considering the reversibility of the intervention, also informed the development of these strategies. Prioritized recommendations as given below according to importance and short- and long-term achievability:

1. Develop a cyclical maintenance and monitoring schedule.
2. Restore passive cooling strategies, such as encouraging ventilation and air circulation. This includes opening preexisting vents where possible, attic window panels, and reopening the ceiling grille.
3. Introduce active cooling systems to work in tandem with the aforementioned passive systems, including attic fans and an electric fan in the crawl space.
4. Install temporary seasonal runners to retain heat during winter months.
5. Upgrade the existing fan-coil console units to allow for individually controlled, on demand heating and cooling systems that better provide for the thermal comfort of inhabitants and energy-efficiency.

Camuffo and della Valle state that it is best to keep a building as "near the historical climate to which they have been acclimated."[46] Indeed, when considering the ideal environmental conditioning program for Christ Church Cathedral, it is crucial that interior temperatures and relative humidity levels are maintained as close to exterior temperatures as human comfort will permit. Preventing disparate conditions between the interior and exterior of the building will protect building fabric by mitigating moisture-related issues including damaging condensation. This being said, special consideration needs to be given to New Orleans' hot/humid microclimate, where summer months can be characterized by warm temperatures paired with high humidity levels. Thus, navigating for human thermal comfort also comes into play. ASHRAE defines the ideal range of human thermal comfort as being between 67 degrees and 81 degrees Fahrenheit and between 35 and 65% humidity ratio in New Orleans (Figure 8.5). Interestingly, this humidity range for human comfort very nearly mirrors the ideal relative humidity range for the conservation of mixed collections, being between 40 to 70%. [47]

When considering the ideal environmental conditioning program for Christ Church Cathedral, it is first recommended that air circulation in the building be encouraged. This can be achieved by restoring parts of the historic ventilation system that have been rendered inoperable. Such an approach would capitalize on existing features that were modified over time, thus avoiding the impact resulting from the installation of new systems. [48] The National Park Service in fact recommends upgrading ventilation within historic buildings to allow for thermal comfort while Dimitri Roby, restoration consultant for Christ Church endorsed the possibility of re-instituting some of the historic ventilation systems. [49] For example, where reasonable, reopening the grille in the ceiling of the nave, the attic vents, and attic window panels so that they are manually operational would better allow the attic to function within its original capacity as a heat buffer. [50] This would in effect reduce the attic temperature, an important fact considering that during the hot summer months, warm air rises and currently accumulates at the ceiling of the cathedral as it cannot escape, thus causing condensation on the walls of the cathedral. [51] The installation of an attic fan can also assist in the ventilation of this space. Similarly, electric fans could be installed in the building's crawlspace and work with vents in the foundation walls to allow for increased air circulation, thus decreasing humidity and temperature levels. In this way, historically functional passive systems at Christ Church could in part be restored and enhanced by electric fans.

The recommendation to improve air circulation by upgrading ventilation at the site is intended to work in tandem with existing active fan-coil systems currently in service at Christ Church. Fan-coil units using piped water is common in historic buildings. This being said, allowing for individually controlled, on demand heating and cooling is key, and would therefore require an upgrade of the existing system. [52] When Christ Church Cathedral was built, the Times Picayune lauded its cutting edge environmental conditioning system, where allowances for natural, passive ventilation provided for the thermal comfort of the building's inhabitants. This can be compared to the current environmental conditioning found at the church, where the active systems installed in 1958 to provide for the heating and cooling of the building are still in use to this day. While the specific life expectancy of the 1958 Marlo brand air compressors used in Christ Church is unknown, the life expectancy of a typical air compressor is generally 20-30 years with good maintenance. If this is the case for the Marlo air handlers, they should have been replaced in 1988 at the latest. Thus, the air handlers are long overdue for an upgrade. New fan coil units can replace the existing units under each of the windows in the cathedral, where the radiators that were historically part of the active system also sat. Certified professionals should supervise their installation, with care taken that the selected fan-coil units are not loud so as to distract from services.

While most recommendations are geared towards cooling, especially considering New Orleans' hot/humid climate, this is not to say that heating is not important. Christ Church was constructed with an active heating system that relied on steam diverted to radiators by pipes. Today, the active system relies on hot water distributed by pipes to fan-coil units. Without altering the active system that has historically functioned in the church, simple solutions could be incorporated to better provide for the comfort of inhabitants during the cooler winter months. For example, simply introducing seasonal runners represents a possible solution, where the carpet provides added insulation at the human level. It is also worthwhile to point out that the church featured carpeting in the past, thus making runners a historically sensitive option. No alterations to existing fabric need be made to accommodate runners, which could easily be put in storage during warmer months.

The original materials of the church should also be considered alongside maintenance of the building's newer mechanical systems. The church is made up of a soft cementitious stucco as well as soft brick, with plaster on the interior of the building. These materials and their breathability worked well alongside the stack ventilation provided by the latches at the bottom of each lower level window when the church relied on passive systems to reach its original standard level of thermal comfort, as the entire building and its envelope were designed for maximum breathability. The R-values of the walls and their heat conduction prove this.
It must be understood that the church was built at a time when the standard level of thermal comfort within a building was very different from that which exists today. When trying to reach today's standard level of thermal comfort, however, the active systems installed and utilized within the church should work in a way that respects the breathable materials that make up the building envelope. This means that mortars used for repointing and stucco applied today and in the future must be soft and breathable like those which came before them. If the breathability of the wall assemblies are not maintained, moisture can become trapped within the walls resulting from condensation from the new mechanical systems.[53] This topic is further discussed in the Masonry section of this report. The best way to ensure the safety and durability of the building with its current systems are to maintain the breathability of the walls as well as the operability and functioning of the air conditioning by inspecting these elements regularly over time. [54]

The church already has evidence of condensation problems relative to material breathability, as the paint on some of its walls is significantly bubbling and peeling in certain areas including but not limited to the sacristy off the side of the sanctuary and the hallways and bathrooms behind the chapel and beneath the choir room. [55] While this could certainly be the result of improper maintenance of the cooling system relative to the wall materials, this could also be an issue of rising damp from within and around the original building piers.

Finally, cyclical maintenance and monitoring schedules are crucial in order to allow for the long-term preservation of Christ Church Cathedral and the longevity of the electrical/mechanical systems. [56] This includes ensuring the proper drainage of the fan-coil units, where the condensate pans must be emptied regularly so they do not overflow. Similarly, air compressors should be kept clean for optimal performance.

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Architectural Finishes

Joseph Newman
Fallin Steffen

Figure 9.1: Ambulatory Wall. Joseph Newman, Fallin Steffen.

Original Design and Composition

The early decorative scheme of Christ Church Cathedral kept very much in line with its Gothic Revival style and the current modes of ornamentation. One account from the day states that the cathedral was “Solidly constructed of brick, and covered on the exterior with stucco, it has the appearance of being built of gray stone. The style of architecture is the English Gothic, which combines elements of elegance, grace and lightness with strength and durability.” [1] Within the main body of the church, the article paints a lovely picture of the interior as it appeared shortly after the completion of construction. The “details of the Gothic style are carried out with much elaboration and taste, and the eye rests upon cypress pillars centering around bronzed columns, foliated capitals, pointed arches, elegant moldings, [and] rounded corbels…characterized by chaste simplicity and beauty.”

While this Times Picayune article begins to describe the finish scheme on the exterior and interior, the discovery of a newspaper article published in the Times-Picayune in November of 1889 illustrates the appearance of the interiors at Christ Church Cathedral in extensive detail. A wealthy benefactor named Mrs. Joseph H. Harris sponsored the cost of the sumptuous program, and was additionally responsible for financing the adjacent chapel that was built in the same year. It should be noted that there is a two-year gap between the completion of the church and the implementation of the scheme discussed in this article, which was a typical length of time and will be discussed later. Considering the lack of interior photographs of the Church available from the 1880s, the article offers substan-

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[1] The Times-Picayune, April 10, 1887.

tial information concerning the appearance of the church during the first decade after its completion. This brand of primary source information reveals a unique snapshot into the contemporary manner of decoration that was considered appropriate at the end of the 19th century, as well as addressing how the advancements in technology and mass production had altered the way that spaces were finished. While the current state of the interior paint scheme, discussed later in this section, differs greatly from this first recorded account of the space, the description offered by the author of the Times Picayune piece is exceedingly detailed and it invokes a vivid picture of what the space once looked like. For the purposes of this study, it is important to take into account that the biases and interpretation of the author of the Times article are inherently present, and it is also important to take into consideration that the standardization of colors and their names was not at all regulated at this point in time.

The first mention of paint that was discovered during the course of the research is simply an invoice[2] for some quantity of Paris White paint, bought in December of 1888 from one David Bernhardt, dealer in oils, varnishes and ready-mixed paints. It is possible that this paint was used to finish parts of the interior before the implementation of the more extensive designs that the later Times Picayune article discusses in length. While it may seem like an inordinately long gap to a modern audience, the two-year period between the building's completion in 1887 and the fresh paint detailed in the 1889 piece is a typical amount of time for the fresh lime plaster on the walls to properly cure before being painted. If a layer of oil paint, typical for the period, is applied to soon onto fresh plaster, the result is that the high alkaline levels of the 'young plaster'[3] will cause the paint to saponify. "Saponification," Brian Powell claims, "can be recognized by a marked softening of the paint layer and may be accompanied by a brown exudation."[4] Additionally, the great cost of construction and the inevitable details that need to be appended in the aftermath, were historic precedents for the non-completion of church interiors during their formative years.[5] Understandably, when the decorative finishing did take place, the semi-circular chancel area and apse were treated with considerable care and attention to detail. The 1889 article details that

The chancel is the most beautiful part of the church, its round back and dome-like roof are painted a warm French gray with a reddish cast. All of the colors throughout the church are of a neutral tint; no positive colors are used. The walls of the chancel are decorated with purple flowers trimmed with gold. Around the arch of the windows the color is bluish gray, while under the windows are rich borders of yellow and deep red and gold. Between these borders and the wainscoting the color is a deep cardinal red with a border of drab black and gold… The arch of the chancel is colored a light drab, with gold trimmings. All the capitals of the chancel, resting on wooden pillars, are green bronzed and richly gilded.

Fig. 9.2: C. Bennette Moore, photographer. Christ Church Cathedral. Interior. Undated. New Orleans Churches, Southeastern Architectural Archive, Special Collections Division, Tulane University Libraries.

In addition to the many opulent details described here, the start of

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[2] Southeastern Architectural Archive, Thomas Sully Office Records Collection 8. "Christ Church Cathedral, J.L. Harris Memorial Chapel, Sully and Toledano, Architects."

[3] Brian Powel & Roger Moss, Editor. Painting Techniques: Surface Preparation and Application in Paint in America: The Colors of Historic Buildings, 214.

[4] Ibid.

[5] Robert Cangelosi. Jr.,"Gothic Revival" Class lecture, History of New Orleans Architecture, Tulane University, New Orleans, LA, February 23, 2015.

the article references a German-born fresco artist named Edward Scharfschwerdt, of Scharfschwerdt & Co. who was responsible for the design of and implementation of the discussed interiors during the summer prior to the article being published. He is also credited as completing the various floral-design frescos once found throughout the church. "A long and winding spray of ivy creeps up the base of the arch over a dark drab background… The groundwork of the main church is ornamented with grape vines and conventional flowers, which are a pretty offset to the other decorations… The decorator reached the culminating point of his art, and it would be hard to find any other decoration in better taste." The frescos described have been long since covered up, most likely the result of the extensive plaster repair and repainting during the 1962 renovation and construction, and possibly earlier due to changes in taste preference. While citywide directory searches revealed that Scharfschwerdt did indeed work as a painter, there is regrettably no evidence of other projects he completed in New Orleans that was discovered.

The passages describing the chancel area above illustrates the lavish decoration while also demonstrating one important feature of late Victorian-era interiors; the tripartite wall. The tripartite wall or wall divided into three areas, according to historic interior specialist Roger Moss is comprised of "wainscoting or dado at the bottom of the wall, a frieze or cornice at the top, and field between the wainscoting and the frieze."[6] This pattern is continued throughout the remainder of the church. "The main portion of the church is painted a bluish gray and is divided into three sections with large borders between each." This style was favored for its capacity to, as one contemporary decoration writer put it "break the monotony of an unrelieved pattern the whole height of the room."[7]

The wainscoting mentioned in the apse was described as being varnished, in addition to the remainder of woodwork in the sanctuary ("The ceiling is the same varnished wood"). An invoice[8] from painter Theodore Janiszewski dated March 8th, 1888, specifies work completed at Christ Church including the varnishing of the stairs leading to the belfry the exterior doors. Christophe Pourny, a specialist in the area of antique finish methodology believes that while the contemporary use of the word varnish describes multiple finish techniques including polyurethane, spray lacquer and shellac, "historically, the term was used to describe a method of finishing wood via various combinations of natural products and solvents: usually tree resin or sap mixed with either oil or turpentine."[9] This is likely the type of finish that would have been applied to the woodwork throughout the church. This treatment of wood surfaces represents a shift in the mentality surrounding the nature of wood decoration by the end of the 19th century. Prior to the 1870s, the graining, or faux painting of wood was an extremely common practice, but one that began to fall out of favor by the time that Christ Church was completed in 1887. Calvert Vaux, a domestic science writer during the 1870s disputed the custom as deceitful and asserted that the cost to grain the inferior wood could have been applied to the purchase of a superior variety of wood to begin with.[10]

The variety of paint hues present - French Gray, bluish gray, yellow, cardinal red, purple and drab- also merits a discussion of the availability of ready-mixed paints and the impact these had on the appearances of buildings such as Christ Church Cathedral. Prior to 1860, pigments for paints were predominately ground by hand and the paint was then mixed, also by hand, by a professional painter.[11] The color configurations were limited to the scope of the painter's expertise and the local availability of pigments. After 1860, however, paint was beginning to be pre-mixed in mass quantities, making it less expensive for the consumer. Robert Young asserts that the quantity of colors available was so extensive that "manufacturers began to offer designer palettes so that [purchasers] could begin to understand how to select paints that complimented or contrasted with one another."[12] The array of hues present in the early description of the

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[6] Roger Moss, Victorian Interior Design, 117.

[7] Ella Rodman Church, as quoted in Roger Moss, Victorian Interior Design, 117.

[8] Southeastern Architectural Archive, Thomas Sully Office Records Collection 8. "Christ Church Cathedral, J.L. Harris Memorial Chapel, Sully and Toledano, Architects."

[9] Christophe Pourny, The Furniture Bible: Everything you Need to Know to Identify, Restore & Care for Furniture, 93.

[10] Moss, Victorian, 77.

[11] Robert A. Young, Historic Preservation Technology, 336.

[12] Ibid.

church is keeping with this late 19th century trend away from the heavy use of wallpaper considered distasteful by influential writers and architects of the day, such as Charles Eastlake. "…no one need regret that it has fallen into disuse" he wrote in reference to the changing tides.[13]

While there is no historical description of the Chapel, completed in 1889, the paint sample analysis taken from this area reveals a vivid blue color (2.5PB2/6) at the earliest stage, suggesting that it was keeping with the trend of utilizing multiple and vibrant colors in even the most modest and liturgical spaces.

In order to understand the current conditions of the church, it is important to refer to the historic description in order gain a sense of the context in which the church was originally meant to inhabit. By referencing the material usage that was common-place in the time-frame Christ Church was constructed, we can begin to paint a picture of the kinds of materials which were available and utilized, and subsequently create a program to preserve the space in the most respectful and accurate manner.

Finishes Analysis

Initial finish samples were collected on Thursday February 26, 2015 with assistance of Michael Shoriak of Cypress Building Conservation, and class professor Laura Blokker of Southeast Preservation. Students chose their various areas of sampling in consultation with Mr. Shoriak and Professor Blokker. The tools used for getting samples were ladders, if height was an issue, a scalpel for removing the sample piece and a labeled mailing envelope to hold the sample. All attempts were made to take samples in a way that caused no major damage to the surfaces selected. The samples are cast in resin and once cured the casting is cut and examined under a microscope revealing the finish layers. Actual finish analysis was carried out with Mr. Shoriak and the findings were then recorded by students.

In order to determine the accuracy of the accounts and understand the morphology of the paint scheme throughout the lifetime of Christ Church Cathedral, paint samples were taken from notable locations throughout the interior of the nave, the chapel the areas around the chancel, the ambulatory and vestry, as well as the exterior. The information from these samples confirms some of the early accounts, and also reveals how some of the work, which has recently been undertaken has subsequently erased the history of finishes in that area.

The most prominent and colorful area of the church currently is the chancel area and the three samples taken from the field of green, the base of a column drop and the base of a granitized column reveal that the entirety of the area was stripped and the plaster sanded down before the implementation of the current appearance. Additionally, the shaped profiles of the arches which frame in the chancel area, which is currently a vivid red, also bear the evidence of having prior finished removed. This evidence verifies accounts given by Revrend Canon Roberts and additional Cathedral Staff.

Confirmation of the account of column bases and capitals bearing gold leaf that was published in the Times-Picayune in 1889 was found on a column which had been enclosed behind a wall that was added to conceal the mechanical workings of the organ, placed to the left side of the altar. This encasement ensured that the original scheme was not stripped away in the 1996 restoration, and therefore, the original gold leaf was evident in both samples from this area.

The historic description of the chapel as being painted blue originally was confirmed through a sample taken from high on the east chapel wall,

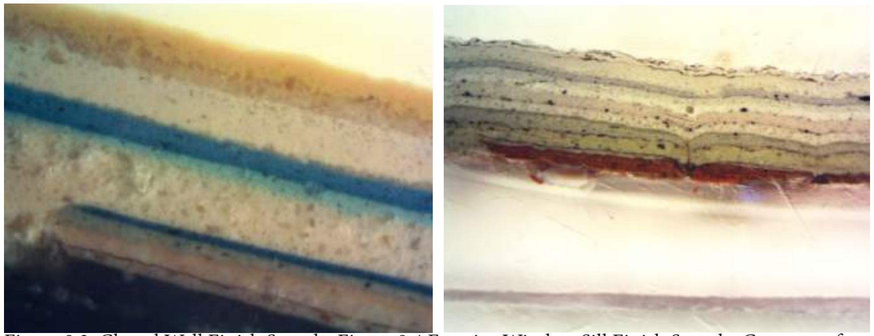

Figure 9.3: Chapel Wall Finish Sample. Figure 9.4 Exterior Window Sill Finish Sample. Courtesy of Michael Shoriak.

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[13] Moss, Victorian, 77.

above the dedication plaque [Figure 9.3]. It revealed two layers of blue paint before the current beige program was implemented in the 1960s.

As was mentioned previously, historic photographs as well as visual observation reveal a dark color surrounding the various windows on the cathedral façade. Paint analysis in two locations, a window sill to the left of the main entrance on the south elevation [Figure 9.4], and one taken from the surface of a window which previously occupied the space above the organ mechanical closet, confirm this theory. The earliest campaign was a dark, oxblood red.

While more extensive sampling of higher areas in the church might reveal evidence of the decorative paint scheme, or perhaps simply yield more untouched specimens, these findings are the most useful in helping to substantiate the known evolution of the finishes within Christ Church Cathedral.

Time Line

April 10, 1887 –
Times-Picayune publishes an article commemorating the opening day of the new Cathedral and describes the exterior as having stucco colored to appear as if "built of grey stone". According to historic photographs, the exterior window sashes were darkly colored, and the results of the paint analysis suggest that they were oxblood (10R2/8).

May 1887 –
Invoice from Theodore Janiszewski, Painter
"For Varnishing Treads of the stairs in the Belfry…$2.50"

December 1887 –
Invoice from David Bernhardt, dealer in oils, varnish and ready-mixed paints
"5 B[uckets] Paris White…$3.15"

February 1888-
Invoice from Theodore Janiszewski, Painter
" For varnishing three outside doors and painting the copula[sic]…$12.00"

Summer 1889 -
Edward Scharfschwerdt implements his elaborate design for the interior of the Church, which is described in the Times-Picayune article in November of the same year.

May 21st, 1962 –
Hans C. Hasen, of Church Supplies, describes the proposed next (known) phase of interior decoration, in an "artistic and liturgical manner" by known ecclesiastical artist, Rudolf Compte. The projected work for the sanctuary included the repair of 'defective plastering and cracked paint' and a subsequent paint scheme in several tones of gray, whereby the ceiling will be lighter than the walls and the ribs on the apse will be finished in a 'stone effect.' All of the woodwork, excepting the wainscoting painted in a 'suitable tone.' The Chancel and the Nave were to be treated in a like manner. Columns were to be ivory with an addition of 23Karat gold leaf to the capitals, and various decorative 'liturgical' stencils were proposed in order to separate various areas of the church. The proposal for the chapel includes the removal, replacement and/or repair of the damaged plaster and the over
painting of the "existing blue color" by a beige that is intended to match the existing woodwork.[14]

Between 1962-2004 –
The paint color was altered in the entirety of the Church at some point during this time to a white color with beige detailing on the ribs, columns and moulding.

1996-

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[14] Hans C. Hasen, May 21,1962, Collection 40, Folder 18, Freret and Wolf Office Papers, Southeastern Architectural Archive, Tulane University.

Tan Elastomeric coating applied to the exterior masonry.

2004 –
The church underwent a massive redecoration scheme to its current day, Arts and Crafts era appearance. This scheme was based on historic decoration precedents of the day, including the tripartite separation of the walls, while the faux-bois columns and wainscoting, were specifically intended to bring the church back to the description of "cypress pillars" published in the 1887 Times-Picayune article.

Current Finishes Scheme

While the authors of historic sources referenced might have had differing opinions about the names of colors, the following description has been referenced to a Munsell color index. The Munsell Color System is a standardized color identification system created to unify perceptions across multiple disciplines. Placed in parentheses, the Munsell index is based on three components: hue, chroma, and value. The descriptions of the current scheme have been arranged in a way that they should closely match the order or description in the 1887 and 1889 articles from The Daily Picayune found during initial research. Comparing the current decorative scheme with the original description demonstrates the clear changes the church finishes have gone through.

Beginning in the rear the church [Figure 9.5], the dome of the apse between the vaulting is currently a pale sky blue (2.5B8/4) outlined in a thin gold colored strip (5Y7/10) and thicker strip of a darker blue (5B3/4). The wall surrounding the apse is an earth toned red (10R3/10). Separated in two sections, the walls of the apse have two different color schemes as well as a lower band of wainscoting. Fully surrounding the apse, the varnished wainscoting is approximately waist height. The upper section of the apse is a background of dark blue (2.5B3/4) and on this field is gold (5Y7/10) fleur-de-lis and diamonds containing red (10R3/10) circles in their center. Separating this upper section from the lower section is a strip of faux-finish wood molding with trefoil cutouts in the center portion of the moulding. The process of painting a less expensive species of wood to look like a more expensive species is sometimes called "graining" or also known as faux-bois.[15] The background color of the lower portion is a pale green (5GY3/4) on which red (10R3/10) geometric lines, star shaped in pattern, enclose additional smaller dark green (7.5GY1/4) geometric patterns and in the center of the star shaped lines are small red (10R3/10) circles. There is not a different color surrounding the arched windows, the dark blue background of the apse extending to the sides of the windows, and the only window trim is a single piece of moulding along the sill edge of the windows. Surrounding the stained-glass windows in the apse wall openings are wood frames with a faux-finish.

The chancel arch is two contrasting color schemes. The portion above the pillar and column capitals is a greenish-brown (7.5Y6/8) and the pillars themselves are varnished and faux-finished. The column drops forming the ribs of the apse vaulting also match this finish scheme. The pillars throughout the rest of the church are all varnished and faux-grained as well. The pillars in the main areas of the church cluster around columns, which have been painted and have a granitizing scheme, a faux-granite

Figure 9.5: Chancel and Apse of the Cathedral. Joseph Newman and Fallin Steffen.

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[15] Robert Young, Historic Preservation Technology, 341

speckling pattern. All column drops in the side aisles of the church are varnished and faux-finished in a lighter shade than

the wood on the ceiling and similar to the shade of the pillars. An unspecified religious emblem above the chancel and near the ceiling, mentioned in one of the 1880's newspaper articles, is no long visible/ existing.

The walls of the main portion of the church [Figure 9.6] are currently a sandy-brown (5Y8/8) color with a varnished band of wood moulding above the pointed arches. This moulding surrounds the main portion of the church at the same height and in the same style. Due to height limitations it is not certain if this molding is faux-finished but based on the manner in which other wood throughout the church is finished an assumption can be made that this moulding is faux-finished as well. The walls themselves are not decorated or ornamented in any other way than their monochromatic finishing. The profile of the wall arches in the main portion of the church alternate between bands of red (10R3/10) and a yellowish (2.5GY5/8) color. The finishes scheme in the vestry and choir-room is a similar sandy-brown color seen in the main portions of the church.

The chapel walls are separated into two different finish schemes. The upper portion of the walls are finished in a beige (2.5Y8/8) colored paint and the lower area is a wood wainscoting. This wainscoting matches the height of the chapel's windows sills. Unlike much of the wood in the Cathedral itself, the wainscoting and all of the other wood throughout the chapel appears to be varnished but not faux-grained.

The exterior coating is currently stucco scored to resemble stone as it was at the time of construction, and finished with an offwhite elastomeric paint. The finish condition of the exterior window framing and trim is a white paint of unidentified composition.

Finish Conditions Issues

Major areas of the finishes, both interior and exterior, are suffering from severe environmentally related damage. The major issue is blistering of the finishes due to water infiltration. Beginning in the rear of the church, several large areas of blistering have occurred where the wood molding separates the portion of the wall with the green background from the portion of the wall with the blue background [Figure 9.7]. In most of these areas the finish has not fully detached from the substrate however there are places where the plaster substrate is clearly visible. The plaster in this location, and the plaster of other areas that are an original part of the church, is suffering relatively little damage and the issue is mainly with the finish itself. In newer additions to the church the plaster itself is suffering damage. This difference is related to the type of plaster used in the original construction versus the kind used for the 1962 addition to the ambulatory. The plaster used in the cathedral has a lime base that resists moisture related deterioration. The addition to the ambulatory has plaster made out of gypsum as in plaster of Paris and like its descendent "plaster board" will spall (the flaking process) in wet conditions.[16]


Figure 9.6: Nave of the Cathedral. Joseph Newman and Fallin Steffen.

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[16] Dimitri Roby, Dimitri Roby's Narratives: Letter #5

Figure 9.7: Blistering on Chancel Wall; Figure 9.8: Blistering on Vestry Wall. Joseph Newman and Fallin Steffen

Figure 9.9: Blistering on Chapel Wall; Figure 9.10: Alligatoring on Exterior Window Frame. Joseph Newman and Fallin Steffen

Portions of the vestry wall [Figure 9.8] closest to the 1960s addition are undergoing severe blistering, alligatoring, and finish-substrate separation. Similar problems of finishes blistering and peeling also exist in spots throughout the side aisle walls and nave walls of the main portion of the church. Considering these places are all part of the original areas of construction, it is assumed that the plaster substrate like in the chancel is also suffering from relatively little damage. A general finishes issue related to the damage seen might be the type of paint used [better assumption once finish analysis results are received]. Latex paint does not breathe as well as oil based paint[17] and based on the moisture infiltration problems combined with finish deterioration it is assumed the paint used for newer decorations is a latex based paint.

Examining the wood varnishes throughout the interior of the church there are many areas of minor cosmetic damage. In numerous spots the finishes have chipped off and another layer underneath, or in some cases, many finish layers are visible. Another problem seen is the overpainting of finishes. This is prevalent along the top of the wainscoting running along the side aisle walls as well as around window trim and radiator units. In these spots cracking of the finish between surfaces was also present, most minor separations while some severe cracking.

Some of the finish condition issues observed in the Cathedral were also observed in the Chapel. A major area of the wall closest to the Cathedral and adjacent to the front entrance is undergoing blistering and peeling [Figure 9.9]. The overpainting of finishes was also seen in several areas around the window frames of the chapel.

Like the interior finishes the finishes on the exterior are suffering from water related damage. The coating on the main exterior structures of the church is severely blistering in many areas due to the moisture trapping properties of the coating used. This finish, and the condition of the substrate, is discussed in further detail in the Masonry section of the report. In several areas, the exterior finish is undergoing staining and discoloration. Some of this seems to be from general environmental factors and some, based on the greenish tint to them, might be from metallic sources on the building itself.

The wood finishes throughout the exterior façade are suffering from severe cracking, also called alligatoring, and in many areas the wood substrate is exposed [Figure 9.10]. This is most likely related to the installation of storm windows over the original stain glass windows. Sometimes this creation of a double glassed window, if not done correctly, creates a situation whereby moisture from the wall and inside space ventilates through the wooden frame causing the exterior paint to badly blister and wooden frames to rot.[18] See “Windows” section for further discussion. From initial visual inspection no clear areas of rotting of the wooden frames was visible. The damage seemed limited to the finish itself. Exces-

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[17] ibid

[18] Dimitri Roby, Dimitri Roby’s Narratives: Letter #4

sive layering of finishes, similar to the condition viewed in some areas of the interior varnishes, is also present on areas of the exterior door jambs.

Case Study: Survey of Holy Trinity Anglican Church; Hawkesbury, Ontario[19]

This article discusses the author's investigation and observations of, as well as conservation related recommendations to, an Anglican Church in Ontario. Although the survey was focused mainly on the church's masonry components some parallels with problems seen at Christ Church Cathedral can be pointed out. Both churches had/have major moisture problems causing blistering and cracking of the finish material. In both buildings these issues are related to moisture infiltration and the poor permeability of the masonry coatings.

The author of the case study article details the regular monitoring of moisture levels and his conclusion that damage relates to rising damp. He cites that the most likely source of moisture infiltration is from ineffective drainage at the base of the wall and high moisture content of the soil beneath the floor of the church without any measures to seal it off. The author's suggestions to further monitor moisture content of the wall, after preventative measures have been carried out, and avoid work on the plaster until the walls dry out are applicable to the Christ Church project.

Case Study: The Historic Anglican Churches of Kolkata[20]

In an article posted on the website www.buildingconservation.com the author discusses the historical significance of St. John's Church, St. James's Church, and St. Paul's Cathedral Anglican churches in the Indian city of Kolkata, formerly called Calcutta. Conservation measures undertaken on St. James's Church are also discussed in further detail. Although these locations are located far away from our site the climates of both locations can be extremely humid. This similarity can lead to similar issues in the damage and deterioration of building finishes.

The damage to the finishes of St. Paul's Cathedral match those found throughout Christ Church Cathedral. Due poor breathability of its wall, and compounded by rising damp, the flaking of finishes is present. Moisture issues were also noticeable in St. James's Church with parishioners able to feel the dampness rising through the floor. The author describes several methods carried out during the restoration of the church, some of which might be applicable to areas of Christ Church. One method is the removal of existing render material to allow the walls to dry out and then re-plastering the masonry with a mixture similar to what was originally used. Although full scale removal might not be needed at Christ Church, analyzing and recreating the original finishes mix might be useful in places of finishes loss. Another method described in the article is using a silicone grout to prevent further damage from rising damp.

Case Study: Batcomb Lodge Grade II Listed[21]

One of the suggested contractors for historic building repairs on buildingconservation.com, this article describes the repair and restoration of a 17th century British house, Batcomb Lodge, suffering from issues similar to those observed in the Cathedral. The lodge was suffering from damp related issues due to its location and the contemporary use of a non-breathable paint. Trapped water has caused iron clamps to rust leading to damage in the adjacent masonry. There were also failures of the interior plasters.

Repairs included the removal of the plastic paints with a high pressure steam system and paint softeners. The company points out this process requires a professional due to possible problems like lead paint remnants or toxic sealants. Joints were re-pointed and interior plasters were replaced with a lime plaster as well as breathable paints. Throughout the building a

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[19] Martin Weaver, "A Masonry Deterioration Case Study: Holy Trinity Anglican Church, Hawkesbury, Ontario," Bulletin of the Association for Preservation Technology, Vol. 10, No. 1 (1978): 10-19.

[20] Mannish Chakraborti. "The Historic Anglican Churches of Kolkata" Building Conservation.com, accessed March 4, 2015. http://www.buildingconservation.com/articles/kolkata-churches/kolkata-churches.html

[21] "Batcomb Lodge Grade II Listed" Lime Repair.com, accessed March 18, 2015. http://limerepair.com/projects/projectbl.html

limewash was also used.

Recommendations for the Future

Christ Church Cathedral is an amazing example of period conChrist Church Cathedral is an amazing example of period construction dating from the end of the 19th century. The finishes of such a historically significant structure, while often viewed as merely cosmetic, serve an extremely vital protective function. The use of inappropriate materials, or the effects of unmaintained protective finishes, can have a direct effect on the deterioration of the delicate historic fabric of the building. As such, the recommendations in this section will include a discussion of the historically appropriate finishes for a structure dating from this era, as well as the possible reparations which can be made to existing fabric.

The vapor barrier created by the layers of elastomeric paint should be removed by following the treatments laid out in the section of this report detailing masonry. The original description of the building details a brick structure that was clad with stucco and painted. The term "painted" can be interpreted as either paint, or as a painted lime wash. The hot, humid climate of New Orleans, as well as the high water table necessitates the use of a product on both the interior and exterior that allows the moisture that inevitably migrates through the walls to properly evaporate. A traditional lime wash is an extremely appropriate finish for interiors as well as exteriors, and will allow the building to breathe properly in the manner it was intended. Additionally, the aesthetic qualities of lime wash would add a spectacular luminescence to the exterior. The only downside of a lime wash can be considered purely cosmetic, and that is the darkening of certain areas when it is exposed to water. While this is typical of how a lime wash will react in the presence of water, it can be a shocking sight for a modern viewer who is accustomed to the properties of modern paints.

An additional option for the exterior, as noted in the Anglican Churches of KolKata case study, is the use of a water-based product called microporous silicone paint. This is an additional option that has worked well for the hot humid climate of India, and should be considered in New Orleans. Like a lime wash, this product is slightly alkaline, non-corrosive, and recommended for historic structures.

Despite what variety of paint is chosen to replace the existing elastomeric paint, a grey color should be used for the exterior so that it is returned to its historically original "stone-like appearance".

Since the interior of the main church has undergone an extensive repair and redecoration campaign in the spirit of the original appearance, which no remnants exists in the nave, the author's do not recommend a return at this time to this scheme. If in the future this is desired, the information in the first section of this finishes analysis should provide a good guide for appropriate colors, while the book by Roger Moss and Gail Winkler entitled Victorian Interior Decoration: American Interiors : 1830-1900 should provide an excellent guide for the appropriate modes of decoration.

The cracked and alligatoring paint present on the wooden surrounds of both the exterior and interior the windows throughout the building, should be removed, sanded and repainted in order to protect them from further deterioration. As the interior restoration has made an effort to emulate the spirit of the original decoration scheme, it might be in the best interest of a proper restoration to repaint the exterior sills a dark red. For further recommendations considering the treatment of the glass within the window frames, please reference the window section.

Moisture abatement is the true basis of the problems affecting the finishes within Christ Church Cathedral, Chapel and the Vestry. Once the problem of rising damp are addressed properly, the source of finish decay will be fundamentally eliminated, or in the least, largely decreased, making the necessary repairs to plaster and paint much more permanent.

While repairs to existing gypsum-based plasters require patching completed with like plaster, gypsum is a water soluble mineral. As such, it will continue to deteriorate in the same manner which is observable in the vestry and at various points throughout the remainder of the sanctuary, as long as the trapped moisture in the church goes unresolved. Lime-based plaster is not water soluble in the same way, and it might be in the best interest to replace the existing gypsum-based plaster completely with lime.

Over-painting of exterior doors, side aisles, interior window trim and sills, areas around radiators should be properly stripped or sanded before the addition of new layers of paint, in order to prevent the failure of adhesion and loss of detail features. It should be advised for the benefit of future restoration or historical research campaigns, that a small area of finishes should be kept intact when work is undertaken. The information that is yielded from the documentation of such changes can help future generations make educated decisions about the treatments to employ in the continued restoration of the Church. For example, the Chancel area was stripped thoroughly before the current paint scheme was implemented, so there is no longer a record of the finish history for what is arguably the center point of the building. By saving a small portion of this information, it gives future of the space the option to restore the building to whichever era of its lifetime they see fit.

Conclusion & Executive Summary

At the conclusion of the semester's work, the students presented their findings to Christ Church Cathedral stakeholders with digital slide shows. Following the presentations, the students gathered to discuss their cumulative recommendations for the preservation of the Christ Church Cathedral buildings. The top priorities identified by the group can be classified by two main themes: water/moisture management and maintenance.

Water/Moisture Management

It was clear at the outset of the project that water and moisture were issues for the Christ Church Cathedral buildings: they almost always are in historic structures. While the problems are obvious, determining proper solutions is typically less so. The recommendations contained in this report are both immediate and long term in nature. The drainage section found on pages 90-105 outlines particulars for improving what is presently a poorly performing drainage system. The landscape section found on pages 106-115 addresses where the water goes, or does not go, once it has been directed away from the buildings. Immediate priorities noted in these sections are the repair and cleaning of gutters, downspouts, and drains so that the existing systems can operate optimally. In the longterm, the entire drainage system should be carefully evaluated and adjusted to better keep water away from the buildings. An immediate recommendation for the landscape is the removal of the plantings against the ambulatory. That this area suffers from moisture issues is readily apparent and removal of moisture holding plantings would be an excellent first step toward remediation.

Moisture management also includes ventilation of non-conditioned spaces and improved air movement throughout. The environmental conditioning and roofing sections on pages 116-135 and 58-75 detail the particular areas of concern for ventilation and potential courses of action. Correlating to ventilation is the operation and control of the HVAC system. It is recommended that a monitoring plan utilizing dataloggers be implemented to better assess current system performance and to evaluate effects of any changes in settings or equipment.

Maintenance

Routine maintenance is essential to the preservation of any building, yet it is commonly overlooked. Many factors including institutional priorities, staffing, and budgets can affect maintenance. One of the best ways to assure that routine maintenance tasks are carried out is to develop a maintenance plan. This can be a simple list or a spreadsheet, but should have space to enter the dates, names, and any details related to the work. Such record keeping provides an easy way to track work and budget for it. Items like gutter cleaning, roof inspections, HVAC filter changes and equipment service should all be included. A master maintenance plan can also include specific protocols for work and standards for all contractors so that there is a known baseline for qualifications and performance. Two maintenance items to be addressed promptly are the cleaning of leaves and debris from gutters and drains and an inspection of the lightening protection system. A lightening protection system must be grounded to be effective. If not grounded, it can actually be more dangerous than no system at all, so it important to have it inspected periodically by a reputable professional.

In addition to these two general themes, a few specific projects were identified as top priorities. Briefly, they are as follows:
- Begin removing aged protective glazing from stained glass windows.
-Repaint window sills.
-Begin testing methods for removal of the elastomeric coating in inconspicuous areas. Once an area of coating has been removed, begin testing masonry and stucco repairs and new coatings for durability and aesthetic suitability.
-Check attachment of crooked finial and secure if needed.

These and other topics are discussed in further detail in the masonry, windows, decorative exterior appurtenances, and architectural finishes sections. The report in whole should be used as a guide and baseline reference for all building activities as the preservation of this landmark proceeds.

-Laura Ewen Blokker
Instructor, PRST6720

Appendix A

Finish Sample Forms

SAMPLE ID: 1

PROJECT

CHRIST CHURCH CATHEDRAL
2919 St. Charles Ave., New Orleans, LA 70115
(504) 895-6602

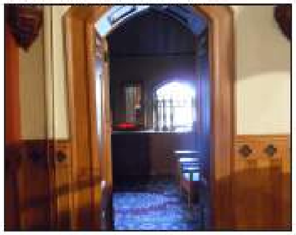
DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
DOOR FINISH	SACRISTY DOOR, INSIDE EDGE (downtown, lakeside)	3/12/2015 (COLLECTED 2/26/2015)

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Trudy Andrzejewski

NOTES

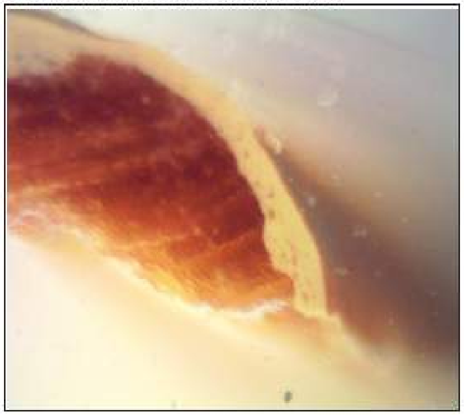
SAMPLE LOCATION

LOCATION PHOTOGRAPH



100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
2	red/brown	
1	yellow	
substrate	wood	

SAMPLE ID: 1

PROJECT

Christ Church Cathedral Paint Analysis
2919 St. Charles Avenue, New Orleans, LA 70115
205-908-2300

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Wainscot panel	Interior, underneath wainscot panel	03/12/2015

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Nathan Marx

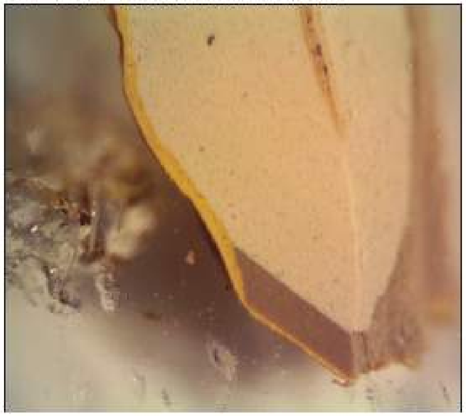
NOTES
The black dots that appear within the samples are more modern paints.

SAMPLE LOCATION

LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
5	Brown	
4	Yellow	
3	Red	
2	Cream	
1	Pink	
Substrate	Plaster	

Sample ID: 2

PROJECT

CHRIST CHURCH CATHEDRAL
2919 St. Charles Ave., New Orleans, LA 70115
(504) 895-6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
FINISH ON AN INTERIOR WINDOW THAT WAS ONCE AN EXTERIOR WINDOW	INTERIOR AMBULATORY WINDOWSILL BOTTOM LEFT CORNER (Riverside, Downtown, close to Sacristy)	3/12/2015 2/26/2015 (collected)

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Stephanie Brisita

NOTES

Specks in sample from sandpapers; different textures in paints; no substrate in sample; final finish is thinner than other layers

SAMPLE LOCATION

LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
7	White	
6	Dark Beige	
5	Tan	
4	Yellow	
3	White	
2	Light Green	
1	Pink/Brown	
NO SUBSTRATE		

SAMPLE ID: #3

PROJECT

Christ Church Cathedral
2919 St. Charles Ave.
New Orleans, LA 70115

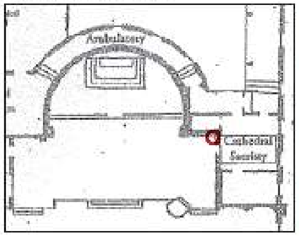
DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Molded Stucco Corner Bracket done in a leaf motif and current color is a dark brown, carving dimension aprox 9 in extension from wall and 12 in height	Facing the alter, in the right aisle past the transept near tomb of Bishop Leonidas Polk. aprox. 7 ft. off the ground on upper right side of top leaf two in from the right	Sample collected: February 26, 2015 Sample analyzed: March 12, 2015

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Kathryn Callender

NOTES

In taking the sample issues arose with the stucco substrate crumbling, took several attempts to get a clean sample, very little of the substrate is visible. The sample revealed five layers with the most prominent being the butter yellow layer that was also seen in other samples throughout the cathedral. The era of the Pale Sage Green paint is unclear, not consistent across other samples.

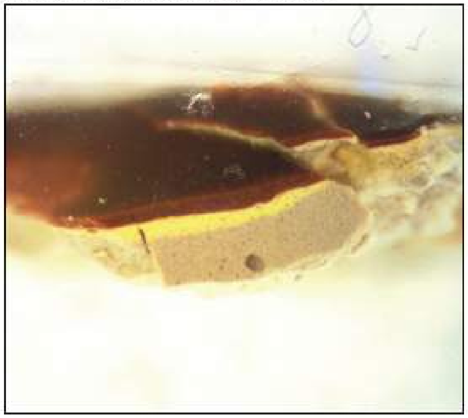
SAMPLE LOCATION



LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
5	Chocolate Brown	
4	Butter Yellow	
3	Grey	
2	Pale Sage Green	
1	Pale Grey/ White	
Substrate	Plaster	

SAMPLE ID: 4

PROJECT

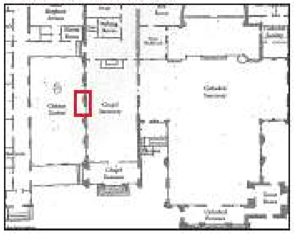
Christ Church Cathedral
2919 Saint Charles Ave., New Orleans, LA 70115
(504)895-6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Paint peeling in the chapel	East chapel wall above the dedication plaque	March 12, 2015

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Christine Carlo

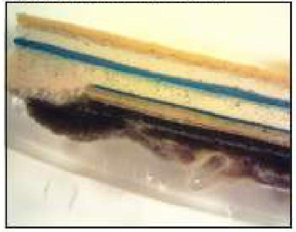
NOTES
-No substrate because the sample was taken from paint peeling off of chapel wall. The substrate, however, is plaster.
-The two thickest white layers are most likely primer
-The left side of the sample is missing the bottom 4 layers, this is most likely due to the paint being stripped, but not throughouly

SAMPLE LOCATION

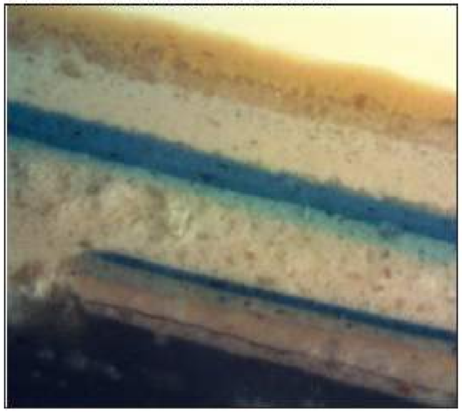


LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH



REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
11	yellow	
10	tan	
9	white	
8	white / primer?	
7	blue	
6	bright green	
5	white / primer?	
4	blue	
3	green	
2	light tan	
1	tan	
	no substrate attached	

SAMPLE ID: 5

PROJECT

Christ Church Cathedral
2919 Saint Charles Ave., New Orleans, LA 70115
(504)895-6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Sample from joint of portico window sill	Cathedral main entrance, left side of portico, left side of outer portico window sill, where sill meets masonry wall	February 26, 2015

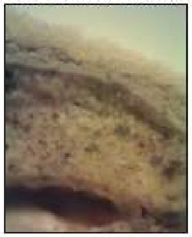
MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Matthew Carick

NOTES
- Sand visible is a component of the stucco substrate.
- Some separation is visible between stucco substrate and layer 1.
- Greyish green layer 2 may have been from a patch or repair attempt as it exists only in a tiny amount.
- Another layer of stucco appears to have been applied as evidenced by grains of sand in layer 3.
- Four layers of exterior coatings were applied after layer 3 and before the existing outermost layer.
- White outermost layer is the elastomeric coating most recently applied to the entire building's exterior.

SAMPLE LOCATION

LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH



REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
8	white	
7	yellow	
6	bluish white	
5	dark brown	
4	white	
3	tan	
2	greyish green	
1	light brown	
^^	separation	
substrate	stucco	

Sample ID: 7

PROJECT

Christ Church Cathedral paint sample

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Inside the organ closet, at the column base.	Behind the door to the organ closet that faces the west transept and is closest to the chapel.	3/12/15

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Cody Ellis

NOTES

- Paint layers were continuing to flake, hard to capture complete sample.
- Possibly mirrored at end. Outer layer can be seen as green in the location photograph but appears beige in reflected light photomicrograph.

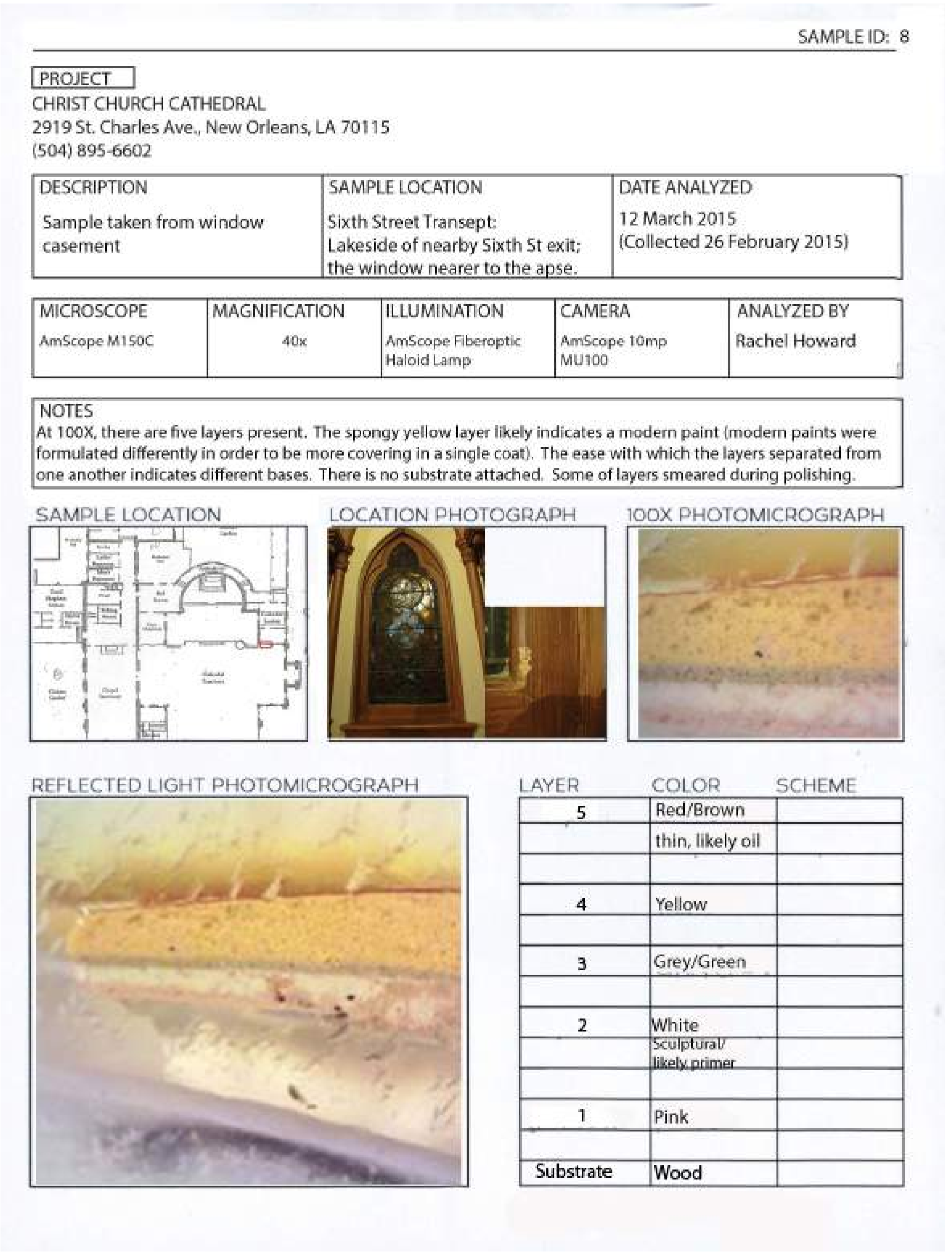
SAMPLE LOCATION

LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
-	mirror start	
8	green	
7	white	
-	dirt	
6	beige	
5	dark green	
-	dirt	
4	yellow	
3	white primer	
2	gold leaf	
1	red	
substrate	wood	



SAMPLE ID: 8

PROJECT

CHRIST CHURCH CATHEDRAL
2919 St. Charles Ave., New Orleans, LA 70115
(504) 895-6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Sample taken from window casement	Sixth Street Transept: Lakeside of nearby Sixth St exit; the window nearer to the apse.	12 March 2015 (Collected 26 February 2015)

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Rachel Howard

NOTES

At 100X, there are five layers present. The spongy yellow layer likely indicates a modern paint (modern paints were formulated differently in order to be more covering in a single coat). The ease with which the layers separated from one another indicates different bases. There is no substrate attached. Some of layers smeared during polishing.

SAMPLE LOCATION

LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
5	Red/Brown	
	thin, likely oil	
4	Yellow	
3	Grey/Green	
2	White	
	Sculptural/ likely primer	
1	Pink	
Substrate	Wood	

SAMPLE ID: 9

PROJECT

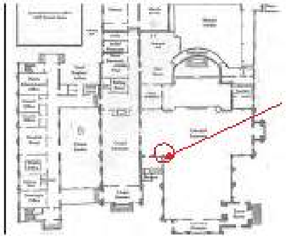
CHRIST CHURCH CATHEDRAL PROJECT
2919 St. Charles Avenue, New Orleans, LA 70115
504.895.6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Sanctuary Wall	Back Eastern wall of Sanctuary, above baseboard, next to column	03/12/2015

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M158C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Meredith Jacobs

NOTES
-Sample taken in area of great paint buildup next to a column
-Sample crumbled from wall during extraction

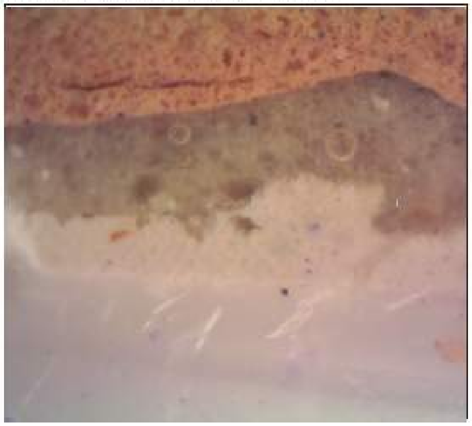
SAMPLE LOCATION



LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
5	Peach Plaster	
4	Grey Primer	
3	Pale Green	
2	White	
1	White	
Substrate	Plaster	

SAMPLE ID:

PROJECT

Christ Church Cathedral
2919 St Charles Avenue
New Orleans, LA 70115
Preservation Technology
Finishes Analysis

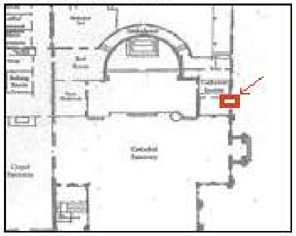
#10 (40.jpg,
41.jpg)

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Interior wall paint sample	Vestry, downtown wall, behind file case	3/12/2015

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M158C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Amanda Keith

NOTES
Paint was already peeling to substrate in this area. Sample taken down to substrate.

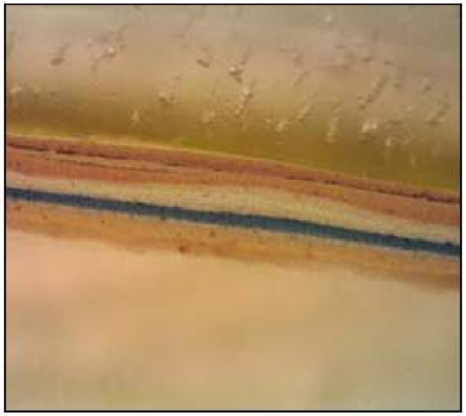
SAMPLE LOCATION



LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
10	tan	
9	cream	
8	peach-orange	
7	cream	
6	white	
5	cream	
4	blue	
3	cream	
2	tan	
1	yellow	
substrate	plaster	

SAMPLE ID: 11

PROJECT

Christ Church Cathedral
2919 Saint Charles Ave., New Orleans, LA 70115
(504)895-6602

DESCRIPTION

exterior finish sample

SAMPLE LOCATION

collected from the portico column base on 6th street side of the chapel

DATE ANALYZED

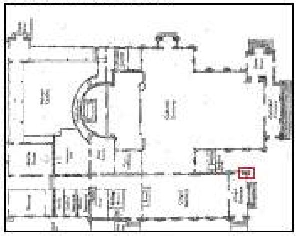
Analyzed: 3/12/15
Collected: 2/26/15

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Halold Lamp	AmScope 10mp MU100	John Rupley

NOTES

- stucco substrate was attached to the sample
- blueish white layer , thin
- brown tan layer thin
- white layer, much thicker (elastomeric coating)

SAMPLE LOCATION



LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
3	white layer	
2	brown tan	
1	blueish white	
substrate	stucco	

SAMPLE ID: 11

PROJECT

Christ Church Cathedral
2919 Saint Charles Ave., New Orleans, LA 70115
(504)895-6602

DESCRIPTION

From baseboard near door casement

SAMPLE LOCATION

cathedral, baseboard near the entry to the tower room, where baseboard meets the door casement

DATE ANALYZED

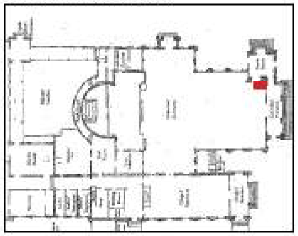
March 12, 2015

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Halold Lamp	AmScope 10mp MU100	Meredith Massey

NOTES

- no substrate was attached to the sample
- blue anomaly likely from stray drop of paint
- clear sample
- graining is visible in the reflected light photomicrograph
- oil based layer at bottom, spongier and thicker towards top

SAMPLE LOCATION



LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
11	dark red	
10	dark beige	
9	yellow	
8	brown	
7	light beige	
6	brown	
5	light beige	
4	tan	
3	brown	
2	tan	
1	light brown	
subsrate	wood	

SAMPLE ID: 13

PROJECT

Christ Church Cathedral
(Preservation Technology)

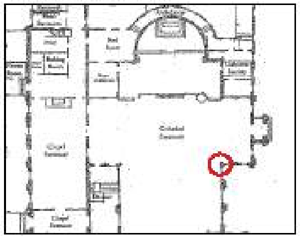
DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Red-painted ribbed arches along nave	Base of arch, just above column capitol where transcept meets nave on the 6th St. side	3-17-15

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Nathan Lott

NOTES

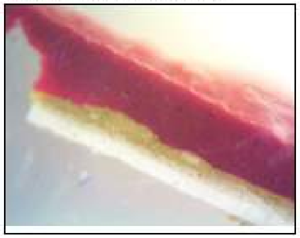
Substrate is plaster; current paint is a deep red. Some white particles are visible in middle (tan) layer. Earliest color (beige) may have been applied in two layers (see lower right portion of photomicrograph). This is not consistent throughout the sample, but that may be explained by the location at the margins of paint coverage (flat surface above columns is unpainted).

SAMPLE LOCATION

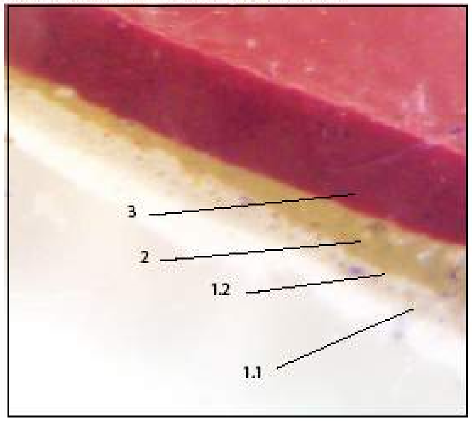


LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH



REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
3	Red	
2	Tan	
1.2	Beige	
1.1	Beige	
Substrate	Plaster (white)	

SAMPLE ID: 15

PROJECT

Christ Church Cathedral
2919 St. Charles Avenue
New Orleans, LA 70115

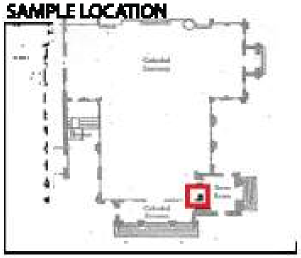
DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Column shaft	Riverside wall of the nave, from the engaged column in the left corner where it meets the chair rail.	2/26/2015

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Kelly Morgan

NOTES

A dirt layer was observed between the third and fourth layer of paint (indicated by the carrot, ^). A layer of repairwork is also evident (layer 8).

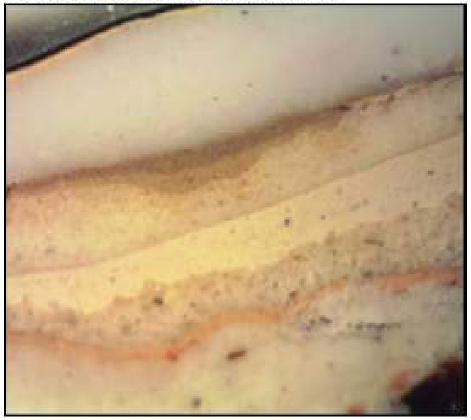
SAMPLE LOCATION



LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
10	Dark green	
9	Butter yellow	
8	Repair	
7	Dark brown	
6	Light brown	
5	Beige	
4	White	
3 ^	Beige	
2	Beige (w/ sand?)	
1	Pink	
Substrate	Plaster	

SAMPLE ID: 16

PROJECT

Christ Church Cathedral
2919 St. Charles Ave, New Orleans LA 70115
(504) 895-6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Chancel Wall	Facing the altar, left-hand side of the chancel from a portion of the field of green in an area near the top of the wainscoting and adjacent to the radiator	March 12, 2015 (sample taken February 26, 2015)

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Joseph Newman

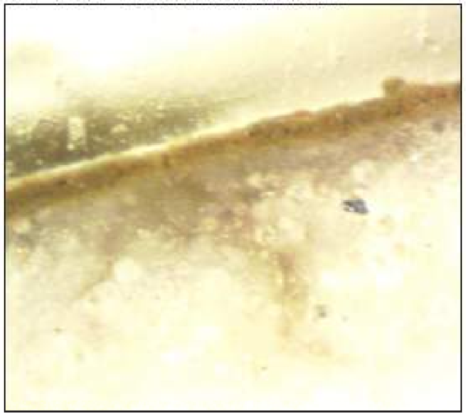
NOTES
Dark flecks present in the analysis images are most likely remnants of the sand paper grit which were not completely washed off after buffing the sample. Minimal layers of paint present suggest the apse was completey stripped of previous finish layers before current painting took place. The first brown-green layer might be some kind of primer or sealant for the plaster.

SAMPLE LOCATION

LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
2	green	
1	brown-green	
substrate	plaster	

SAMPLE ID: 17

PROJECT

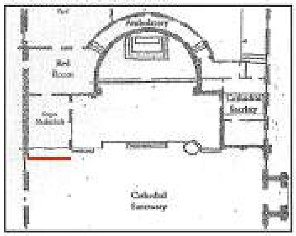
Christ Church Cathedral
2919 St. Charles Avenue
New Orleans, LA 70115
(504) 895-6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Sample taken from the casement of a stained glass window	In the cathedral the sampled window was historically located to the left of the altar, above the twentieth century organ machinery.	March 12, 2015

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Elizabeth Shultz

NOTES • Sample taken from one of a group of windows that were removed during the twentieth century to accommodate a large organ for the Cathedral. Windows have since been put into storage in the church tower. The sample location noted below shows the historic location of the window, located approximately twenty feet above floor level. • Sample clearly shows evidence of at least four paint layers prior to the window's removal, the earliest of which appears to be a hearty crimson, and the most recent of which is a thin layer of white. Beneath the red layer is a large chunk of the wooden substrate. • It appears as though some remnants of the smoothing agent were left on the sample.

SAMPLE LOCATION



LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
-	Dirt Layer	
4	White	
3	Light Brown	
2	Brown	
1	Red	
Substrate	Wood	

Fallin Steffen

SAMPLE ID: 18

PROJECT

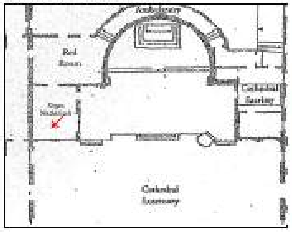
Christ Church Cathedral
2919 St Charles Ave, New Orleans, LA 70115

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Column Capital	Column capital in the crawl space behind the organ pipes, left of the chancel area.	03.13.15

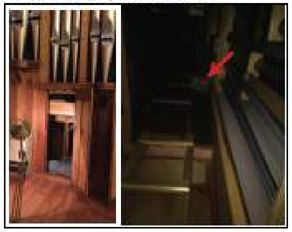
MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M158C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Fallin Steffen Michael Shorlek

NOTES: Sample was taken from a location on the left side of the nave which was formerly exposed, but was eventually walled up by the organ pipes and forms the closet for the mechanical components of the organ; the large section of off-white (2) looks to be some sort of repair with plaster or filler; the blue color (7) has slipped through a fissure and appears to be between the substrate and the first layer of gilding, but it should still be considered among the modern paint schemes.

SAMPLE LOCATION



LOCATION PHOTOGRAPH



100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
8	Tan	Modern
7	Blue	Modern
6	White	Modern
5	Pinkish Red	Modern
4	Tan	
3	Reddish Brown	
2	Off-White	Repair
1	Metallic Gold	Original
Substrate	White	Plaster

SAMPLE ID: 19

PROJECT

Christ Church Cathedral
2919 St. Charles Ave., New Orleans, LA 70115
(504)895-6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Exterior Wood Window Sill Paint Sample	South Elevation of Cathedral, Window to left of main entrance.	3/19/2015 (Collected 2/26/2015)

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M158C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Samantha Williams

NOTES

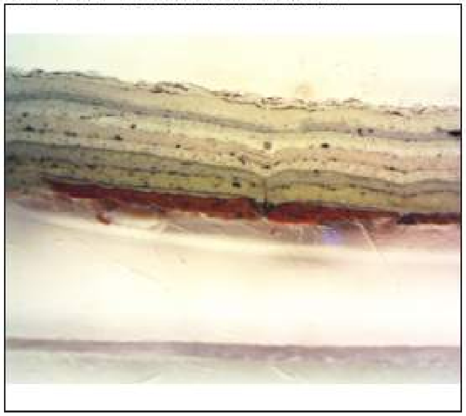
The sample is missing the substrate due to the fact that it was peeling. The black specks are contributed to residue from the sanding/polishing process of the sample.

SAMPLE LOCATION

LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH



LAYER	COLOR	SCHEME
9	Grey	
*	Dirt line	
8	Yellow Beige	
7	Dark Grey	
6	White	
5	Taupe	
4	Beige	
3	Green Grey	
*	Dirt line	
2	Yellow Green	
*	Dirt line	
1	Red	
*	Substrate - Wood - not intact	

SAMPLE ID: ??

PROJECT

CHRIST CHURCH CATHEDRAL
2919 St. Charles Ave., New Orleans, LA 70115
(504) 895-6602

DESCRIPTION	SAMPLE LOCATION	DATE ANALYZED
Base of engaged column	Cathedral, at the decorative base of an interior engaged column on the wall shared by the organ mechanical room.	3/19/2015 (COLLECTED 2/26/2015)

MICROSCOPE	MAGNIFICATION	ILLUMINATION	CAMERA	ANALYZED BY
AmScope M150C	40x	AmScope Fiberoptic Haloid Lamp	AmScope 10mp MU100	Laura Stokley

NOTES

When the sample was removed, there were several layers of old newspaper behind it. I believe the base of these columns was formed using a plaster papier-mâché.

SAMPLE LOCATION

LOCATION PHOTOGRAPH

100X PHOTOMICROGRAPH

REFLECTED LIGHT PHOTOMICROGRAPH

LAYER	COLOR	SCHEME
12	dark brown	
11	yellow	
10	grey primer	
9	tan	
8	light brown	
7	white	
6	yellow	
5	white	
4	light brown	
3	pinkish tan	
2	dark blue	
1	light brown	
Substrate	plaster	