Sustainable reuse: the adaptive reuse of the Chattanooga Choo Choo into the Chattanooga Market using LEED

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Sustainable Reuse: The Adaptive Reuse of the Chattanooga Choo Choo into the Chattanooga

Market Using LEED

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Departmental Honors Thesis

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Abstract

Buildings account for a significant percentage of energy use, material consumption, and waste production. This study argues that a solution for this issue is the adaptive reuse of existing buildings. Research shows that reusing existing buildings for new design projects helps to decrease the amount of energy consumed and waste produced. When adapting historic buildings specifically, the cultural significance within the community is maintained (Department of the Environment and Heritage, 2004). Sustainability has often been seen as more difficult when adapting historic buildings due to the importance of protecting the historical character and design of the building (Polo Lopez & Frontini, 2014). This thesis creates a hypothetical adaptive reuse plan for adapting the Chattanooga Choo Choo into the Chattanooga Market, a location that will be used by local farmers and vendors to sell their goods. The project will use the LEED v4: New Construction and Major Renovation rating system in an attempt to document a LEED certification for the building based on its current state. Showing that historically significant buildings can be renovated and reused in a sustainable manner can help pave the way for increased sustainable implementation of other historically significant buildings.
Chapter 1: Introduction

Introduction

The city of Chattanooga, Tennessee has often incorporated the process of adaptive reuse of buildings to house new projects in the pursuit of sustainable development (Pare, 2018). The Secretary of the Interior defines adaptive rehabilitation, otherwise known as adaptive reuse, as a process that retains the property’s existing historical character while altering or adding to the property (Secretary of the Interior, 2019). Reusing existing buildings can decrease the amount of energy and raw material consumption by new buildings as well as keep the existing building’s embodied energy (Department of the Environment and Heritage, 2004). Chattanooga has continued to focus on the reuse and repurposing of existing buildings as the downtown and its neighboring areas continue to grow (Pare, 2018). Along with environmental benefits, adaptive reuse of historic buildings can allow for the cultural significance of that building to remain within the community (Department of the Environment and Heritage, 2004).

However, there are times when “efforts to preserve and revitalize historic buildings run up against financial obstacles, restrictive zoning and codes, contamination, and structural problems that create challenges in reusing these unique structures” (Cantell, 2005, p. 2). These challenges can inhibit the number of historical buildings that are reused.

Changing the existing occupancy of the building can also bring community improvements. According to a public survey, the city of Chattanooga does not have enough opportunities for local craftsmen and farmers to display and sell their merchandise and produce year-round (See Appendix B). Therefore, this thesis will focus on the sustainable adaptation of the Chattanooga Choo Choo into The Chattanooga Market, a location that will allow for local farmers and vendors to sell their goods. Using the Leadership in Energy and Environmental Design (LEED) v4 rating system for this project helps document and implement specific
sustainable features within the project and set certain standards for how the building should be reused. By documenting a hypothetical LEED certification for a historical building, it can act as a guide for the implementation of sustainable practices when restoring other historic buildings.

**Purpose**

The purpose of this thesis is to document a hypothetical, sustainable, adaptive reuse of the Chattanooga Choo Choo into The Chattanooga Market using the LEED v4: New Construction and Major Renovation rating system. Information will be gathered regarding the current building state of the Chattanooga Choo Choo, the application of adaptive reuse for historic buildings using the LEED rating system, and sustainable solutions from case studies that could be implemented within this thesis project. The goal for this thesis is to attain the minimum of 40 points needed to achieve a LEED certification for the project.

**Background**

**Adaptive Reuse.** Adaptive Reuse is a building technique that can be used to restore existing buildings. Reuse can “create valuable community resources from unproductive property, substantially reduce land acquisition and construction costs, revitalize existing neighborhoods, and help control sprawl” (Bullen, 2007, p.22). Some definitions of adaptive reuse include the following:

- A process that retains as much as possible of the original building while upgrading the performance to suit modern standards and changing user requirements (Latham, 2000).
- Conversion of a building to undertake a modified change of use required by new or existing owners (Douglas, 2002).
• Rehabilitation or renovation of existing buildings or structures for any uses other than the present uses (Dolnick & Davidson, 1999).

• A process that changes a disused or ineffective item into a new item that can be used for a different purpose (Department of Environment and Heritage, 2004).

There are many technical differences between reusing a space through the process of adaptation, restoration, and renovation. The difference is “that restoration returns a building to the condition it was when originally constructed, whereas renovation modifies a building so that it meets current standards and codes” (Bullen, 2007, p. 21). Adaptation is a combination between restoration and renovation through the improvement of the existing structure and a conversion of the building from its original intended use. Belsass describes it as the conscious decision to preserve the past while planning for the future (2018). The importance of adaptive reuse stems, not only from the preservation of historic buildings, but also as a tool for environmental sustainability. According to Belsass, it is a critical process to ensure communities do not use or waste more materials then necessary (2018). Regarding an overall project, it can also be a contributing factor in better time management, cost of materials, and reduction of overall project waste. Along with those previously stated, a big “driving factor behind adaptive reuse is the ability to keep stories and memories intact” (Belsaas, 2018, p.2). The Chattanooga Choo Choo has significant historical impact on the surrounding Chattanooga area, and preserving that significance while bringing something new to the community can act as a bridge between the old and new styles and add “new chapters without rewriting the entire book” (Belsaas, 2018, p.2).

**Adaptive Reuse of Historic Buildings.** There are many advantages to reusing existing buildings for new projects and occupancies. However, when the existing building is historically significant, things can become more problematic. When renovating existing historical buildings
“it is not possible to operate freely” (Polo Lopez & Frontini, 2014, p.1494). Sustainable changes within a historic building are sometimes discouraged “since the aesthetic appearance would be affected” (Polo Lopez & Frontini, 2014, p.1494). Today, there are major tensions between preservation and sustainability and how they dictate the way to sustainably renovate or preserve a historic building (Avrami, 2016). However, if proper care is used, these buildings can be reused for different purposes while incorporating features that will make them more sustainable. According to the Whole Building Design Guide (WBDG) Historic Preservation Subcommittee, it is much better to design the space with the least amount of change to the building design and architectural structure (Whole Building Design Guide, 2017). For this thesis project, the building will focus on sustainable solutions that will not affect the design of the exterior building envelope or the design of the existing dome space. The LEED credits proposed will be cognizant of the historic significance in order to create a guide for restoring historical buildings sustainably with the rating system.

**Leadership for Energy and Environmental Design (LEED) Certification.** The U.S. Green Building Council is a United States non-profit that promotes sustainability-focused practices in the building industry. In the year 2000, they formed a green building rating system called Leadership in Energy and Environmental Design (LEED). Since its inception, LEED has become the international standard for environmentally sound buildings, certifying hundreds of thousands of square feet per day. The current version of the LEED rating system is LEED v4. It has made small improvements to the previous versions of the rating systems by focusing on materials to get a better understanding of what is in them and the effect those components have on human health and the environment. It also provides a clearer picture of water efficiency by
evaluating total building water use and using a stronger performance-based approach to indoor environmental quality for better occupant health (U.S. Green Building Council, 2019).

**Chattanooga LEED Certification.** The city of Chattanooga has come a long way since being previously designated as one of America’s dirtiest cities by the federal government in 1969 (Beach, 2016). Today, it houses many popular Green Program projects, including Leadership in Energy and Environmental Design. There are currently 54 LEED certified projects ranging from a base LEED rating of LEED Certified to the highest attainable rating of LEED Platinum with over 6.8 million square feet certified (Green Building Information Gateway, 2018). Choosing to pursue LEED certification for city projects such as the Chattanooga Choo Choo can help contribute to the sustainable progress that is being made within the city.

**Existing Building: The Chattanooga Choo Choo.** The Chattanooga Choo Choo is located at 1400 Market Street, Chattanooga, TN 37402. It was originally constructed in 1909 as the Terminal Station, a passenger train terminal created to relieve the over-crowding of Chattanooga’s railway system (National Geographic, 2018). The station “was built as two different structures combined. One was the outside brick edifice; the other is the steel superstructure to support the domed ceiling and concourse roof” (Strickland, 2009, p.21)(See Figure 1.0). The station functioned as a train station throughout the early 20th century, but in the 1950’s and 60’s, rail traffic decreased significantly. In 1970, the last passenger train left Terminal Station and it was left as storage. Two years later, a group of businessmen bought the station and its surrounding property, renaming it the Chattanooga Choo Choo (Turkel, 2013). The building has continued to function as a hotel since that time, and it was added to the National Register of Historic Places in 1974 (The Chattanooga Choo Choo Hotel, 2014).
Proposed Chattanooga Market. The Chattanooga Market is a two-story location for local vendors and craftsmen to sell their goods year-round. The building consists of a bottom floor of approximately 23,000 square feet, and a second floor of approximately 10,400 square feet. The Market contains areas for permanent vendor stalls, temporary vendor tables, a hotel lobby for the Chattanooga Choo Choo, office and employee space for hotel employees, an art gallery that will display local artists’ work, office space for a local preservationist office, office space for an art gallery manager, office space for an event coordinator, a large storage area for the building, food vendor stalls, and public restrooms. The bottom level of the building will contain the vendor stalls and hotel space while the upper level will accommodate the art gallery, storage, and offices. The Market provides temporary vendor tables to sellers that allow for a smaller selection of goods to be sold. These tables are moveable and can be brought in and out of storage depending on the number of vendors each day. The Market also has permanent vendor stalls for merchandise. These stalls contain lockable storage for sellers to keep personal items and more merchandise, and they also provide for a large amount of shelf display space. These permanent stalls are all equipped with a moveable cash register cart and have lockable gates for
security so that sellers can keep their goods in the Market over-night. Within the new building wing, individual stalls were created to house small local restaurants, bakeries, and cafes. The space is equipped with two small kitchens and a walk-in freezer for food vendors to store and warm the food that they bring into the Market each day. The design of the Market is inspired by the existing Beaux-Arts style of the domed space. A neutral color pallet was selected based on the typical color selection of the Beaux-arts style. This color pallet will not conflict with the continually changing variety of merchandise that will be displayed.

**Significance**

This research is significant because it documents a way for historically significant buildings to be renovated and reused in a sustainable manner. By documenting a hypothetical LEED certification for a historical building, it creates a guide for the implementation of sustainable practices when restoring other historic buildings.

**Problem Statement**

This research proposes to incorporate a market into the Chattanooga Choo Choo. According to information gathered from a public survey of Chattanooga residents (See Figure 1.1), the city does not have enough opportunities for local craftsmen and farmers to display and sell their merchandise and produce year-round.
Chattanooga’s southside has undergone significant reconstruction in recent years, and the location has gained popularity within the community. This contributed to why the Chattanooga Choo Choo was chosen. Another reason for choosing the building was its lack of current use. The winged half of the building is not in use, and the dome space is in need of renovation (See Figure 1.2). By incorporating the new Chattanooga Market into the Chattanooga Choo Choo, it will revitalize the entire historic building. The Market will also be a way for the city to focus more attention on the creative arts, businesses, and producers within the community.

Figure 1.2: Building Plan

**Research Questions**

The following are research questions that were analyzed throughout this thesis:
1. What is the current building status of the Chattanooga Choo Choo?

2. What solutions from other case studies could be implemented within The Chattanooga Market?

3. In what ways can LEED credits be achieved for the new Market?

Assumptions of Study

The following assumptions were made regarding this study:

1. The renovation of the Chattanooga Choo Choo will include bringing the building up to code, taking out and adding walls, updating finishes and fixtures, and adding new occupancies.

Limitations of Study

The following limitations applied to this study:

1. Access to the whole building was limited.

2. Limited time-period for the study.

3. Actual construction and implementation of design did not occur, limiting the documentation of LEED credits for the project.

4. The scope of this thesis focused solely on the interiors of the building.

Delimitations of Study

The following delimitations were imposed based on the purpose of the study:

1. The Chattanooga Choo Choo was the only building analyzed in this study.

2. The LEED rating system was the only sustainable rating system used to document sustainability within this study.
Definitions

- **Adaptive Reuse** - Rehabilitation or renovation of existing buildings or structures for any uses other than the present uses (Dolnick & Davidson, 1999).

- **Aesthetic** - The philosophical study of beauty and taste (Munro & Scruton, 2018).

- **Axial Floor Plan** - A plan in which parts of a building or structure are arranged lengthwise, along a given axis (Yundle Law Admin, 2016).

- **Casement Windows** - A window that is attached to its frame by one or more hinges at the side (Poppeliers, 1983).

- **Coffered Ceiling** - Ceiling created with coffered panels or “coffers”. Coffers are sunken panels attached to a suspended grid to create a new ceiling with depth and architectural interest (Armstrong Ceilings, 2018).

- **Decompression Area** - The zone or area that a customer enters immediately after walking into a building (Fleener, 2008).

- **Degradation** - The process by which something is made worse. Degrades (Cambridge Dictionary, 2019).

- **Demolition** - The act of demolishing (Merriam-Webster Dictionary, 2019b)

- **Edifice** - Building, especially a large or massive structure (Merriam Webster Dictionary, 2018).

- **Embodied Energy** - The energy consumed by all of the processes associated with the production of a building, from the acquisition of natural resources to product delivery (European Commission, 2018).

- **Façade** - Any face of a building given special architectural treatment (Merriam-Webster Dictionary, 2019a).
• **HVAC**- Heating, Ventilation, and air-conditioning

• **LEED Prerequisite**- Required elements, or green building strategies, that must be included in any LEED certified project (Kottiyattil, 2015).

• **Municipal Water**- Water that is processed and treated to meet drinking water standards set by the EPA that is supplied to households and industries (International Bottled Water Association, 2015).

• **Potable Water**- A water fit for drinking, being free from contamination (Farlex Medical Dictionary, 2012).

• **Parapet**- A dwarf wall or heavy railing around the edge of a roof, balcony, terrace, or stairway (The Editors of Encyclopedia Britannica, 2018).

• **Rivet**- A headed pin or bolt of metal used for uniting two or more pieces by passing the shank through a hole in each piece then beating or pressing down the plain end so as to make a second head (Merriam-Webster Dictionary, 2017).

• **Rosettes**- A round, stylized flower design (Oxford Pocket Dictionary, 2009).

• **Sustainability**- Form of intergenerational ethics in which the environmental and economic actions taken by present persons do not diminish the opportunities of future persons to enjoy similar levels of wealth, utility, or welfare (Meadowcroft, 2019).

• **Terrazzo Flooring**- Composite material, poured in place or pre-cast, which is used for floor and wall treatments. It consists of chips of marble, quartz, granite, glass, or other suitable material, poured with a cementitious binder (North Central Terrazzo Association, 2019).

• **Urban Sprawl**- The rapid expansion of the geographic extent of cities and towns (Rafferty, 2019).
Conclusions

This chapter documented research pertaining to adaptive reuse, LEED, and the Chattanooga Choo Choo, as well as the research questions that will be answered within this thesis. The following chapter explores topics that will assist in the sustainable development of The Chattanooga Market.
Chapter 2: Literature Review

Introduction

The application of adaptive reuse can take many forms under the Leadership in Energy and Environmental Design Rating System. In order to understand the application of LEED within the project, it is first important to identify the system itself and how it has previously been applied to adaptive reuse projects of historical buildings. This chapter explores the topics of historic renovation, LEED credits, building and site histories, as well as case studies with topics pertaining to sustainable reuse.

Historical Renovation

There are many benefits that come with the reuse of an existing building. According to the Whole Building Design Guide Historic Preservation Subcommittee, keeping existing historical buildings maximizes the use of existing materials and infrastructure, reduces waste, and preserves the historic character of the building (Whole Building Design Guide, 2017). Within the study, The Greenest Building, the National Trust for Historic Preservation states that reusing existing buildings with an average level of energy performance almost always offers environmental savings over demolition and more energy-efficient new construction (National Trust for Historic Preservation, 2011). Pairing the renovation with a rating system such as LEED can add substantial energy savings within a project and allow for even more environmental benefits (Whole Building Design Guide, 2017). Along with the environmental benefits of reusing an existing building, the historical character and significance of the building within the community can also be preserved (Department of Environment and Heritage, 2004).
LEED Credits

There are many different rating systems within LEED v4 that can be used for different project types. The rating system used for this thesis fell under Building Design and Construction (BD+C). Under BD+C, there are “common market sectors to give a tailored experience that recognizes a project’s specialized requirements” (U.S. Green Building Council, 2014a). These sectors include New Construction and Major Renovation, Core and Shell Development, Schools, Retail, Data Centers, Warehouses and Distribution Centers, Hospitality, and Healthcare. This thesis focused on the rating system of Building Design and Construction for New Construction or Major Renovation. This system “addresses design and construction activities for both new buildings and major renovations of existing buildings. This includes major HVAC improvements, significant building envelope modifications, and major interior rehabilitation” (U.S. Green Building Council, 2014a).

The New Construction and Major Renovation rating system “is organized into 6 environmental categories: Location & Transportation, Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, and Indoor Environmental Quality” (U.S. Green Building Council, 2014a, p. 13). Each environmental category rewards credits that encourage development pertaining to that section. The U.S. Green Building Council gives the following definitions to the different credit sections within their Credit Library:

- **Location and Transportation**- rewards thoughtful decisions about building location, with credits that encourage compact development, alternative transportation, and connection with amenities such as restaurants and parks (U.S. Green Building Council, 2018).

- **Sustainable Sites**- focuses on the environment surrounding the building, awarding credits for projects that emphasize the vital relationships among buildings, ecosystems,
and ecosystem services. It focuses on restoring project site elements, integrating the site with local and regional ecosystems, and preserving the biodiversity that natural systems rely on (U.S. Green Building Council, 2018).

- **Water Efficiency**- addresses water holistically, looking at indoor use, outdoor use, specialized uses, and metering. The section is based on an “efficiency first” approach to water conservation (U.S. Green Building Council, 2018).

- **Energy and Atmosphere**- approaches energy from a holistic perspective, addressing energy use reduction, energy-efficient design strategies, and renewable energy sources (U.S. Green Building Council, 2018).

- **Materials and Resources**- focuses on minimizing the embodied energy and other impacts associated with the extraction, processing, transport, maintenance, and disposal of building materials. The requirements are designed to support a life-cycle approach that improves performance and promotes resource efficiency (U.S. Green Building Council, 2018).

- **Indoor Environmental Quality**- rewards decisions made by project teams about indoor air quality and thermal, visual, and acoustic comfort. Green buildings with good indoor environmental quality protect the health and comfort of building occupants (U.S. Green Building Council, 2018).

Regional bonus points and Innovation in Design are additional sections not covered within the other categories. Within each category, there is a combination of prerequisites and credits that can be achieved. Prerequisites are required to receive a LEED certification, but it is optional which credits are used within the project in order to gain certification. There are different point values for each credit within the rating system that are “allocated points based on the relative importance of the building-related impacts that it addresses…” Credits that most directly address...
the most important impacts are given the greatest weight” (U.S. Green Building Council, 2014, p. 14). In order for a project to earn LEED Certification, “the applicant project must satisfy all the prerequisites and qualify for a minimum number of points to attain the established project rating” (U.S. Green Building Council, 2014, p. 16). The project ratings are: LEED Certified with a point range of 40-49 points, LEED Silver with a range between 50-59 points, LEED Gold with a range of 60-79 points, and LEED Platinum with a range of 80 points or higher. Figure 2.0 is a representation of the LEED Project Checklist that will be used throughout this thesis in order to document the credits that are successfully achieved and those that are not.

Figure 2.0: LEED Project Checklist

Site History

During the early 20th century, Chattanooga’s Southside was home to the Terminal Station. The streets surrounding the station included businesses such as grocers, launderers,
doctor’s offices, lawyer’s offices, and more (Golden Ink, 2016). The area continued to expand until the time of World War I and the Great Depression, but by the 1960s, the downtown Chattanooga had a decreasing population and increasing crime which marked the Scenic City as an area to be avoided (Golden Ink, 2016). There were many issues that led to the shift including “an end to America’s century-long love affair with trains…and the move away from an industrial economy” due to the downfall of iron and steel business, as well as the closing of the last coal mine in Chattanooga (Golden Ink, 2016, p.1). However, by 1989, things began to turn around and the next twenty years brought revitalization to the area (Golden Ink, 2016). During the mid-to-late 90s, the Chattanooga River City Company commissioned a study that produced a blueprint for what the location could be someday (CityScope Magazine Editors, 2018). During this study, meetings were held which eventually produced “the South-Central Business District Plan which called for a new football stadium, expansion of the convention center, improved housing, greening of the neighborhood, and commercial development”. In 1996 “construction began on the $28.5 million Finley Stadium…while the Tourism Development Zone funds and new sales tax revenues supported a $117 million bond issue to fund the expansion of the convention center, construction of an environmentally friendly building to house city and country offices, and the construction of the Chattanoogan Hotel”. With the new development brought investors that helped contribute to the cultural preservation of the area (CityScope Magazine Editors, 2018).

Along with the changes being made to the area “came a growing sense of place within the community…the Southside became a poster child for uniquely local values: from the great outdoors, to sustainable design, to regional art, to manufacturing history, and a hub for startups” (CityScope Magazine Editors, 2018, p.3). Development of Southside is still growing, with plans
to expand the housing market and develop more areas surrounding the Chattanooga Choo Choo and the hotel itself (CityScope Magazine Editors, 2018).

**Building History**

In 1905, Southern Railway announced its intention to invest $4 million dollars into the Chattanooga community (Strickland, 2009). After the needed land had been acquired by the railroad and demolition of the surrounding structures had been completed, construction of the new Terminal Station could move forward. On May 10, 1906, the Southern Railway chose the final plans for the station. The architect for the project was Donn Barber, a New York architect that had attended the L’Ecole des Beaux Arts. The design that was eventually used for Terminal Station was a design that Barber created for a design competition while he was still in school. The competition requirements asked the students to design a “railroad terminal suitable to the needs of a large city” (Strickland, 2009, p.19). Barber won the competition, and years later when Samuel Spencer, the President of Southern Railway, was searching for a design for the new station, he happened upon Barber’s prize-winning design. Before construction began, Spencer asked Barber to make one alteration to the original design, and that was to “change the interior to resemble the National Park Bank in New York City (Strickland, 2009)(See Figure 2.1).
There were many groups and contractors that worked on the Terminal Station project. A local contractor named “R.L. Wescott and Company was awarded the demolition contract for the Stanton House and surrounding properties that were acquired by the Southern Railway” (Strickland, 2009, p.19). The contractor for the main edifice was awarded to a New York firm, Wells Brothers Construction Company, supervised by Maj. W. Dunbar Jenkins. (Strickland, 2009). Along with the edifice, the Wells Brothers completed the main terminal, baggage and express building, telegraph office, and more interior spaces (Strickland, 2009). Throughout the project, eleven contractors were needed to complete the work (Strickland, 2009). The original plans contained a second floor that connected the two wings of the station on either side of the large dome, but as construction was carried out, the adjustment was made to only have single-floor wings on either side. The station “was built as two different structures combined. One was the outside brick edifice; the other is the steel superstructure to support the domed ceiling and concourse roof” (Strickland, 2009, p.21).
Building Style Significance: Beaux Arts

The Beaux-Arts style sought to revitalize the classical architecture from ancient Greece and Rome with Renaissance ideas (Craven, 2018). It became a reflection of the wealth that accumulated in the country during the Industrial Revolution when governments and individuals alike sought to create an image of prosperity, culture, and national pride (Harwood, May, Sherman, 2012). The style was most popular in the architecture of state capitols, courthouses, banks, train stations, and more significant city buildings (Jackson, 2015)(See Figures 2.2-2.5).

There are many characteristics and details that help to define the Beaux-Arts style of architecture and interiors that were included in the design of the Chattanooga Choo Choo. Some of those characteristics include, “Symmetrical articulation, lavish surface decoration, a single
grand architectural element set as a grand gesture, coupled columns, facades composed around advancing and receding wall planes, entablatures that advance and recede to mark the locations of columns, a flat roofline, monumental runs of steps approaching a building’s entrance, floor plans that culminate in a single grand room, and axial floor plans that establish vistas through different spaces.” (Fricker & Fricker, 2012, p.4). The selected materials of brick and limestone along with ornamentation helped add to the large proportion and grandiose of the exterior (See Figure 1.1). Interior materials included terrazzo, brass and bronze, and gold leaf (Fricker & Fricker, 2012, p.4-5)(See Figure 2.6). The Chattanooga Choo Choo also contains a large central dome that allows light to enter the space through a decorative glass oculus (See Figure 2.7). Many of these characteristics will be preserved within the design of the Chattanooga Market.

Case Studies

Case Study: Ayres Hall. Ayres Hall is an academic hall and office building located on the campus of the University of Tennessee in Knoxville, Tennessee. The building was constructed in 1919 by a local architecture firm, Barber and McMurry, in the Collegiate Gothic style (Jones, 2012)(See Figure 2.8).
The cost of the project was over $600,000 at the time of construction. The building was named “for Dr. Brown Ayres (1856—1919), the university's president from 1904 to 1919 and former president of Tulane University” (Jones, 2012). Robbie D. Jones describes the building design as:

“Designed with a symmetrical I-shaped floor plan, Ayres Hall features a central, four-story parapet roof pavilion flanked by three-story wings. A muscular square bell tower rises 140-feet above the central section. The building has a steel and reinforced concrete frame, brick load-bearing walls with limestone trim, cut limestone foundation and water table, arched recessed doorways, grouped casement windows, bay windows, parapet walls, buttresses, gargoyles, and copper gutters and downspouts. The gable roofs are covered with red terra-cotta tiles. At the top of the bell tower the brick is set in a checkerboard pattern that became a university icon when it was replicated on the university’s athletic fields” (Jones, 2012).

The building received a LEED Silver certification in 2012 (Jones, 2012).

**Case Study: White Stag Block.** The White Stag Block is a group of buildings located in the city of Portland, Oregon. The block of buildings “is composed of the White Stag Building, the Skidmore building, and the Bickel building” and is located in the Skidmore/Old Town
Historic District, a district that is listed on the National Register of Historic Places (Batten & McIntyre, 2012, p.1)(See Figure 2.9)

The styles of the three buildings include Gothic, Italianate, and Utilitarian architectural styles. The restoration project began in 2006 and was completed in 2008. Like the Chattanooga Choo Choo, “the White Stag Block was the perfect location for a preservation and redevelopment project…as it helped play an important role in the revitalization of this historic district” (Batten & McIntyre, 2012, p.2). Also, similarly to the Choo Choo, the historic styles “presented the challenge of respecting the historic architectural character while also incorporating environmentally sustainable techniques to modernize the buildings. The requirement and limitation of preserving the buildings’ exteriors required that all technical improvements had to be made internally” (University of Oregon, 2008). In 2006, buildings underwent major renovations that were in line with Historic Landmark restrictions (Batten & McIntyre, 2012). Batten describes the buildings as follows:

“The buildings are each five story, timber-framed concrete commercial buildings…At the east façade, the non-historic brick façade was removed to reveal the cast iron work on the ground floor. Each building’s unique character was restored in the redevelopment
process. High ceilings, cast-iron columns, exposed brick walls and paint-stripped wood columns and beams highlight the buildings’ pasts” (Batten & McIntyre, 2012).

The project earned a LEED Silver certification under New Construction and Renovation with a total of 43 points (Batten & McIntyre, 2012).

**Case Study: Sant’ Apollinare Medieval Fortress.** The Sant’ Apollinare Medieval Fortress is an ancient stable located in Perugia, Italy. The historic building is set to be renovated to accommodate an International research center to “support the research around biomass plants and new energy technologies, which are already implemented in the same Abbey construction complex” (Boarin, 2014, p. 1030). The building consists of three floors, and the original stone structure, wood paving, and ceilings are all preserved (Boarin, 2014)(See Figure 2.10-2.11).

The renovation focused on the design of a new high-performance building envelope that was dictated by the Architectural Preservation Office to preserve the building’s historical characteristics. The study also focused on ways to reduce heat absorption with the use of exterior coatings. The building received a LEED Gold certification (Boarin, 2014).
Conclusions

This chapter focused on historic renovation, LEED credits, the existing building and site of the Chattanooga Choo Choo, and case studies of other existing historical buildings. The following chapter explains the methods that were used in order to create the space plan and design for the Chattanooga Market and answer each research question.
Chapter 3: Methodology

Introduction

This chapter documents the methods that were used to answer each research question presented within this thesis as well as develop the design and function of the Chattanooga Market. Items such as surveys, a Historic Structures Report, and LEED credit documentation were created to assist in this exploration. The purpose of this chapter was to gather information regarding the new occupancy and use of the Chattanooga Choo Choo, the current building state of the Chattanooga Choo Choo, the application of adaptive reuse for historic buildings using the LEED: New Construction/Major Renovations rating system, and sustainable solutions from other projects that could be implemented within this thesis project. The following are explanations of how the research questions of this thesis were explored.

Chattanooga Market Project Methods

In order to determine the new occupancy, design, and function of the Chattanooga Choo Choo, many research strategies were used over the course of two semesters. Within the first semester, pre-design research strategies focused on gathering information about how the existing building is used and what occupancies might be lacking in the Chattanooga community. Some of this information was gathered through processes such as interviews, public surveys, field observations, case studies, and literature searches. Programming strategies included creating adjacency matrices, bubble diagrams, spatial analysis, and design concepts in order to develop the space plan of the building. Within the second semester of study, floor plans were developed along with construction documents, specifications, and finish renderings to convey the new design of the Chattanooga Market.
**Research Question 1**

In order to understand the current building state of the Chattanooga Choo Choo, a Historic Structures Report was created. This report was created by reviewing existing literature at the local Chattanooga Library, the University of Tennessee at Chattanooga Library, and using online sources that pertained directly to the history of Chattanooga and the Chattanooga Choo Choo. Field surveys were also conducted to gain information on the surrounding buildings and the current conditions of the building materials. By conducting research in this way, information was gathered including historical significance, building history, building style, site history, and site context. Descriptions of the exterior, descriptions of the interior, and existing conditions of the building were found by making site visits to the Chattanooga Choo Choo and documenting the details of the spaces while there. This research was qualitative rather than quantitative which allowed for more information regarding the current state of the building to be documented.

**Research Question 2**

In order to understand what sustainable solutions from other studies could be implemented within the Chattanooga Choo Choo building while creating the Chattanooga Market, three case studies were analyzed by reading articles and literature that described each building and the sustainable solutions that were implemented in each. Other information was gathered regarding the building type, the new occupancy, the renovation information, the sustainable features implemented, and the LEED certification achieved. After finding sustainable solutions from each case study, those solutions were then analyzed by finding articles and information pertaining to their performance and applicability within certain projects. This research was qualitative rather than quantitative in order to understand what each case study did to implement their sustainable solutions and achieve a LEED Certification for their building.
**Research Question 3**

For this thesis project, the LEED for New Construction and Major Renovation rating system was used to document and explore the credits that could be achieved if placed within the Chattanooga Choo Choo building. This process included assessing each individual credit within the rating system and explaining whether or not the credit could be achieved with the use of figures. If the credit could be achieved, an explanation was given about how to achieve that credit and the earned points were given. If a credit could not be achieved, the explanation states that the credit was unable to be achieved or did not fall under the scope of the project, therefore the project received zero points for that credit. Throughout the documentation, the points earned were recorded within the USGBC’s credit scorecard to show the amounts earned within each section for the entire project. The scorecard also stated the total amount of points earned as well as the final certification earned for the project. Quantitative and qualitative approaches were used to gather specific information regarding the implementation of LEED credits. In addition, a mathematical tool was used to derive the final total of credits earned.

**Conclusion**

This section explained the methodology behind addressing each research question regarding the adaptive reuse of The Chattanooga Choo Choo. Creating and researching items such as an existing Historic Structures Report, LEED credit documentation, and case studies helped in the process of generating the information needed to inform the rest of this thesis. The following chapter reports the findings of this research.
Chapter 4: Findings

Introduction

The purpose of this thesis is to document a hypothetical, sustainable, adaptive reuse of the Chattanooga Choo Choo into the Chattanooga Market using the LEED v4 rating system within the scope of interiors. Within this section, findings regarding the current state of the Chattanooga Choo Choo and its surrounding site were documented. The major design decisions of each individual LEED credit within the LEED v4: New Construction/Major Renovation rating system were also documented, and the results explained (See Appendix A for more details). And lastly, applicable sustainable solutions from case studies were explained and documented.

Chattanooga Market Design

Through the process of programming, schematic design, and design development, a final design for the Chattanooga Market was created. The building now includes spaces for permanent and temporary vendor spaces that sell produce, food, crafts, and more local merchandise. The figures below show the new floor plans of the Chattanooga Market (See Figure 4.0-4.1).

![Figure 4.0: Level 1 Floor Plan](image-url)
The dome space accommodates permanent vendor stalls and temporary vendor tables. The design characteristics of this space remain the same as existing with restored features such as the terrazzo flooring and walls. A new mezzanine was added to expand the art gallery space from the adjacent wing (See Figure 4.2).
Within the adjacent building wing, new permanent vendor stalls were added along with a new hotel lobby and hotel employee offices on the bottom floor. On the upper floor, the majority of space is dedicated to storage for the entire building as well as art gallery space. This section also accommodates public restrooms, a mechanical room, and office space for gallery and event coordinators. This space is portrayed in the rendering below (See Figure 4.3).

![Market Wing Rendering](image)

Figure 4.3: Market Wing Rendering

Within the food wing of the building, permanent food stalls were added along with dining and lounge seating (See Figure 4.4). These stalls will be occupied by local restaurants, bakeries, and cafes that will sell already-made goods to Market customers. The floor-to-ceiling windows bring light into the space and allow for a view of the exterior courtyard.
Research Question 1

Site Context. According to the 1914 plat map (See Figure 4.5) the Chattanooga Terminal Station was located at 1434 Market Street, Chattanooga. The plat map also gives information about the surrounding properties. Today, the Chattanooga Choo Choo still resides on the same property, but the surrounding area has changed drastically over the past century.
A survey of the neighborhood revealed that the buildings directly across the street from the Choo Choo include the St. George Hotel, Chattanooga Whiskey Experimental Distillery, The Hot Chocolatier, Wildflower Tea Shop and Apothecary, and Teeter Law Office. To the right of the hotel property is the South Shuttle Station for the city of Chattanooga that doubles as a parking structure. To the left of the hotel property sits the Terminal Brew House restaurant and Gallery 1401 (See Figure 4.6). Within the Chattanooga Choo Choo’s property, there are many new businesses. These include The Frothy Monkey, Stir, Sweetly Southern, Comedy Catch at the Choo Choo, The Revelry Room, Regan’s Place, and Backstage Bar. The area of Chattanooga has been under development in recent years, which has brought lots of new restaurants, art galleries, and venues to the area.

![Figure 4.6: 2019 Area Map](http://googlemaps.com/chattanooga-choo-choo/)
**Descriptions of Exterior.** The front exterior of the Chattanooga Choo Choo was designed in the Beaux-Arts style (See Figure 4.7). It is built of red brick and red and white limestone. From floor to ceiling of the exterior, there are six arched windows flanking either side of the central entrance.

![Figure 4.7: Chattanooga Choo Choo Exterior](image1)

Retrieved from *Chattanooga Choo Choo, River City Company, 2018, downtownchattanooga.org*

These windows are framed with wood that create two arches with divided panes within each arch (See Figure 4.8). These windows also extend along the side of the two building wings with three windows each. When it was first constructed, the wings also contained these windows along the back portion of the exterior, but they have since been removed to accommodate shop spaces. Today they are outlined with black painted steel, red and brown brick, and white painted wood (See Figure 4.9).

![Figure 4.8: Exterior Windows](image2)

![Figure 4.9: Exterior of Building](image3)
The main entrance also contains two white side doors that flank either side. The front doors are white painted wood with inset glass panels and gold detailing. Surrounding the doors is white painted wood detailing (See Figure 4.10). As your eyes move up the front exterior, you see a large black and red awning that was added for valet services (See Figure 4.11). The large brick arch, once the largest in the world, encompasses a traditional fan light with multiple panes divided by wood mullions. The cornice of the building has dentil detailing created from white limestone.

**Descriptions of Interior.** The interior of the dome room retains a fair amount of the original historic detailing that has been preserved over the course of the building’s lifetime. The flooring is a brown and clay-red terrazzo that encompasses the entire area of the interior (See Figure 4.12). The interior walls are painted white and surrounded by a series of complex wooden moldings that are painted a darker shade of beige (See Figure 4.13). At the entrance to the lobby, there is a small decompression area with a lower, slightly barrel-vaulted plaster ceiling (See Figure 4.14). The area surrounding it has white painted walls with beige accents. There are also three antique glass and bronze chandeliers that are original to the building (See Figure 4.14). As
you move into the domed space, there is a modern wooden front desk with a glass awning that is currently used as the hotel check-in and information desk.

![Image](image1.png)

Figure 4.12: Existing Terrazzo

![Image](image2.png)

Figure 4.13: Wood Molding

![Image](image3.png)

Figure 4.14: Decompression Area

The interior space of the dome room consists of many different materials and details. The steel structure that supports the dome can be seen throughout the space. It contains rivet details and is painted the same beige hue as the surrounding walls. There are large windows with painted wooden framing on the entrance and exit sides of the dome room. Along the walls there are rounded arches that mimic the shape and size of the steel arches. These have a painted diamond detail (See Figure 4.15). The ceiling of the dome room is historically iconic and very detailed. There are dark beige painted details that resemble a coffered ceiling that arch up to meet the central glass skylight at the peak of the dome. Surrounding the glass is a ring of lights
which are surrounded by a ring of gilded rosettes. The glass skylight itself is constructed of a composition of frosted yellow glass within a steel frame. (See Figure 4.16).

**Condition of Fabric.** The condition of the exterior of the Chattanooga Choo Choo is in good shape compared to the interior. The exterior was constructed of brick and stone with painted wood arched windows and wooden doors along the front of the building. Today, the brick and limestone are still in good condition (See Figure 4.17). They have been maintained and kept clean over the course of the building’s lifetime. The window and door
surrounds have been repainted over time, but the wood remains in good condition (See Figure 4.18). The back of the building was originally constructed to house train platforms and 14 rail lines. Three sets of platform tracks that were no longer being used for passenger cars were transformed into the formal gardens. The back-terminal building wing that is adjacent to the large dome room is under construction to accommodate new shops and restaurants (See Figure 4.19). The platform tracks remain intact, but the wooden platform awnings are chipped and cracked in many places. There are also many sections of the concrete platform that are cracked and need to be replaced.

While the exterior of the Chattanooga Choo Choo is in relatively good shape, there are many problems within the interior. The lobby of the Choo Choo, once used as the central terminal entrance, has many cosmetic issues. This space has undergone a few changes since its creation including multiple occupancies. For example, at one time a dropped ceiling was installed, only to be later removed (Strickland, 2009). This space has also been cleaned up and restored following the change into a hotel. Some of the changes were simply cosmetic, including the repainting of the entire interior and laying a new terrazzo flooring throughout the space. Today, problems with the space include many cracks in the terrazzo flooring. The walls of the interior dome have issues including water stains and bubbling paint that could be caused by water damage from a leaking roof (See Figure 4.20-4.21). The paint on the interior walls is also chipped in many places. All of this information gathered through field surveys helped to inform the final design of the Chattanooga Market through the documentation of existing characteristics and areas in need of repair.
Research Question 2

Case Study: Ayres Hall Results. Ayres Hall was restored from 2008-2010, becoming the first building on UTK’s campus to become LEED Certified. Many design features that were not previously implemented during the original construction of the building were finally added during this time, including “terrazzo floors and benches, four clock faces, and an exterior plaza along the north elevation. The project also installed modern mechanical systems and new energy-efficient windows, refurbished classroom furnishings, and restored the original hardwood and marble floors” (Jones, 2012). Solutions from this case study that were implemented into the design of the Chattanooga Market include new energy efficient windows, restored terrazzo flooring, and restored existing wood trim around windows and doors. Within the Chattanooga Choo Choo wing, existing windows within the building wing were replaced with high-efficiency, NFRC rated and certified NanaWall folding glass walls as shown in (See Figure 4.23). The doors meet the 2015 Energy Star Qualification Criteria for thermal performance. Figure 4.24 depicts a rendering of their placement within the building wing.
The Dome room of the Chattanooga Choo Choo currently contains terrazzo flooring. Like Ayres Hall, the terrazzo flooring would be restored using an epoxy-resin and color matching agent that matches the existing flooring. The grid pattern of concrete that divides the existing terrazzo flooring would be stripped, stained with a dark gray color agent, sanded and resealed. Figure 4.25 shows the existing terrazzo and Figure 4.26 is a rendering depicting the coloring of the flooring after restoration.
The Chattanooga Choo Choo has many existing windows and doors that would be repainted with Sherwin Williams — Cotton White paint and restored to match the original style. The large windows within the dome section would be painted with Sherwin Williams — Urbane Bronze paint. These colors were selected because they resemble the neutral color palettes often used within Beaux-Arts interiors. Figures 4.27-4.28 are examples of the existing windows and trim and Figures 4.29-4.30 include an existing image of the dome space and a rendering depicting the repainted window within the dome space.

Figure 4.27: Window

Figure 4.28: Trim

Figure 4.29: Existing Dome Space

Figure 4.30: Rendering Depiction
Case Study: White Stag Block Results. The White Stag Blocks project was an adaptive reuse project that led to the accumulation of a LEED Silver certification while maintaining historic preservation requirements. This project “emphasized five key areas of sustainability in the renovation: sustainable site development; water savings; energy efficiency; materials selection; and indoor environmental quality…Points were achieved by earning all water efficiency points, increasing energy performance, diverting 98% of construction waste from landfills, increasing recycled content from 10% to 20%, and buying Green power” (Batten & McIntyre, 2012). Some techniques that the White Stag Block incorporated that were also implemented into the design of The Chattanooga Market include bike facilities and showers, the use of low-flow toilets, and reusing 98% of the original materials (Batten & McIntyre, 2012).

Figure 4.33 shown later in the project shows the location of the new shower facilities. The following figures 4.31-4.32 document the existing building walls that were reused within the project. A specification for the low-flow toilets used within the project can be found in Appendix A.

Figure 4.31: Existing Walls
Case Study: Sant’ Apollinare Medieval Fortress Results. The Sant’ Apollonare Medieval Fortress study focused on ways to decrease the heat island phenomena by incorporating reflective coatings that could be applied to a historic building exterior, as well as the surrounding paving materials, in order to increase their albedo (Becherini, F., Lucchi, E., Gandini, A., Casado Barrasa, M., Troi, A., Roberti, F., Bernardi, A., 2018). The coatings that were used are described:

“Coating 1: A silica film synthesized via sol-gel methodology, using silica alkoxide precursors and Indium tin oxide nanoparticles. After dissolution in alcohol, these precursors hydrolyse to form silanols” (Becherini, et al., 2018, p. 3). Coating 2: A water-based solution and/or ethanol solution incorporating ITO in various granularities, with the
addition of SiO2 and TiO2 in different concentrations and proportions” (Becherini, et al., 2018, p. 4).

A primer that is acceptable when restoring heritage structures was applied along with two layers of the coatings (Becherini, et al., 2018). The results of a full-scale brick wall mock-up showed significant reduction in heat flow compared to the brick material without the coatings (Becherini, et al., 2018).

This case study documents the incorporation of exterior coatings that can be applied to a buildings structure and surrounding paved areas to decrease heat absorption. This technique can be applicable within historic building projects attempting to earn LEED credits. Within this thesis project, the application of coatings to the exterior brick edifice of the Chattanooga Choo Choo as well as the surrounding concrete paved areas would be suggested to decrease heat absorption around the building.

Research Question 3

LEED Credits. The LEED documentation for this project demonstrates that the project could achieve a certification level of LEED Certified with a total of accumulated points equaling 42 points in the overall documentation. Each individual credit along with its full explanation and application to this thesis project can be found within Appendix A. These credits were looked at from an interiors scope. Within a real LEED project, integration would exist between other design professionals including engineers, architects, and more to cover the scope of each credit within the rating system. For this thesis, credits that did not pertain to the interiors were marked as unachievable. Each credit category governed specific design solutions that were implemented into the project. Within the Location and Transportation credit section, 13 credits were achieved that pertained to the building site and surrounding area. These credits can be found in Figure
4.32. The LEED for Neighborhood Development Location credit would require integration between other design professionals to achieve completion, therefore it is not within the scope of this thesis project.

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Figure 4.32: LT Credits

In order to achieve the Bicycle Facilities credit, a shower room was incorporated into the renovation of the Chattanooga Choo Choo along with the addition of 28 bike storage locations as shown in the Figures 4.33-4.34 below.

Figure 4.33: Shower Room
Within the Sustainable Sites credit category, 6 project credits were achieved regarding the site and heat island reduction. These specific credits can be found in Figure 4.35. For example, in order to achieve the SS Credit: Site Development — Protect or Restore Habitat, 40% of the existing greenfield area on the project site will be preserved from all development. Figure 4.36 below shows the locations in which native trees will be planted on the site to preserve these spaces.
Heat island reduction is another credit that affected the final design of the project. A new roofing system using Berridge Double-Rib Panels on the roof along with the incorporation of solar panels on top of the exterior pavilions helped to achieve this credit. Figure 4.37 depicts the locations of the nonroof measures. Solar coverage, and the locations of the new roofing system.
For the Water Efficiency credit category, 2 points were earned regarding water use reduction and water metering. These credits can be found in Figure 4.38. WaterSense plumbing fixtures were specified to meet the Indoor Water Use Reduction prerequisite and credit. The fixture specifications can be found within the Appendix A.

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Energy and Atmosphere credits did not directly affect the building design of the Chattanooga Market, however, 6 points were received for the Enhanced Commissioning,
Demand Response Enhanced Refrigerant Management, and Green Power and Carbon Offsets credits as shown in Figure 4.39.

In the Materials and Resources credit category, 6 credits were achieved as shown in Figure 4.40. For example, in order to achieve the Storage and Collection of Recyclables Prerequisite, designated areas for the collection of mixed paper, corrugated cardboard, glass, plastics, metals, batteries, and electronic waste were specified on the project floor plans as shown in Figures 4.41-4.42.
In order to achieve the Life Cycle Impact Reduction credit, 86% of the existing project area was reused. Furthermore, building products were specified that had Environmental Product Declarations and publicly released reports from their raw material suppliers to achieve the Building Product Disclosure and Optimization credits.

Within the Indoor Environmental Quality credit section, 6 credits were achieved with the incorporation of walk-off mats at all main building entrances (Figures 4.43-4.45), and the incorporation of thermal and lighting control systems within the building. Locations of these control systems can be found within Appendix A.

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Figure 4.41: Recycling Locations

Figure 4.42: Recycling Locations

Figure 4.43: EQ Credits
Three Regional Priority credits were achieved in the following areas: Renewable Energy Production, Surrounding Density and Diverse Uses, Access to Quality Transit, Bicycle Facilities, Rainwater Management, and Outdoor water use. Because this thesis achieved the required credit threshold for Surrounding Density, Access to Quality Transit, and Bicycle Facilities the project was awarded points as illustrated in Figure 4.46.

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Figure 4.46: RP Credits

Overall, the hypothetical project received 42 credit points within the LEED documentation. By achieving this point threshold, the proposed project would receive a LEED Certified building certification. Figure 4.47 represents the project checklist that documents the exact amount of points received for each individual credit.
Conclusions

This section explains the findings related to the current state of the building, LEED documentation, as well as the case studies and how solutions from this research were implemented within the project. Findings regarding the current state of the building, the LEED credits that would be attainable, and the solutions from other similar case studies help to generate information needed to inform the design of the Chattanooga Market.
Chapter 5: Discussion and Conclusions

Introduction

The findings of this thesis presented many solutions for the sustainable adaptive reuse of The Chattanooga Choo Choo into The Chattanooga Market. Within this chapter, the applications of research along with the LEED credits and historical preservation are discussed. Recommendations for practice integration and future historical building projects are also documented.

Discussion

Application of Research. The approach to answering the research questions of this thesis included documenting a hypothetical situation in which sustainable practices could be implemented to earn LEED credits. This method was used because it allowed for the individual analysis of every LEED credit and its potential application within the project. However, because the scope of this thesis focused only on interior applications, some solutions were limited. This project is hypothetical and not all LEED credits could be fully achieved or fell within the scope of the project, so discretion is advised when viewing the results. The interiors scope of the project also limited which LEED credits were achievable due to the required integration between other design professionals such as engineers and architects. Along with the LEED credits, the solutions from case studies were hypothetically incorporated and should be viewed as possible successful solutions for the project. This research included analysis of existing case study projects which allowed exploration of possible design solutions. This approach was successful by showing that The Chattanooga Choo Choo could be restored successfully and sustainably. It acts as an example for restoring more historic properties in the same way. It is possible to achieve a high level of sustainability for an existing historical building while still maintaining the
historical design and significance of the building as shown by the achievement of 42 credits through the LEED v4 rating system.

**Historical Accuracy v. LEED Credits.** When documenting a LEED certification for the building, there were instances in which preservation techniques to preserve historical accuracy inhibited the ability to earn certain sustainability credits under the LEED v4 rating system. For example, when trying to achieve Materials and Resources Credit: Building Product Disclosure and Optimization — Material Ingredients, the selection of certain finishes was inhibited by their compliance with the historical character of the building and therefore could not be used within the project. Other LEED credits such as Environmental Quality Credit: Enhanced Indoor Air Quality Strategies and Environmental Quality Credit: Thermal Comfort were achieved by implementing the requirements of the credit within the portions of the building that were not listed on the National Register of Historic Places. The majority of credits were achieved by utilizing the location of the building and its surrounding density, maintaining a large percentage of the existing structure, and the incorporation of equipment that met the LEED standard. Regardless of the limitations presented by preservation, the project was still able to achieve a LEED certification.

**Conclusions**

This thesis explored how to make an existing building, The Chattanooga Choo Choo, more environmentally sustainable when adapting it to become the Chattanooga Market using the LEED v4 rating system. Through the process of completing this thesis, many obstacles were presented through the integration of preservation and sustainability as previously mentioned in
the discussion. These obstacles affected how the reuse of the building could be carried out and informed recommendations for future integration and educational possibilities.

Recommendation for Greater Integration Between Preservation and Sustainability.

While researching for this thesis, many issues between the practices of preservation and sustainability came to light. When renovating an existing building, if preservation and sustainability are considered at all, there are often groups that will only focus on one practice or the other regarding implementation in the project. It is difficult enough to push preservation or sustainability separately when reusing a building because each is often seen as more time consuming and costlier than a basic renovation. Combining the two practices is assumed to be even more costly and time consuming. This can become an issue, especially when you are attempting to reuse a historically significant building, because one practice often takes precedence over the other and they are rarely combined. However, this decision is not base-less. Throughout this thesis specifically, many issues arose regarding the limitations that the practice of preservation had on the ability to achieve certain LEED credits. It is certainly more difficult to preserve a building when you are also trying to make it more sustainable and vice versa. However, a solution to these conflicts could be found with a higher integration of the groups that are pushing for the practices. If integration existed between the groups pushing for sustainability and preservation, then solutions for the combination of the two may finally be found. These practices have been separated for so long, but the benefits of each practice could increase exponentially if combined and lead to better overall sustainable results for building projects. Buildings can become more sustainable, historical characteristics can be preserved, and the community that uses the building can reap the benefits of both. This thesis recommends that education of each practice and integration of the groups that are promoting them be increased so
that solutions for the incorporation of both can be found and more easily incorporated into new projects.

**Recommendation for Using Historical Buildings as Educational Examples of Sustainability.** The Chattanooga Choo Choo is a historically significant and well-known building within the Chattanooga community. Because of its level of exposure, the sustainable reuse of the building would be better known than if it were a lesser-known building. Showing the community that a building of this significance can be preserved to retain its historical character while also becoming more environmentally sustainable can act as a tool to spread awareness about the importance of these practices. This is not just an opportunity within the city of Chattanooga. The Chattanooga Choo Choo is just one of thousands of historically significant buildings all over the country. These buildings are so well known within their communities that people would recognize improvements that are made. If sustainability is incorporated along with these improvements, it can increase public education on how the improvement of existing buildings can contribute to the welfare of our environment. Education on this topic could also be incorporated into design features within the buildings. Solutions can be as simple as discussion boards within the newly reused building explaining what was accomplished sustainably by using this historic building. Sustainability practices within building design and construction can have such a significant impact on the environment, and it is important for people to understand. The hope is that education on a topic such as sustainability can lead to increased awareness and implementation of that practice. More historic buildings should take advantage of their level of exposure and use it as an opportunity to promote sustainable education.
This thesis explored how to make an existing building, The Chattanooga Choo Choo, more environmentally sustainable when adapting it to become The Chattanooga Market using the LEED v4 rating system. Considering the information gathered regarding sustainability and LEED incorporation within adaptive reuse projects, it is regarded as a positive practice that can have major environmental benefits. Choosing to renovate the Chattanooga Choo Choo rather than demolish and rebuild is a decision that can not only help to preserve the historical significance of the building within the community, but it can also help to decrease negative environmental effects on the surrounding environment. By showing that The Chattanooga Choo Choo could be restored in a sustainable way, it acts as an example for restoring more historic properties. It is possible to achieve a high level of sustainability for an existing historical building while still maintaining the historical design and significance of the building as shown through the achievement of LEED Certified certification for this project.
References


Appendix A

LEED Findings

1. LOCATION AND TRANSPORTATION (LT)

- LT CREDIT: SENSITIVE LAND PROTECTION

  **Intent**
  To avoid the development of environmentally sensitive lands and reduce the environmental impact from the location of a building on a site.

  **Requirements**
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
  Option 1.
  Locate the development footprint on land that has been *previously developed*.

  **Explanation:**
  This project is an adaptive reuse of an existing building. All construction for the project will take place on the interior of the existing building and no further land will be developed.

  **Total Points Earned:** 1

- LT CREDIT: HIGH-PRIORITY SITE

  **Intent**
  To encourage project location in areas with development constraints and promote the health of the surrounding area.

  **Requirements**
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
  Option 2. Priority Designation (1 point BD&C except Core and Shell, 2 points Core and Shell)

  **Explanation:**
  This project is located in Chattanooga’s Southside, an area that is located on the EPA’s National Priorities List for Lead Contamination. The documentation for this designation is located in the following figure.
LT CREDIT: SURROUNDING DENSITY AND DIVERSE USES

**Intent**
To conserve land and protect farmland and wildlife habitat by encouraging development in areas with existing infrastructure. To promote walkability, and transportation efficiency and reduce vehicle distance traveled. To improve public health by encouraging daily physical activity.

**Requirements**
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, HOSPITALITY

**Option 1. Surrounding Density (2–3 points BD&C except Core and Shell, 2-4 points Core and Shell)**
Locate on a site whose surrounding existing density within a ¼-mile (400-meter) radius of the project boundary meets the values in Table 1. Use either the “separate residential and nonresidential densities” or the “combined density” values.

**Option 2. Construct or renovate a building or a space within a building such that the building’s main entrance is within a ¼-mile (800-meter) walking distance of the main entrance of four to seven (1 point) or eight or more (2 points) existing and publicly available diverse uses (listed in Appendix 1).**

**Explanation:**
Option 1
Within a quarter-mile radius of the entrance to the Chattanooga Choo Choo, the surrounding density using the separate non-residential density was equal to .504, earning 2 points. The image below shows the buildings along with their square footages within the radius that were used to calculate the density for the area.

Option 2
Within a half-mile radius of the entrance to the Chattanooga Choo Choo, there are 6 different diverse uses. These uses include the following:

*Civic and Community Facilities:* (1) Chattanooga Fire Station 1 & (2) Battle Academy for Teaching/Learning (these location are outlined in bright blue on the map)
*Services:* (3) Alleia & (4) Stir Restaurants (these locations are outlined in yellow on the map)
*Community-Serving Retail:* (5) Sports Collectibles & (6) Scout Boutique (these locations are outlined in bright green on the map)
Points Earned: 3

- LT CREDIT: ACCESS TO QUALITY TRANSIT

Intent
To encourage development in locations shown to have multimodal transportation choices or otherwise reduced motor vehicle use, thereby reducing greenhouse gas emissions, air pollution, and other environmental and public health harms associated with motor vehicle use.

Requirements
NC, CS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, RETAIL
### Route 28 - Annicolia Highway

**Service Dates:** Begins on the dates specified below, unless otherwise indicated.

**Departure Times:**
- **Monday-Friday:** 6:30 AM - 8:30 PM
- **Saturday:** 6:30 AM - 8:30 PM
- **Sunday:** 6:30 AM - 8:30 PM

**Route Map:**
- The route map illustrates the stops and directions for each leg of the journey.

**Legend:**
- Red line: Route number 28
- Blue line: Route number 6
- Green line: Route number 8

**Important Notes:**
- **Breaks:** There are breaks in service on selected days.
- **Holiday Service:** Service may be extended on certain holidays.

### Route 1 - Alton Park

**Service Dates:** Please refer to the map on page 14.

**Saturday Service:**
- 5:30 AM - 12:40 AM

**Outbound from Downtown / Saliendo del Centro**

<table>
<thead>
<tr>
<th>Time</th>
<th>Stop 1</th>
<th>Stop 2</th>
<th>Stop 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-5:30</td>
<td>5:40</td>
<td>5:55</td>
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<td>G-6:50</td>
<td>7:20</td>
<td>7:35</td>
<td>7:50</td>
</tr>
</tbody>
</table>

**Inbound to Downtown / De ida hacia el Centro**

<table>
<thead>
<tr>
<th>Time</th>
<th>Stop 1</th>
<th>Stop 2</th>
<th>Stop 3</th>
</tr>
</thead>
<tbody>
<tr>
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<td>6:15</td>
<td>6:25</td>
<td>6:45</td>
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<td>8:15</td>
<td>8:30</td>
<td>8:45</td>
</tr>
</tbody>
</table>

Please visit www.gocarta.org for more information.
### Route 1
#### Alton Park

**SUNDAY / DOMINGO** • 8:50 AM – 9:15 PM

<table>
<thead>
<tr>
<th>Outbound from Downtown / Saliendo del Centro</th>
<th>Inbound to Downtown / De ida hacia el Centro</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bus Goes</strong></td>
<td><strong>Bus Goes</strong></td>
</tr>
<tr>
<td>6 to 6:30 PM</td>
<td>5:55</td>
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<tr>
<td>7</td>
<td>6:05</td>
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<tr>
<td>8</td>
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<td>7:25</td>
</tr>
<tr>
<td>16</td>
<td>7:35</td>
</tr>
</tbody>
</table>

- Indicates when the bus leaves or arrives at the CARTA Garage. See To/From Garage routing on map. / Indica cuando el bus sale o llega al garaje de CARTA. Ver en el mapa la ruta de servicio Desde/Hacia Garage.
- Indicates trips where buses line up on Market Street for ease in transferring to other routes. / Indica viajes donde los buses forman una línea en Market Street para facilitar el trasbordo hacia otras rutas.

### Route 16
#### Northgate

**SUNDAY / DOMINGO** • 8:05 AM – 9:00 PM

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<th>Inbound to Downtown / De ida hacia el Centro</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bus Goes</strong></td>
<td><strong>Bus Goes</strong></td>
</tr>
<tr>
<td>6:45</td>
<td>9:05</td>
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<td>8</td>
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<td>9:50</td>
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<tr>
<td>16</td>
<td>9:55</td>
</tr>
</tbody>
</table>

- Indicates when the bus leaves or arrives at the CARTA Garage. See To/From Garage routing on map. / Indica cuando el bus sale o llega al garaje de CARTA. Ver en el mapa la ruta de servicio Desde/Hacia Garage.
- Indicates trips where buses line up on Market Street for ease in transferring to other routes. / Indica viajes donde los buses forman una línea en Market Street para facilitar el trasbordo hacia otras rutas.

---

**Note:** All times are approximate and subject to change. Please refer to the current schedule for the most accurate information.
**Explanation**
Weekday Daily Trips: 400+
Weekend Trips: 270+

**Points Earned:** 5

- LT CREDIT: BICYCLE FACILITIES

**Intent**
To promote bicycling and transportation efficiency and reduce vehicle distance traveled. To improve public health by encouraging utilitarian and recreational physical activity.

**Requirements**
NC, CS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY

**Explanation:**
The bike storage is located approximately .1 miles from Carta Shuttle Park South, a rapid transit bus stop.

Bike Storage Calculations:
Total Occupancy: 1,101
Regular Building Occupants: $5 + \text{vendors (x .05)} = 5 + 32(.05) = 6.6 = 7$
Peak Visitors: Market visitors (x .025) = 1101 x .025 = 27.5 = 28

Shower Room Calculation:
Because there are approximately 7 regular building occupants, there needs to be one shower room on site.

Points Earned: 1

- LT CREDIT: REDUCED PARKING FOOTPRINT

**Intent**
To minimize the environmental harms associated with parking facilities, including automobile dependence, land consumption, and rainwater runoff.

**Requirements**
NC, CS, RETAIL, SCHOOLS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

**Explanation**
This project will not be proving parking directly controlled by the project. All parking will be street parking or parking provided at locations outside of the project boundary.
Points Earned: 1

- LT CREDIT: GREEN VEHICLES

  **Intent**
  To reduce pollution by promoting alternatives to conventionally fueled automobiles.

  **Requirements**
  NC, CS, DATA CENTERS, HOSPITALITY. RETAIL, HEALTHCARE

  **Explanation:**
  5% of all parking spaces used by the project are designated preferred parking for green vehicles with a minimum green score of 45 on the American Council for an Energy Efficient Economy annual vehicle rating.

  *Electrical vehicle supply equipment (EVSE)* has been installed in 2% of all parking spaces used by the project.
  The EVSE:
  - Provides a Level 2 charging capacity (208 – 240 volts) or greater.
  - Complies with the relevant regional or local standard for electrical connectors, such as SAE Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler or IEC 62196 of the International Electrotechnical Commission for projects outside the U.S.
  - Is networked or internet addressable and is capable of participating in a demand-response program or time-of-use pricing to encourage off-peak charging.

  Points Earned: 1

2. SUSTAINABLE SITES (SS)

- SS PREREQUISITE: CONSTRUCTION ACTIVITY POLLUTION PREVENTION

  **Intent**
  To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust.

  **Requirements**
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

  **Explanation:**
  The project implements an erosion and sedimentation control plan for all construction activities associated with the project. The plan conforms to the erosion and sedimentation
requirements of the 2012 U.S. Environmental Protection Agency (EPA) Construction General Permit (CGP).

- **SS CREDIT: SITE ASSESSMENT**

  **Intent**
  To assess site conditions before design to evaluate sustainable options and inform related decisions about site design.

  **Requirements**
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

  Complete and document a site survey or assessment1 that includes the following information:
  - _Topography_. Contour mapping, unique topographic features, slope stability risks.
  - _Hydrology_. Flood hazard areas, delineated wetlands, lakes, streams, shorelines, rainwater collection and reuse opportunities, TR-55 initial water storage capacity of the site (or local equivalent for projects outside the U.S.).
  - _Climate_. Solar exposure, heat island effect potential, seasonal sun angles, prevailing winds, monthly precipitation and temperature ranges.
  - _Vegetation_. Primary vegetation types, greenfield area, significant tree mapping, threatened or endangered species, unique habitat, invasive plant species.
  - _Soils_. Natural Resources Conservation Service soils delineation, U.S. Department of Agriculture prime farmland, healthy soils, previous development, disturbed soils (local equivalent standards may be used for projects outside the U.S.).
  - _Human use_. Views, adjacent transportation infrastructure, adjacent properties, construction materials with existing recycle or reuse potential.
  - _Human health effects_. Proximity of vulnerable populations, adjacent physical activity opportunities, proximity to major sources of air pollution.

  **Explanation:**
  Because this is not a real project, I am unable to complete this credit. However, if the project were to be real, this credit would be accomplished.

  **Points Earned:** 1

- **SS CREDIT: SITE DEVELOPMENT – PROTECT OR RESTORE HABITAT**

  **Intent**
  To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

  **Requirements**
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
Explanation:
40% of the existing greenfield area on the site will be preserved from all development and construction as shown in the figure below highlighted in green.

Option 1: 30% of all portions of the site identified as previously disturbed will be restored. Because the density of the project has a floor-area ratio of less than 1.5, the restored area also includes a green roof. See the below figure for the previously disturbed areas in red and the restored areas in purple.

39% of previously disturbed land was restored.
Points Earned: 2
SS CREDIT: OPEN SPACE

**Intent**
To create exterior open space that encourages interaction with the environment, social interaction, passive recreation, and physical activities.

**Requirements**
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

**Explanation:**
Outdoor space is provided that is greater than 30% of the total site area. A minimum of 25% of that area is vegetated. Refer to figure below for outdoor area percentage highlighted in orange and the secondary figure for designation of vegetative area.
Points Earned: 1

- SS CREDIT: RAINWATER MANAGEMENT

**Intent**
To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.

**Requirements**
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

**Option 1. Percentile of Rainfall Events**
**Path 1. 95th Percentile (2 points except Healthcare, 1 point Healthcare)**
In a manner best replicating natural site hydrology processes, manage on site the runoff from the developed site for the 95th percentile of regional or local rainfall events using low-impact development (LID) and green infrastructure.
Use daily rainfall data and the methodology in the U.S. Environmental Protection Agency (EPA) Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act to determine the 95th percentile amount.
OR
**Path 2. 98th Percentile (3 points except Healthcare, 2 points Healthcare)**
Achieve Path 1 but for the 98th percentile of regional or local rainfall events, using LID and green infrastructure.

**Explanation:**
Credit does not fall within scope of project. Unable to complete.

**Points Earned:** 0

- **SS CREDIT: HEAT ISLAND REDUCTION**

  **Intent**
  To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.

  **Requirements**
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

  **Explanation**
  Refer to image below for area designation of roofing materials, square footage, and calculations.

  The entire roofing system of the Chattanooga Market has a roof with an SRI value of 82 initially and 64 after 3 years. For non-roof measures, solar panels were attached to the exterior pavilions providing shade as well as creating energy. Trees were also planted in the exterior pavilion space creating shade. Specifications are attached for the roofing material as well as the solar panels.
Area of Non-roof Measures: 38,462 sq. ft
Area of High-Reflectance Roof: 31,723 sq. ft
Total Roof Area: 33,007 sq. ft
Total Site Paving Area: 81,795 sq. ft

\[
\frac{38,462 \text{ sq. ft}}{.5} + \frac{31,723 \text{ sq. ft}}{.75} \geq 81,795 \text{ sq. ft} + 33,007 \text{ sq. ft}
\]

\[
119,221 \text{ sq. ft} \geq 114,802 \text{ sq. ft}
\]
## Equipment Specification
### Solar Panels

**Project:** Boutique Hotel  
**Location:** Portland Oregon  
**Date:** 11/15/18  
**Revision:** 3  
**Prepared by:** ARD

**Vendor/Manufacturer:** Kohler

**Item/Stock Number:** K-5244-ET-0

**Item/Collection Name:** Renusol CS60 Ballast Mount  
**15° Tilt Angle**

**Description:** 100% recycled HMWPE (high molecular weight polyethylene) ballasted flat roof system compatible with optional roof anchoring.

**Dimensions:** 1020mm W x 1685mm L

**Orientation:** Landscape

**Weight:** 19 lbs.

**Ballast Size:** 4” x 8” x 16”

---

**Notes/Instructions:**
1. On-Site Training Upon Request
2. 25 year warranty

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Cost per Unit: TBD</th>
<th>Total Cost: TBD</th>
</tr>
</thead>
</table>
**SS CREDIT: LIGHT POLLUTION REDUCTION**

**Intent**
To increase night sky access, improve nighttime visibility, and reduce the consequences of development for wildlife and people.

**Requirements**
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

**Explanation**
Exterior lighting does not fall under the scope of this project, therefore the credit could not be completed.

Points Earned: 0

3. WATER EFFICIENCY (WE)

- WE PREREQUISITE: OUTDOOR WATER USE REDUCTION REQUIRED

  **Intent**
  To reduce outdoor water consumption.

  **Requirements**
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

  **Explanation**
  Option 1: The landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

- WE PREREQUISITE: INDOOR WATER USE REDUCTION REQUIRED

  **Intent**
  To reduce indoor water consumption.

  **Requirements**
  NC, CS, SCHOOLS, NC-RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, NC-HOSPITALITY, HEALTHCARE

  **Explanation**
  Refer to below to following specifications for WaterSense specifications for toilets, urinals, faucets, and showerheads.
# Fixture Specification

## Shower Head

**Item Reference #: F-5**

<table>
<thead>
<tr>
<th>Project: Boutique Hotel</th>
<th>Date: 11/5/18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location: Portland Oregon</td>
<td>Revision: 1</td>
</tr>
<tr>
<td></td>
<td>Prepared by: DMV</td>
</tr>
</tbody>
</table>

**Vendor/Manufacturer:** DELTA

**Item/Stock Number:** T14297-LHP--H795--R10000-UNBX

**Item/Collection Name:** Monitor® 14 Series H2Okinetic® Shower Trim - Less Handle

**Description:** H2Okinetic Shower technology sculpts water into a unique wave pattern, forming a powerful drench spray

**Dimensions:** 7W x 21H x 8D in.

**Finish:** Chrome

**Notes/Instructions:**
EPA WaterSense certified

| Quantity: 15 | Cost per Unit: $294.00 | Total Cost: $4,410.00 |
### Fixture Specification

**Toilet**

**Item Reference #:** F-1

<table>
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<tr>
<th>Project:</th>
<th>CHATTANOOGA MARKET</th>
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<tbody>
<tr>
<td>Location:</td>
<td>CHATTANOOGA, TN</td>
</tr>
<tr>
<td>Date:</td>
<td>12/12/18</td>
</tr>
<tr>
<td>Revision:</td>
<td>1</td>
</tr>
<tr>
<td>Prepared by:</td>
<td>ARD</td>
</tr>
</tbody>
</table>

**Vendor/Manufacturer:** DELTA

**Item/Stock Number:** C43901-WH

**Item/Collection Name:** Elongated Toilet

**Description:** Delta® toilets feature the exclusive SmartFit® tank-to-bowl connection reducing potential leak points, over-tightening of the fasteners and cracking the toilet.

**Dimensions:** 29 1/4L x 16 13/16W x 32 15/16H in.

**Finish:** White

**Notes/Instructions:**
EPA WaterSense certified

<table>
<thead>
<tr>
<th>Quantity:</th>
<th>TBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per Unit:</td>
<td>$265.00</td>
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<tr>
<td>Total Cost:</td>
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</table>
# Fixture Specification

## Lavatory Faucet

<table>
<thead>
<tr>
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<th>CHATTANOOGA MARKET</th>
<th><strong>Location:</strong></th>
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<th><strong>Date:</strong></th>
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<tr>
<td><strong>Vendor/Manufacturer:</strong></td>
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<td><strong>Item/Stock Number:</strong></td>
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<td><strong>Revision:</strong></td>
<td>1</td>
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<td><strong>Item/Collection Name:</strong></td>
<td>Two Handle Widespread Bathroom Faucet - Low Arc Spout - Less Handles</td>
<td><strong>Prepared by:</strong></td>
<td>ARD</td>
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</tr>
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</table>

**Description:**

- **Dimensions:** 6W x 6D x 4H in.
- **Finish:** Chrome

**Notes/Instructions:**

- Standard mounting deck thickness can be extended 1" with RP10612.
- EPA WaterSense certified

| **Quantity:** | TBD | **Cost per Unit:** | $405.10 | **Total Cost:** | TBD |
# Fixture Specification

## Urinal

<table>
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<th>Item Reference #</th>
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<tr>
<td><strong>Project:</strong></td>
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<tr>
<td><strong>Vendor/Manufacturer:</strong></td>
<td>Kohler</td>
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<tr>
<td><strong>Item/Stock Number:</strong></td>
<td>K-5244-ET-0</td>
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<tr>
<td><strong>Item/Collection Name:</strong></td>
<td>Steward®</td>
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</tbody>
</table>

**Description:** Modeled after the popular Steward waterless urinals, this Steward Hybrid urinal combines a sleek design aesthetic with a rinsing flush that prevents drainline issues and reduces maintenance. At 0.125 gpf, this high-efficiency urinal offers 80% water savings compared to standard 1.0-gpf urinals. The large footprint covers the old urinal wall print, making this model ideal for water conservation replacement projects.

**Dimensions:** 29-5/8H x 15W x 15-5/8D in.

**Finish:** White

**Notes/Instructions:**

- EPA WaterSense certified

**Quantity:** TBD

**Cost per Unit:** $606.90

**Total Cost:** TBD
• WE PREREQUISITE: BUILDING-LEVEL WATER METERING REQUIRED

Intent
To support water management and identify opportunities for additional water savings by tracking water consumption.

Requirements
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Explanation
Project installed permanent water meters that measure the total potable water use for the building and associated grounds. Meter data must be compiled into monthly and annual summaries; meter readings can be manual or automated. Project committed to sharing with USGBC the resulting whole-project water usage data for a five-year period beginning on the date the project accepts LEED certification or typical occupancy, whichever comes first. This commitment must carry forward for five years or until the building changes ownership or lessee.

• WE CREDIT: OUTDOOR WATER USE REDUCTION

Intent
To reduce outdoor water consumption.

Requirements
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
Reduce outdoor water use through one of the following options. Nonvegetated surfaces, such as permeable or impermeable pavement, should be excluded from landscape area calculations. Athletic fields and playgrounds (if vegetated) and food gardens may be included or excluded at the project team’s discretion.

Option 1. No Irrigation Required (2 points except Healthcare, 1 point Healthcare)
Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

Explanation:
Credit does not fall within scope of project. Unable to complete credit.

Points Earned: 0

• WE CREDIT: INDOOR WATER USE REDUCTION

Intent
To reduce indoor water consumption.
Requirements
NC, CS, SCHOOLS, NC-RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, NC-HOSPITALITY, HEALTHCARE
Further reduce fixture and fitting water use from the calculated baseline in WE Prerequisite Indoor Water Use Reduction. Additional potable water savings can be earned above the prerequisite level using alternative water sources. Include fixtures and fittings necessary to meet the needs of the occupants. Some of these fittings and fixtures may be outside the tenant space (for Commercial Interiors) or project boundary (for New Construction). Points are awarded according to Table 1.

Explanation
Refer to previous specifications for WaterSense specifications for toilets, urinals, faucets, and showerheads.

Points Earned: 1

• WE CREDIT: COOLING TOWER WATER USE

Intent
To conserve water used for cooling tower makeup while controlling microbes, corrosion, and scale in the condenser water system.

Requirements
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE,
For cooling towers and evaporative condensers, conduct a one-time potable water analysis, measuring at least the five control parameters listed in Table 1.

Explanation
Unable to achieve this credit due to not being able to conduct a potable water analysis for the site’s cooling towers and evaporative condensers.

Points Earned: 0

• WE CREDIT: WATER METERING

Intent
To support water management and identify opportunities for additional water savings by tracking water consumption.

Requirements
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
Install permanent water meters for two or more of the following water subsystems, as applicable to the project:
Explanation

Indoor plumbing fixtures and fittings. Metered water systems serving at least 80% of the indoor fixtures and fitting described in WE Prerequisite Indoor Water Use Reduction, either directly or by deducting all other measured water use from the measured total water consumption of the building and grounds.

Domestic hot water. Metered water use of at least 80% of the installed domestic hot water heating capacity (including both tanks and on-demand heaters).

Points Earned: 1

4. ENERGY AND ATMOSPHERE (EA)

- EA PREREQUISITE: FUNDAMENTAL COMMISSIONING AND VERIFICATION REQUIRED

Intent

To support the design, construction, and eventual operation of a project that meets the owner’s project requirements for energy, water, indoor environmental quality, and durability.

Requirements

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Commissioning Process Scope

Complete the following commissioning (Cx) process activities for mechanical, electrical, plumbing, and renewable energy systems and assemblies, in accordance with ASHRAE Guideline 0-2005 and ASHRAE Guideline 1.1–2007 for HVAC&R Systems, as they relate to energy, water, indoor environmental quality, and durability.

Requirements for exterior enclosures are limited to inclusion in the owner’s project requirements (OPR) and basis of design (BOD), as well as the review of the OPR, BOD and project design. NIBS Guideline 3-2012 for Exterior Enclosures provides additional guidance.

- Develop the OPR.
- Develop a BOD.

The commissioning authority (CxA) must do the following:
- Review the OPR, BOD, and project design.
- Develop and implement a Cx plan.
- Confirm incorporation of Cx requirements into the construction documents.
- Develop construction checklists.
- Develop a system test procedure.
- Verify system test execution.
- Maintain an issues and benefits log throughout the Cx process.
- Prepare a final Cx process report.
- Document all findings and recommendations and report directly to the owner throughout the process.
The review of the exterior enclosure design may be performed by a qualified member of the design or construction team (or an employee of that firm) who is not directly responsible for design of the building envelope.

**Commissioning Authority**

By the end of the design development phase, engage a commissioning authority with the following qualifications.

- The CxA must have documented commissioning process experience on at least two building projects with a similar scope of work. The experience must extend from early design phase through at least 10 months of occupancy;
- The CxA may be a qualified employee of the owner, an independent consultant, or an employee of the design or construction firm who is not part of the project’s design or construction team, or a disinterested subcontractor of the design or construction team.

If projects smaller than 20,000 square feet (1,860 square meters), the CxA may be a qualified member of the design or construction team. In all cases, the CxA must report his or her findings directly to the owner.

Project teams that intend to pursue EA Credit Enhanced Commissioning should note a difference in the CxA qualifications: for the credit, the CxA may not be an employee of the design or construction firm nor a subcontractor to the construction firm.

**Current Facilities Requirements and Operations and Maintenance Plan**

Prepare and maintain a current facilities requirements and operations and maintenance plan that contains the information necessary to operate the building efficiently. The plan must include the following:

- a sequence of operations for the building;
- the building occupancy schedule;
- equipment run-time schedules;
- setpoints for all HVAC equipment;
- set lighting levels throughout the building;
- minimum outside air requirements;
- any changes in schedules or setpoints for different seasons, days of the week, and times of day;
- a systems narrative describing the mechanical and electrical systems and equipment;
- a preventive maintenance plan for building equipment described in the systems narrative; and
- a commissioning program that includes periodic commissioning requirements, ongoing commissioning tasks, and continuous tasks for critical facilities.

**Explanation**

Because this is a hypothetical project, I am unable to complete these activities. However, in the case of a real project, all actions would be completed.
**EA PREREQUISITE: MINIMUM ENERGY PERFORMANCE REQUIRED**

**Intent**
To reduce the environmental and economic harms of excessive energy use by achieving a minimum level of energy efficiency for the building and its systems.

**Requirements**
**NC, CS, SCHOOLS, RETAIL, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE**

**Option 1. Whole-Building Energy Simulation**
Demonstrate an improvement of 5% for new construction, 3% for major renovations, or 2% for core and shell projects in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to ANSI/ASHRAE/IESNA Standard 90.1–2010, Appendix G, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.), using a simulation model. Projects must meet the minimum percentage savings before taking credit for renewable energy systems.

The proposed design must meet the following criteria:
- Compliance with the mandatory provisions of ANSI/ASHRAE/IESNA Standard 90.1–2010, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.);
- Inclusion of all energy consumption and costs within and associated with the building project; and
- Comparison against a baseline building that complies with Standard 90.1–2010, Appendix G, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.).

Document the energy modeling input assumptions for unregulated loads. Unregulated loads should be modeled accurately to reflect the actual expected energy consumption of the building.

If unregulated loads are not identical for both the baseline and the proposed building performance rating, and the simulation program cannot accurately model the savings, follow the exceptional calculation method (ANSI/ASHRAE/IESNA Standard 90.1–2010, G2.5).

Alternatively, use the COMNET Modeling Guidelines and Procedures to document measures that reduce unregulated loads.

**Retail only**
For Option 1, Whole-Building Energy Simulation, process loads for retail may include refrigeration equipment, cooking and food preparation, clothes washing, and other major support appliances. Many of the industry standard baseline conditions for commercial kitchen equipment and refrigeration are defined 67 Updated to reflect the July 2, 2018 LEED v4 Building Design and Construction Addenda

in Appendix 3, Tables 1–4. No additional documentation is necessary to substantiate these predefined baseline systems as industry standard.

**Explanation**
Because this is simply a hypothetical project, I am unable to complete these activities. However, in the case of a real project, all actions would be completed.
• EA PREREQUISITE: BUILDING-LEVEL ENERGY METERING REQUIRED

**Intent**
To support energy management and identify opportunities for additional energy savings by tracking building-level energy use.

**Requirements**
NC, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
Install new or use existing building-level energy meters, or submeters that can be aggregated to provide building-level data representing total building energy consumption (electricity, natural gas, chilled water, steam, fuel oil, propane, biomass, etc). Utility-owned meters capable of aggregating building-level resource use are acceptable.
Commit to sharing with USGBC the resulting energy consumption data and electrical demand data (if metered) for a five-year period beginning on the date the project accepts LEED certification. At a minimum, energy consumption must be tracked at one-month intervals.
This commitment must carry forward for five years or until the building changes ownership or lessee.

**Explanation**
Because this is simply a proposed documentation and not a real project, I am unable to complete these activities. However, in the case of a real project, all actions would be completed.

• EA PREREQUISITE: FUNDAMENTAL REFRIGERANT MANAGEMENT REQUIRED

**Intent**
To reduce stratospheric ozone depletion.

**Requirements**
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
Do not use chlorofluorocarbon (CFC)-based refrigerants in new heating, ventilating, air-conditioning, and refrigeration (HVAC&R) systems. When reusing existing HVAC&R equipment, complete a comprehensive CFC phase-out conversion before project completion. Phase-out plans extending beyond the project completion date will be considered on their merits.
Existing small HVAC&R units (defined as containing less than 0.5 pound [225 grams] of refrigerant) and other equipment, such as standard refrigerators, small water coolers, and any other equipment that contains less than 0.5 pound (225 grams) of refrigerant, are exempt.

**Explanation**
All requirements will be met within the project.
EA CREDIT: ENHANCED COMMISSIONING

**Intent**
To further support the design, construction, and eventual operation of a project that meets the owner’s project requirements for energy, water, indoor environmental quality, and durability.

**Requirements**
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
Implement, or have in place a contract to implement, the following commissioning process activities in addition to those required under EA Prerequisite Fundamental Commissioning and Verification.

**Commissioning Authority**
- The CxA must have documented commissioning process experience on at least two building projects with a similar scope of work. The experience must extend from early design phase through at least 10 months of occupancy;
- The CxA may be a qualified employee of the owner, an independent consultant, or a disinterested subcontractor of the design team.

**Option 1. Enhanced Systems Commissioning (3-4 points)**

**Path 1: Enhanced Commissioning (3 points)**
Complete the following commissioning process (CxP) activities for mechanical, electrical, plumbing, and renewable energy systems and assemblies in accordance with ASHRAE Guideline 0–2005 and ASHRAE Guideline 1.1-2007 for HVAC&R systems, as they relate to energy, water, indoor environmental quality, and durability.

The commissioning authority must do the following:
- Review contractor submittals.
- Verify inclusion of systems manual requirements in construction documents.
- Verify inclusion of operator and occupant training requirements in construction documents.
- Verify systems manual updates and delivery.
- Verify operator and occupant training delivery and effectiveness.
- Verify seasonal testing.
- Review building operations 10 months after substantial completion.
- Develop an on-going commissioning plan.

Include all enhanced commissioning tasks in the OPR and BOD.

**Explanation**
All commissioning process activities would be implemented if it were to occur within a real project.

**Points Earned:** 3
• **EA CREDIT: OPTIMIZE ENERGY PERFORMANCE**

**Intent**
To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic harms associated with excessive energy use.

**Requirements**
**NC, CS, SCHOOLS, RETAIL, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE**
Establish an energy performance target no later than the schematic design phase. The target

**Explanation**
Unable to complete a full building energy simulation. No points were earned for this credit.

**Points Earned: 0**

• **EA CREDIT: ADVANCED ENERGY METERING**

**Intent**
To support energy management and identify opportunities for additional energy savings by tracking building-level and system-level energy use.

**Requirements**
**NC, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE**
Install advanced energy metering for the following:
- all whole-building energy sources used by the building; and
- any individual energy end uses that represent 10% or more of the total annual consumption of the building.

The advanced energy metering must have the following characteristics.
- Meters must be permanently installed, record at intervals of one hour or less, and transmit data to a remote location.
- Electricity meters must record both consumption and demand. Whole-building electricity meters should record the power factor, if appropriate.
- The data collection system must use a local area network, building automation system, wireless network, or comparable communication infrastructure.
- The system must be capable of storing all meter data for at least 36 months.
- The data must be remotely accessible.
- All meters in the system must be capable of reporting hourly, daily, monthly, and annual energy use.
Explanation:
This credit does not fall under the scope of this project. Unable to complete credit.

Points Earned: 0

- **EA CREDIT: DEMAND RESPONSE**

  **Intent**
  To increase participation in demand response technologies and programs that make energy generation and distribution systems more efficient, increase grid reliability, and reduce greenhouse gas emissions.

  **Requirements**
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
  Design building and equipment for participation in demand response programs through load shedding or shifting. On-site electricity generation does not meet the intent of this credit.

  **Explanation**
  The figure below shows that the state of Tennessee does not have a provided Demand/Response program. However, the building will provide infrastructure to take advantage of future demand response programs or dynamic, real-time pricing programs and complete the following activities.

  - Install interval recording meters with communications and ability for the building automation system to accept an external price or control signal.
  - Develop a comprehensive plan for shedding at least 10% of building estimated peak electricity demand. Peak demand is determined under EA Prerequisite Minimum Energy Performance.
  - Include the DR processes in the scope of work for the commissioning authority, including participation in at least one full test of the DR plan.
  - Contact local utility representatives to discuss participation in future DR programs.
Points Earned: 1

• EA CREDIT: RENEWABLE ENERGY PRODUCTION

  Intent
  To reduce the environmental and economic harms associated with fossil fuel energy by increasing self-supply of renewable energy.

  Requirements
  NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
  Use renewable energy systems to offset building energy costs. Calculate the percentage of renewable energy with the following equation:

  Explanation
  Unable to calculate total building annual energy cost.

  Points Earned: 0

• EA CREDIT: ENHANCED REFRIGERANT MANAGEMENT

  Intent
  To reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.

  Requirements
  NC, CS, SCHOOLS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
  Option 1. No Refrigerants or Low-Impact Refrigerants (1 point)
  Do not use refrigerants, or use only refrigerants (naturally occurring or synthetic) that have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of less than 50.

  Explanation
  The project will not use refrigerants.

  Points Earned: 1

• EA CREDIT: GREEN POWER AND CARBON OFFSETS

  Intent
  To encourage the reduction of greenhouse gas emissions through the use of grid-source, renewable energy technologies and carbon mitigation projects.
Requirements
NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Explanation
This project is engaged in a contract with Carbon Solutions group for qualified resources that have come online since January 1, 2005, for a minimum of five years, to be delivered at least annually. The contract with Carbon Solutions Group specifies the provision of at least 50% of the project’s energy from wind power. The wind power is Green-e Energy Certified.

Carbon Solutions Group (CSG)
Website: http://www.carbonsolutionsgroup.com

Green-e Certified Renewable Energy Product(s)

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Clean Build</th>
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<tr>
<td>Product Type</td>
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<tr>
<td>Available In</td>
<td>Everywhere</td>
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<tr>
<td>Renewable content mix</td>
<td>100% Wind</td>
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</table>

Points Earned: 1

5. MATERIALS AND RESOURCES (MR)

- MR PREREQUISITE: STORAGE AND COLLECTION OF RECYCLABLES REQUIRED
Intent
To reduce the waste that is generated by building occupants and hauled to and disposed of in landfills.

Requirements
NC, CS, SCHOOLS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE
Provide dedicated areas accessible to waste haulers and building occupants for the collection and storage of recyclable materials for the entire building. Collection and storage areas may be separate locations. Recyclable materials must include mixed paper, corrugated cardboard, glass, plastics, and metals. Take appropriate measures for the safe collection, storage, and disposal of two of the following: batteries, mercury-containing lamps, and electronic waste.

Explanation
Recyclable materials for the project include mixed paper, corrugated cardboard, glass, plastics, and metals. There are also locations for the safe disposal of batteries and electronic waste. Refer to the figures below for locations of recyclable materials throughout the project marked in red.
MR CREDIT: BUILDING LIFE-CYCLE IMPACT REDUCTION

Intent
To encourage adaptive reuse and optimize the environmental performance of products and materials.

Requirements
NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE

Demonstrate reduced environmental effects during initial project decision-making by reusing existing building resources or demonstrating a reduction in materials use through life-cycle assessment. Achieve one of the following options.

Option 3. Building and Material Reuse (2–4 points BD&C, 2-5 points Core and Shell)

Reuse or salvage building materials from off site or on site as a percentage of the surface area, as listed in Table 1. Include structural elements (e.g., floors, roof decking), enclosure materials (e.g., skin, framing), and permanently installed interior elements (e.g., walls, doors, floor coverings, ceiling systems). Exclude from the calculation window assemblies and any hazardous materials that are remediated as a part of the project.

Materials contributing toward this credit may not contribute toward MR Credit Material Disclosure and Optimization.

Explanation
Refer to images below in order to see the remaining existing walls within the Chattanooga Choo Choo. The average percentage of completed project surface area reused between the two floor is 86%, thus giving the project 4 points.
Points Earned: 4

- MR CREDIT: BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION – ENVIRONMENTAL PRODUCT DECLARATIONS

**Intent**
To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products from manufacturers who have verified improved environmental life-cycle impacts.

**Requirements** NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE
Achieve one or more of the options below, for a maximum of 2 points.

**Option 1.** Environmental Product Declaration (EPD) (1 point) Use at least 20 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria below.
- Product-specific declaration.
  - Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope are valued as one quarter (1/4) of a product for the purposes of credit achievement calculation.
- Environmental Product Declarations which conform to ISO 14025 and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
Industry-wide (generic) EPD -- Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator are valued as one half (1/2) of a product for purposes of credit achievement calculation.

Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator are valued as one whole product for purposes of credit achievement calculation.

- USGBC approved program – Products that comply with other USGBC approved environmental product declaration frameworks.

**Explanation**

**Option 1:**
The following 20 listed permanently installed products all have public EPDs that can be found through the links provided below.

1. Insulation: [https://www.certainteed.com/resources/CertainTeed_Sustainable_Insulation_EPD.pdf](https://www.certainteed.com/resources/CertainTeed_Sustainable_Insulation_EPD.pdf)
11. Ceramic Wall Tile:
   file:///C:/Users/hdg17/Downloads/Ceramic%20Wall%20Tiles%20(1).pdf
12. Toilet:
13. Sink:
14. Portland Cement:
15. Slag Cement:
16. Natural Aggregate Fine and Course:
17. Crushed Aggregate Fine and Course:
18. Accelerating Admixture:
19. Waterproofing Admixture:
20. Plasticizing Admixture:

Points Earned: 1

- MR CREDIT: BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION – SOURCING OF RAW MATERIALS

**Intent**
To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products verified to have been extracted or sourced in a responsible manner.

**Requirements NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE**

**Option 1. Raw Material Source and Extraction Reporting (1 point)** Use at least 20 different permanently installed products from at least five different manufacturers that
have publicly released a report from their raw material suppliers which include raw material supplier extraction locations, a commitment to long-term ecologically responsible land use, a commitment to reducing environmental harms from extraction and/or manufacturing processes, and a commitment to meeting applicable standards or programs voluntarily that address responsible sourcing criteria.

- Products sourced from manufacturers with self-declared reports are valued as one half (1/2) of a product for credit achievement.
- Third-party verified corporate sustainability reports (CSR) which include environmental impacts of extraction operations and activities associated with the manufacturer’s product and the product’s supply chain, are valued as one whole product for credit achievement calculation. Acceptable CSR frameworks include the following:
  - Global Reporting Initiative (GRI) Sustainability Report
  - Organization for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises
  - U.N. Global Compact: Communication of Progress
  - ISO 26000: 2010 Guidance on Social Responsibility
  - USGBC approved program: Other USGBC approved programs meeting the CSR criteria.

**Explanation**

**Option 1:**
The following information lists the 20 products and links to the company’s Corporate Sustainability Reports:
1. CertainTeed Gypsum
2. CertainTeed Ceilings
3. CertainTeed Fiber Cement Siding
4. CertainTeed Form-A-Drain Piping
5. CertainTeed Sustainable Insulation
6. CertainTeed Landmark Solaris Roofing
CSR Link: [https://www.certainteed.com/resources/Green_CertainTeed-Sustainability-Report.pdf](https://www.certainteed.com/resources/Green_CertainTeed-Sustainability-Report.pdf)

7. USG Sheetrock Brand Ultralight Panels

8. Panasonic Air Conditioner
9. Panasonic Wiring Devices
10. Panasonic Ventilation Equipment

11. JSR Acrylic Emulsion Exterior Paint
12. JSR Weather-Resistant Resin AES Grade
CSR Link: [http://www.jsr.co.jp/jsr_e/csr/](http://www.jsr.co.jp/jsr_e/csr/)
13. Crossville Natural Stone Calce
14. Crossville Porcelain Tile Collection
15. Crossville Tile Blend Nero
16. Crossville Tile Basalt Magma
CSR Link:  http://database.globalreporting.org/reports/44049/

18. Firestone EPDM Platinum
19. Firestone EPDM Adhesive and Sealant
20. Firestone Concealed Fastener Panels
CSR Link:  http://database.globalreporting.org/reports/47915/

Points Earned:  1

- **MR CREDIT: BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION-MATERIAL INGREDIENTS**

  **Intent**
  To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products for which the chemical ingredients in the product are inventoried using an accepted methodology and for selecting products verified to minimize the use and generation of harmful substances. To reward raw material manufacturers who produce products verified to have improved lifecycle impacts.

  **Requirements**

  **NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE**

  Option 1. Material Ingredient Reporting (1 point) Use at least 20 different permanently installed products from at least five different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm).

  **Explanation**
  Limitations on the materials that could be used within the project existed due to the goal of preserving the existing dome space within the project and maintaining historical accuracy.

  Points Earned:  0
• MR CREDIT: CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

Intent
To reduce construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials.

Requirements
NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE
Recycle and/or salvage nonhazardous construction and demolition materials. Calculations can be by weight or volume but must be consistent throughout. Exclude excavated soil, land-clearing debris from calculations. Include materials destined for alternative daily cover (ADC) in the calculations as waste (not diversion). Include wood waste converted to fuel (biofuel) in the calculations; other types of waste-to-energy are not considered diversion for this credit. However, for projects that cannot meet credit requirements using reuse and recycling methods, waste-to-energy systems may be considered waste diversion if the European Commission Waste Framework Directive 2008/98/EC and Waste Incineration Directive 2000/76/EC are followed and Waste to Energy facilities meet applicable European Committee for Standardization (CEN) EN 303 standards.

Explanation
Because this is a hypothetical project, there is not a way for me to calculate total waste generation or to divert any amount of waste into material streams.

Points Earned: 0

6. Indoor Environmental Quality (EQ)

• EQ PREREQUISITE: MINIMUM INDOOR AIR QUALITY PERFORMANCE REQUIRED

Intent
To contribute to the comfort and well-being of building occupants by establishing minimum standards for indoor air quality (IAQ). Requirements NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY

Meet the requirements for both ventilation and monitoring.

Explanation
The requirements of this credit do not fall under the scope of this thesis project, however, if the project were real, the minimum requirements of ASHRAE Standard 62.1–2010, Sections 4–7, Ventilation for Acceptable Indoor Air Quality (with errata), or a local equivalent would be met.
• EQ PREREQUISITE: ENVIRONMENTAL TOBACCO SMOKE CONTROL REQUIRED

**Intent**
To prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke.

**Requirements NC, CS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE**
Prohibit smoking inside the building. Prohibit smoking outside the building except in designated smoking areas located at least 25 feet (7.5 meters) from all entries, outdoor air intakes, and operable windows. Also prohibit smoking outside the property line in spaces used for business purposes. If the requirement to prohibit smoking within 25 feet (7.5 meters) cannot be implemented because of code, provide documentation of these regulations. Signage must be posted within 10 feet (3 meters) of all building entrances indicating the no-smoking policy.

**Explanation**
Smoking will be prohibited within the Chattanooga Market and outside of the building except in designated smoking areas located at least 25 ft. from all entries and operable windows. Signage will be posted within 10 feet of all building entrances indicating the no-smoking policy.

• EQ CREDIT: ENHANCED INDOOR AIR QUALITY STRATEGIES

**Intent**
To promote occupants’ comfort, well-being, and productivity by improving indoor air quality.

**Requirements NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE**

**Option 1. Enhanced IAQ Strategies (1 point)**
Comply with the following requirements, as applicable.
Mechanically ventilated spaces:
A. entryway systems;
B. interior cross-contamination prevention; and
C. filtration.

**Option 2. Additional Enhanced IAQ Strategies (1 point)**
Comply with the following requirements, as applicable. Mechanically ventilated spaces (select one):
A. exterior contamination prevention;
B. increased ventilation;
   C. carbon dioxide monitoring; or
D. additional source control and monitoring.
Explanation:

Option 1:
Mechanically ventilated spaces:

A. Entryway systems: must be permanently installed at least 10 ft. in the primary direction of travel at all exterior entrances. Walk-off mat locations shown below.

B. Interior cross-contamination prevention:
   The design team consulted a building engineer to determine the sufficient exhaust for each space where hazardous chemicals are present.

C. Filtration:
   The mechanical engineer for our design team meets the MERV of 13 or higher, in accordance to ASHRAE Standard 52.2-2007.

Option 2:
Mechanically Ventilated Spaces

C. Carbon Dioxide monitoring:
   The design team provides a CO2 monitor within all of our densely occupied spaces. The location of these monitors are 3 to 6 ft. above the floor. The setpoints comply with ASHRAE 62.1-010, Appendix C.

Points Earned: 2

- EQ CREDIT: LOW-EMITTING MATERIALS

Intent
To reduce concentrations of chemical contaminants that can damage air quality, human health, productivity, and the environment.
Requirements NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

This credit includes requirements for product manufacturing as well as project teams. It covers volatile organic compound (VOC) emissions in the indoor air and the VOC content of materials, as well as the testing methods by which indoor VOC emissions are determined. Different materials must meet different requirements to be considered compliant for this credit. The building interior and exterior are organized in seven categories, each with different thresholds of compliance. The building interior is defined as everything within the waterproofing membrane. The building exterior is defined as everything outside and inclusive of the primary and secondary weatherproofing system, such as waterproofing membranes and air- and water-resistive barrier materials.

Option 1. Product Category Calculations
Achieve the threshold level of compliance with emissions and content standards for the number of product categories listed in Table 2.

Explanation
The project could not meet the threshold percentages that are required to complete this credit.

Points Earned: 0

- EQ CREDIT: CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT PLAN

Intent
To promote the well-being of construction workers and building occupants by minimizing indoor air quality problems associated with construction and renovation.

Requirements NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY
Develop and implement an indoor air quality (IAQ) management plan for the construction and preoccupancy phases of the building.

Explanation
The IAQ Management Plan addresses all of the following:
2. Absorptive materials stored on-site and installed are protected from moisture damage.
3. Permanently installed air-handling equipment during construction are not operated unless filtration media with a minimum efficiency reporting value (MERV) of 8, as determined by ASHRAE 52.2–2007, with errata (or equivalent filtration media class of F5 or higher, as defined by CEN Standard EN 779–2002, Particulate Air Filters for General Ventilation, Determination of the Filtration
Performance), are installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media. Immediately before occupancy, replace all filtration media with the final design filtration media, installed in accordance with the manufacturer’s recommendations.

4. The use of tobacco products inside the building and within 25 feet (7.5 meters) of the building entrance during construction is prohibited.

Points Earned: 1

- EQ CREDIT: INDOOR AIR QUALITY ASSESSMENT

  Intent
  To establish better quality indoor air in the building after construction and during occupancy.

  Requirements NC, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

  Explanation:
  Option 1.
  Flush-Out (1 point) Path 1. Before Occupancy Install new filtration media and perform a building flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot (4,267,140 liters of outdoor air per square meter) of gross floor area while maintaining an internal temperature of at least 60°F (15°C) and no higher than 80°F (27°C) and relative humidity no higher than 60%.

  Because this is a hypothetical project, a flush out cannot be completed. However, if the project was real, then a full flush-out before occupancy would be completed.

  Points Earned: 1

- EQ CREDIT: THERMAL COMFORT

  Intent
  To promote occupants’ productivity, comfort, and well-being by providing quality thermal comfort. Requirements Meet the requirements for both thermal comfort design and thermal comfort control.

  Thermal Comfort Design NC, SCHOOLS, RETAIL, DATA CENTERS, HOSPITALITY, HEALTHCARE
  Option 2. ISO and CEN Standards Design HVAC systems and the building envelope to meet the requirements of the applicable standard:
• ISO 7730:2005, Ergonomics of the Thermal Environment, analytical determination and interpretation of thermal comfort, using calculation of the PMV and PPD indices and local thermal comfort criteria; and

Explaination
Option 2:
Mechanical engineers will be designing the HVAC systems and the building envelope to meet the requirements of ISO 7730:2005, Ergonomics of the Thermal Environment, analytical determination, and interpretation of thermal comfort, using calculation of the PMV and PPD indices and local thermal comfort criteria. They will also comply with the CEN Standard EN 15251:2007, Section A2. The designers have indicated where the thermostats should be in regularly occupied spaces. Thermometer locations are designated with a yellow rectangle within the attached images.
Points Earned:  1

- EQ CREDIT: INTERIOR LIGHTING

**Intent**
To promote occupants’ productivity, comfort, and well-being by providing high-quality lighting.

**Requirements NC, SCHOOLS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY**

**Option 1. Lighting Control (1 point)**
For at least 90% of individual occupant spaces, provide individual lighting controls that enable occupants to adjust the lighting to suit their individual tasks and preferences, with at least three lighting levels or scenes (on, off, midlevel). Midlevel is 30% to 70% of the maximum illumination level (not including daylight contributions). For all shared multi-occupant spaces, meet all of the following requirements.

- Have in place multizone control systems that enable occupants to adjust the lighting to meet group needs and preferences, with at least three lighting levels or scenes (on, off, midlevel).
- Lighting for any presentation or projection wall must be separately controlled.
- Switches or manual controls must be located in the same space as the controlled luminaires. A person operating the controls must have a direct line of sight to the controlled luminaires.

**Explanation**

**Option 1:**
For the interior lighting of our project, we have installed the HubbellCX Lighting Control Panel System throughout the building. All individually occupied spaces will contain a relay system and a control panel will be located in the multi-occupied spaces. The control panel allows for multi-zone control as well as individual location control. The locations of the panels are shown with a red rectangle in the images attached, and the product information for the Panel System is attached.
Points Earned:  1

**EQ CREDIT: DAYLIGHTING**

**Intent**
To connect building occupants with the outdoors, reinforce circadian rhythms, and reduce the use of electrical lighting by introducing daylight into the space.

**Requirements NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE**
Provide manual or automatic (with manual override) glare-control devices for all regularly occupied spaces. Select one of the following three options.

**Option 1. Simulation: Spatial Daylight Autonomy and Annual Sunlight Exposure (2–3 points, 1-2 points Healthcare)**
Demonstrate through annual computer simulations that spatial daylight autonomy300/50% (sDA300/50%) of at least 55%, 75%, or 90% is achieved. Use regularly occupied floor area. Healthcare projects should use the perimeter area determined under EQ Credit Quality Views. Points are awarded according to Table 1.
**Explanation**
Because this is a hypothetical project, illuminance levels were unable to be calculated.

**Points Earned:** 0

- **EQ CREDIT: QUALITY VIEWS**

**Intent**
To give building occupants a connection to the natural outdoor environment by providing quality views.

**Requirements NC, CS, SCHOOLS, RETAIL, DATA CENTERS, HOSPITALITY**
Achieve a direct line of sight to the outdoors via vision glazing for 75% of all regularly occupied floor area. View glazing in the contributing area must provide a clear image of the exterior, not obstructed by frits, fibers, patterned glazing, or added tints that distort color balance. Additionally, 75% of all regularly occupied floor area must have at least two of the following four kinds of views:
- multiple lines of sight to vision glazing in different directions at least 90 degrees apart;
- views that include at least two of the following: (1) flora, fauna, or sky; (2) movement; and (3) objects at least 25 feet (7.5 meters) from the exterior of the glazing;
- unobstructed views located within the distance of three times the head height of the vision glazing; and
- views with a view factor of 3 or greater, as defined in “Windows and Offices; A Study of Office Worker Performance and the Indoor Environment.” Include in the calculations any permanent interior obstructions. Movable furniture and partitions may be excluded. Views into interior atria may be used to meet up to 30% of the required area.

**Explanation**
The project was unable to achieve a direct line of sight to the outdoors via vision glazing for 75% of the regularly occupied floor area.

**Points Earned:** 0

- **EQ CREDIT: ACOUSTIC PERFORMANCE**

**Intent**
To provide workspaces and classrooms that promote occupants’ well-being, productivity, and communications through effective acoustic design.

**Requirements NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY**
For all occupied spaces, meet the following requirements, as applicable, for HVAC background noise, sound isolation, reverberation time, and sound reinforcement and masking.

**Explanation**
Not enough information is provided within this project to calculate the Sound Transmission Class or the Reverberation Time Requirements for the Market, therefore I am unable to achieve this credit. I do not have a sound level meter that conforms to ANSI S1.4 for type 1 (precision) or type 2 (general purpose) sound measurement instrumentation, or a local equivalent required by the credit.

**Points Earned:** 0

7. **REGIONAL PRIORITY (RP)**

- **RP CREDIT: REGIONAL PRIORITY**

**Intent**
To provide an incentive for the achievement of credits that address geographically specific environmental, social equity, and public health priorities.

**Requirements**
NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Earn up to four of the six Regional Priority credits. These credits have been identified by the USGBC regional councils and chapters as having additional regional importance for the project’s region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website, [http://www.usgbc.org](http://www.usgbc.org)

One point is awarded for each Regional Priority credit achieved, up to a maximum of four.

**Explanation**
Regional Priority Credits could be achieved for the following: Renewable Energy Production, Surrounding Density and Diverse Uses, Access to Quality Transit, Bicycle Facilities, Rainwater Management, and Outdoor Water Use Reduction. Because the project reached the minimum required point threshold for Surrounding Density, Access to Quality Transit, and Bicycle Facilities the project was awarded 3 points.

**Points Earned:** 3
Appendix B

Survey Responses

Are you...?
88 responses

What is your age?
86 responses
Are you originally from Chattanooga, TN?

88 responses

- 77.3% Yes
- 22.7% No

How long have you lived in the Chattanooga area?

88 responses

- 53.4% 0-5 years
- 13.6% 6-10 years
- 11.5% 11-15 years
- 10.0% 15+ years
- 0.5% I do not live in the Chattanooga area
Have you ever visited the Chattanooga River Market at the Tennessee Aquarium or the Chattanooga Market at the First Tennessee Pavilion?

88 responses

- Yes: 80.7%
- No: 19.3%

Do you shop from local Chattanooga vendors?

88 responses

- Yes: 62.5%
- No: 37.5%
Do you prefer to buy locally-grown produce when available?

88 responses

![Pie chart showing 87.5% Yes and 12.5% No]

Would you be more likely to purchase locally-grown produce or locally-made consumer products if there were more permanent retail locations for them?

88 responses

![Pie chart showing 95.5% Yes and 4.5% No]
Do you feel that there are enough opportunities for local vendors to sell their products in the Chattanooga area?

86 responses

- Yes: 53.5%
- No: 46.5%