THE BELL MUSEUM: A SIGNIFICANT MODERN BUILDING

A THESIS
SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
OF THE UNIVERSITY OF MINNESOTA
BY

JOHANNA R. FRIENDSHUH

PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE ARCHITECTURE
HERITAGE PRESERVATION AND CONSERVATION

JANUARY, 2011

ADVISOR: ROBERT C. MACK

CO-CHAIR: THOMAS FISHER AND SCOTT ANFINSON

ACKNOWLEDGEMENTS

I would like to acknowledge my family for their support through this journey, especially the late nights, the dinners by the computer or at school, and the constant juggle between family and school responsibilities. I would also like to acknowledge the mentorship and guidance I've received in the past two years from Robert C. Mack, whose ever quiet demeanor, yet calm reasoning and probing questions have kept me on course without falling off the cliff. I would also like to acknowledge Tom Fisher, Dean, College of Design, University of Minnesota whose willingness to listen, and provide feedback has helped me push the boundaries set before me as a designer and educator. Thank you all for your help and wisdom. I could not have done it without you!

ABSTRACT

This thesis researches the possibilities of adaptive reuse of the Bell Museum, by first using the criteria provided by the National Register of Historic Places to determine if the building is fit for local and national designation and second, documenting the building's energy efficiencies and water usage for further study and providing some design solutions and third, discussing how the current space can be reprogrammed to be more efficient and effective for either the museum or another program. This research is done through written and visual documentation.

KEY WORDS: James F. Bell Museum, Heritage Preservation, Sustainable Design, Green Design, Programming, College of Design, University of Minnesota.

TABLE OF CONTENTS

List of Tables

List of Figures

PART I

Introduction

The James F. Bell Museum is a significant modern building that can be adapted to a new use if the museum moves out. This thesis shows through research and precedence that the Bell Museum is worthy of a historic designation with the National Register of Historic Places. This thesis also analyzes and recommends several adaptive reuse solutions in regards to this late 1930s building by creating better energy efficiency through updated building technology and systems, relying less on traditional forms of energy, all the while either retrofitting the building to work with the current museum, or finding another appropriate college program to move into the space based on current building programming.

Current Information on the James F. Bell Museum

The James Ford Bell Museum, located at 10 Church Street SE, Minneapolis, Minnesota, is part of the College of Food, Agricultural and Natural Resource Sciences (CFANS) at the University of Minnesota. CFANS "plays a lead role in keeping Minnesota competitive and connected as challenges and discoveries abound in genomics, plant and animal biology, the relationship of

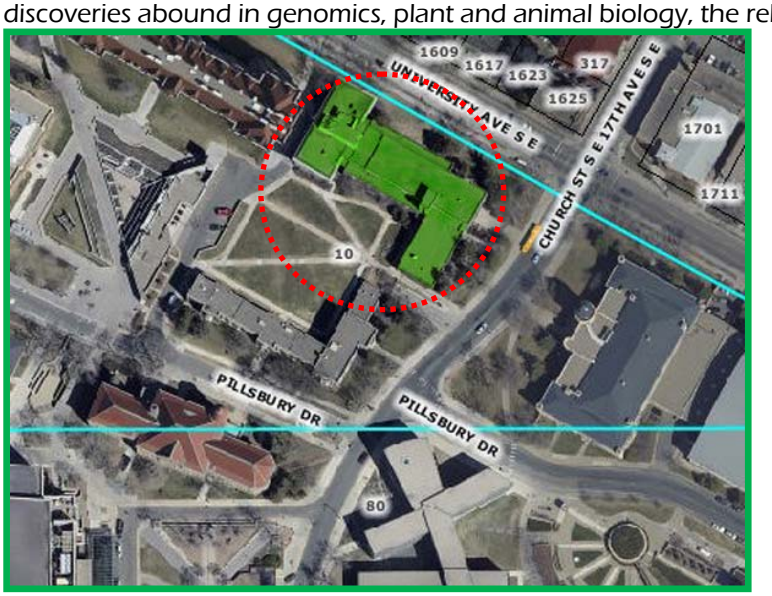

Figure 1: GIS Map, 8/9/2010. Courtesy of Hennepin County, Minnesota.

food to health, the inter-relatedness of ecosystems, renewable energy, the promise of biocatalysis and bioinformatics, and the economic, communication, and policy issues associated with these discoveries."[1]

The museum's mission is to "advance the quest to discover, document, and understand life in its many forms and to inspire curiosity, delight, and informed stewardship of the natural world."[2]

The 84,970 square foot space currently houses the museum gallery space, administrative office space, an auditorium, classroom space, lab space, mechanical space and storage.

The museum continues to be a natural history resource for grade school children throughout Minnesota, families and adult individuals. During the summer, it hosts various camps for kids and in the cold winter months some weekend workshops and school functions.

National Register of Historic Places

The National Register of Historic Places is a division of the National Park Service within The Department of the Interior. Its focus is to "coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources." [3]

Evaluation criteria have been developed by the National Register to determine if a place, building or object etc. qualifies for designation at the local, state and/or national level. The criteria look at two main areas integrity and significance.[4]

Integrity, according to the National Register is defined as "the ability of a property to convey its significance." Bulletin #15, Section VIII goes on to state that integrity is sometimes difficult to evaluate because the judgment can be subjective. However, there has to be an understanding of a property's physical features and how they relate to its significance. The National Register recognizes seven qualities that define integrity.[5]

---

[1] http://www.cfans.umn.edu/DepartmentsCenters/index.htm
[2] http://www.bellmuseum.org/about.html
[3] http://www.nps.gov/nr/about.htm
[4] http://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm
[5] http://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm

"Those seven qualities are:

1) Location. This is the place where the historic property was constructed or the place where the historic event occurred.
2) Design. Design is the combination of elements that create the form, plan, space, structure and style of the property.
3) Setting. Setting is the physical environment of a historic property.
4) Materials. Materials are the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property.
5) Workmanship. Workmanship is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory.
6) Feeling. Feeling is a property's expression of the aesthetic or historic sense of a particular period of time.
7) Assessment. Association is the direct link between an important historic event or person and a historic property."[6]

Bulletin #15, Section VIII states further that "Integrity is based on significance: why, where, and when a property is important. Only after significance is fully established can you proceed to the issue of integrity.

The steps in assessing integrity are:

- Define the essential physical features that must be present for a property to represent its significance.
- Determine whether the essential physical features are visible enough to convey their significance.
- Determine whether the property needs to be compared with similar properties. And,
- Determine, based on the significance and essential physical features, which aspects of integrity are particularly vital to the property being nominated and if they are present."[7]

[6] http://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm
[7] http://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm

To accomplish the steps there are four criteria that help assess significance. The criteria states that "The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or
B. That are associated with the lives of significant persons in or past; or
C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. That has yielded or may be likely to yield, information important in history or prehistory." [8]

The Bell Museum and the National Register of Historic Places

Based on the National Register's criteria listed above, the Bell Museum qualifies as a historic "building" for a local designation because the building has "integrity and significance" through various historical aspects that fit within the qualities of criterions A and C. The Bell Museum building is over 50 years of age, and is associated with the natural history renaissance period during the mid-to-late-1800s, and is a Public Works Administration (PWA) project. One of its main patrons, James F. Bell, is a well known Minneapolis businessman and philanthropist, and the building style is Art Moderne/Art Deco, a popular design style during the 1930s – all of which work with Criterion "A". The interior dioramas are a significant element because they are designed by top artists of the day, and reflect a significant artistic style through materials and methods, which falls under Criterion "C".

The 1960s addition would be included with the original building in the designation, which is required by the National Register.[9]

All these aspects are discussed in further detail below.

[8] http://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_2.htm
[9] http://www.nps.gov/history/nr/publications/bulletins/pdfs/nrb15.pdf

A Brief History of Natural History Programs and Museums

In western societies, the study, collection and housing of natural history collections date back to the late 1500s. An early example is the Museo di Storia Naturale dell'Universita di Pisa, which is part of the University of Pisa, an Italian university funded by the Medici family.[10]

During the 18th Century, collections begin to increase due to university studies and community curiosity, and natural history museums begin to show up in European cities such as London, Paris, Madrid, Florence, and the Netherlands.[11]

The 19th Century proves to be a renaissance period for natural history collections and this is evident through the addition of more than 30 stand-alone museums and study programs/museums added to European and American colleges, and universities. Some of the oldest natural history museums in the United States within higher education systems are the Peabody Museum at Yale University (1802), the Academy of Natural Sciences of Philadelphia (1812), the Pratt Museum at Amherst College (1825), University of Michigan (1837), Wisconsin-Madison University (1848), The California Academy of Sciences (1853), Harvard Museum of Natural History (1859), Kansas University Natural History (1864), and the Massachusetts Museum of Natural History at the University of Massachusetts, Amherst (1866).

The interest in natural history continues strongly through the early 20th Century, and peaks in the late 1960s as peoples' tastes begin to change. Natural history museums start focusing on children and family in the late 60's in order to bring in younger crowds. In the process, they lose older patrons who are not interested in the 'Touch and See' exhibits, but prefer the more intellectual interactions within the museum. Today, it is a struggle for natural history museums to bring in and keep patrons due to budget cuts, waning interest, or lack of scientific understanding[12] and technology.[13] People have a lot of choices in regards to entertainment. Natural history museums are now competing with other types of museums, music concerts,

[10] http://www.unipi.it/english/university/history/history.htm_cvt.htm
[11] http://www.ucmp.berkeley.edu/subway/nathistmus.html.
[12] Falk, J. H., et. al., Forum: communication about science in a traditional museum—visitors' and staff's perceptions. Cultural Studies of Science Education v. 1 no. 4 (December 2006) p. 821-9
[13] Gropp, Robert E. "*Expanding Access to Natural History Museums.*" Bioscience May2004, Vol. 54 Issue 5, p392-392 1p.

movies and vacations. On one hand, exhibits need to be updated and fresh to the young eye in order to keep their interest, which is further hindered by the age of technology. On the other hand, exhibits in their traditional setting have a quality about them that are appealing to our older generations as they create a sense of the our past and place. In the 21st Century, natural history museums continue to figure out their place in our world.

The James Bell Natural History Museum Background – Criterion "A"

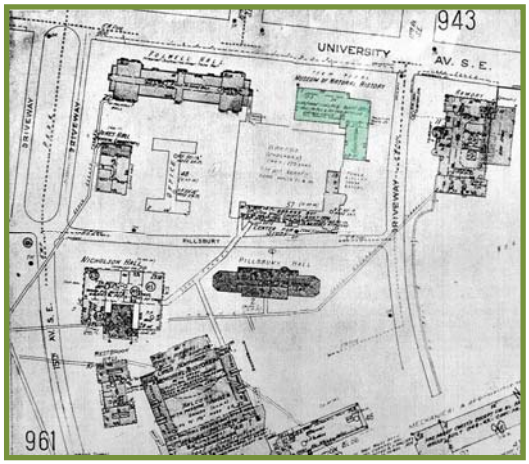

Figure 2: Circa 1940 Map Showing Bell Museum. Courtesy of UMN Archives


Figure 3: Bell Museum. 1940. Courtesy of Minnesota Historical Society.

The Museum of Natural History is founded in 1872 as the Geological and Natural History Survey, and is housed in the Main Building, or "Old Main" in a small north room on an upper floor on the University of Minnesota Minneapolis campus and its director is Professor N.H. Winchell. Many of the fossils, mammals and birds come from the State of Minnesota as well as other places including "mammals collected in the Black Hills by the Custer Expedition in 1875."[14]

By 1880, the collection grows to 147 mounted specimens, 309 skins, 383 marine fish and invertebrates and 44 dry specimens totaling 883, that later get packed off to New Orleans in 1884 for the New Orleans Industrial and Centennial Exposition.

In 1889, the museum moves to Pillsbury Hall, also known as Science Hall, due to the ever growing exhibits. During the Pillsbury stay, the Survey divides into the Geological, Zoological and

[14] Roberts, Thomas S. M.D., Director. *Annals of the Museum of Natural History. University of Minnesota. 1872-1939.* 1939. Pg. xi. Minneapolis.

Botanical Divisions in 1890, where H.F. Nachtrieb runs the Zoological Division including the Zoological Museum.

In 1911, James Bell, a1901 alumni of the University of Minnesota, and employee of the Washburn-Crosby Flour Mill, donates the Caribou Group to the museum. This is the first time documentation indicates any formal relationship between Bell and the museum.

In the summer and fall of 1916, the museum moves from Pillsbury Hall to the Animal Biology Building, later known as the Zoology Building. At this time, the White Mountain or Dall's Sheep Group is also donated by Bell on behalf of his late father. On September 30, 1916, Bell is involved in "settling details" of the Deer Group, and a month later donates a motion-picture machine that is installed in the basement lecture room for showing wildlife documentaries.

1917 proves to be a rather chaotic, but interesting year for the museum. In the spring, the university comptroller's office tells the museum administrators to stop planning for a new building to house the museum. However, since most of the money towards the museum is from private donations from citizens interested in constructing a museum, the museum administrators ignore the comptroller's instructions and continue to raise money through a new subscription.[15]

On January 6, 1928, the museum changes its name from Zoological Museum to The Museum of Natural History.

In May 1931, James F. Bell offers the university $125,000 towards building a new museum, as long as the state matches an equal amount. The state legislature that year decides not to allocate funds, so Bell takes back his offer.

As the collections continue to grow, and staff is added, it is realized by many on the university campus that a larger building really is required in order to keep up with demand from the faculty and students, researchers and the local community.[16]

According to Dr. Thomas Roberts, the main objective of the museum is "to collect and preserve in realistic and permanent manner the wild life of our state for the present and future

[15] Roberts, Thomas S. M.D., Director. *Annals of the Museum of Natural History. University of Minnesota. 1872-1939.* Pgs. xiii, xiv. 1939. Minneapolis.
[16] Roberts, Thomas S. M.D., Director. *Annals of the Museum of Natural History. University of Minnesota. 1872-1939.*

generations." Even in 1940, people realize that wildlife is disappearing, or have already disappeared and a museum is the only way to document what existed. It is also recognized that most people at this time do not travel nationally or internationally to experience the world, so again, a museum seems a logical choice. [17] In 1938 James Bell, provides a $150,000 donation to help in the design and construction of the new Minnesota Museum of Natural History. This donation covers over half of the total estimated building costs of $272,000. The remaining monies come from private donations and the Public Works Administration, a federally funded program that is implemented by President Franklin D. Roosevelt in 1933.[18] The building is to be located on the corner of University Avenue and Church Street on the University of Minnesota East Bank Campus in Minneapolis, Minnesota.

Clarence H. Johnston, Jr., son of famed architect,[1920] Clarence H. Johnston Sr., is chosen to design the building.[21] Johnston Senior's firm has designed university buildings for years, and understands the workings of the University of Minnesota so the architect is a logical choice. The contractor who wins the bid is Devereux-Olson Construction Company. Groundbreaking occurs in November of 1938, the museum is completed in 1940 and the building dedication is held September 28, 1940.

For the next twenty years, the museum staff expands and the biological science area explodes with new research. This, in turn, cramps the museum quarters. In 1963, an addition is suggested to be built along the backside of the museum, adjacent to Folwell Hall. By this time, Clarence Johnston, Jr. has passed on, so a new firm, Cavin & Page Architects, is hired to design the addition. Initial costs come in at $503,526. On July 23, 1964, ground is broken for the new wing of the museum. The final cost comes to $711,400, which includes a $50,000 donation from

[17] Remarks of Dr. Thomas J Roberts at the Dinner Preceding the Dedication of the Minnesota Natural History Museum. 9/28/1940.
[18] PWA Form No. 175. 11/10/1938.
[19] Remarks of Regent J.F. Bell at Corner Stone Ceremony 9/14/1940
[20] Remarks of Regent J.F. Bell at Dedication of Museum of Natural History, 9/28/1940.
[21] It has been noted previously that Clarence Johnston Sr. designed the building, but according to documents he died in 1936, and this project did not start until 1938.

the National Science Foundation, $250,800 in private donations and a $410,600 allocation from the state legislature.[22]

In 1967, the Minnesota Museum of Natural History is renamed the James Ford Bell Museum of Natural History in honor of its main patron, the late James Ford Bell.

It takes seven years for the addition to be completed, including the interiors and furniture. The project has to be put on hold several times due to lack of public and private funding. The 5,750 square foot addition is completed in April 1971 and the building dedication is May 8, 1971.[23]

Even with the new addition, by the mid-1970s the staff and faculty feel the building does not meet their needs. The eight curators have 7,650 square feet of collection space, with another 1,945 square feet in curatorial office space and preparation laboratories. There is no room for expansion, and the building does not have adequate mechanical systems to handle updated scientific methods used in the industry.[24]

In the past 30 years, there has been great interest to either remodel or move the museum to the University of Minnesota's St, Paul campus so it can be closer to its biological science counterparts. In 2008, the most recent funding request for $24 Million dollars comes before the Minnesota State Legislature to build a new building on the St. Paul campus. It is approved by the state legislature, but due to massive state budget cuts that coincide with the current recession, Governor Timothy Pawlenty vetoes the request. The university decides to take the new building off their 2010 construction agenda, but they are determined to figure out a way to readdress building funding at a later time.[25]

History of the Art Moderne and Art Deco Styles

Art Moderne originates with the Bauhaus movement, which begins in Germany under the leadership of Walter Gropius. The movement, later under the leadership of Ludwig Mies Van

[22] News Service, UMN, Ground Will Be Broken Thursday for Bell Memorial Wing of Museum.
[23] Press Release, UMN. *Dedication of the New Wing.* May 8, 1971. UMN Archives.
[24] Rubenstein, Doris. *Fact Sheet: Bell Museum of Natural History.* 1989. University of Minnesota Archives.
[25] http://www1.umn.edu/twincities/faculty-staff/features/2008/UR_180309_REGION1.html

Der Rohe closes during the Nazi occupation in 1933. These designers and architects use the principles of classical architecture in their most pure forms - triangles, squares, curves and cones. There is no excess or ornamentation.[26]

The Art Moderne style is recognized by "horizontal orientation, a flat roof, asymmetry, cube-like shape, no cornices or eaves, sleek, stream-lined appearances, smooth white walls, rounded corners highlighted by wraparound windows, aluminum or stainless steel door and window trim, mirrored panels, steel balustrades, a suggestion of speed and movement, little or no ornamentation and open floor plans."[27]

Art Moderne ornamentation consists of mirrored panels, cement panels, metal panels with low relief, decoration around doorways and windows. [28]

The popularity of the Art Deco style comes about due to its freshness compared to the traditional style of the Beaux Art and the influence of the Victorian and Edwardian period home styles. Art Deco is named from the 1925 Paris International Exposition.

As the Age of Machinery matures, this style represents its modernity and sleek style. Not only are Art Deco attributes applied to buildings; they are also applied as decoration to furniture, art and objects.[29]

It is also inspired by Cubism in Europe, a style associated with Pablo Picasso, and the avant-garde movement of the late 19th and early 20th Century, and North and South American Indian Art.[30] The designs consist of low relief geometrical designs, parallel straight lines, zigzags, chevrons, and stylized floral motifs.

Materials used are concrete, smooth-faced stone and metal accents in terra-cotta, glass and colored mirrors. Polychromy is evident, and forms are streamlined and simplified.[31]

---

[26] Duncan, Alastair. American Art Deco. 1986. Harry N. Abrams, Inc. New York.
[27] Duncan, Alastair. American Art Deco. 1986. Harry N. Abrams, Inc. New York.
[28] Harmon, Robert B. The Art Moderne Style in American Architecture: A Brief Style Guide. 1983. Vance Bibliographies. Monticello, IL.
[29] Harmon, Robert B. The Art Deco Style in American Architecture: A Brief Style Guide. Vance Bibliographies. Monticello, IL... 1983.
[30] http://en.wikipedia.org/wiki/Cubism
[31] Harmon, Robert B. The Art Deco Style in American Architecture: A Brief Style Guide. Vance Bibliographies. Monticello, IL... 1983.

These particular styles are not as distinct as their European counterparts, but a mixture of American influences within the styles during the 1930s. According to Giovanna Franci, Rosella Mangoaroni and Esther Zago, "the term used in the US was more ambiguous. "Deco" used as an umbrella term for the most diverse manifestations of the "modern" in America. It connected to the field of industrial design, laws of marketplace and desire to explore the new possibilities opened up by the so-called Machine Age." [32]

Art Moderne and Art Deco are very similar, yet have specific differences. They both have stripped-down forms and geometric design, yet the Art Moderne tends to appear sleeker and plainer, while the Art Deco is more ornate. Art Moderne tends to use the color white throughout, while Art Deco uses brighter colors. The Art Moderne style also tends to be used on more public buildings, while the Art Deco is used on more residential buildings.[33]

Although these two styles do not last long, their influence is evident through the Post Modern Styles that come later in the 1940s, 50s and 60s.

Architectural Style of the Bell Museum – Criterion "C"

To determine architectural style, this researcher uses The National Park Service, Preservation Brief #17, *Architectural Style,* as a guide. The three-step process which is described in this brief includes 1) Identifying the Overall Visual Aspects which involves looking at the building from afar to assess the character of its site and setting, 2) Identifying the Visual Character at Close Range which involves looking at the building up close to assess material surface qualities, texture, and color, surface assessment of craftsmanship and age, and 3) Identifying the Visual Character of Interior Spaces, Features and Finishes.[34]

[32] Franci, Giovanna, Mangaroni, Rosella, and Zago, Esther. A Journey Through American Art Deco. University of Washington Press. Seattle. 1997.
[33] Duncan, Alastair. American Art Deco. Harry N. Abrams, Inc. New York. 1986.
[34] http://www.nps.gov/hps/tps/briefs/brief17.htm

Identifying Overall Visual Aspects

The overall visual experience of the site and building can be seen in Figures. 1, 2 and 3. In Figures 3 and 5, specifically, the exterior shows the cube-like building form with strong vertical and horizontal architectural features like windows and material changes.

Figure 4: Current photo of the Bell Museum taken 1/2010.

Figure 5: 1940 Exterior Perspective of the Bell Museum. Courtesy of UMN Archives.

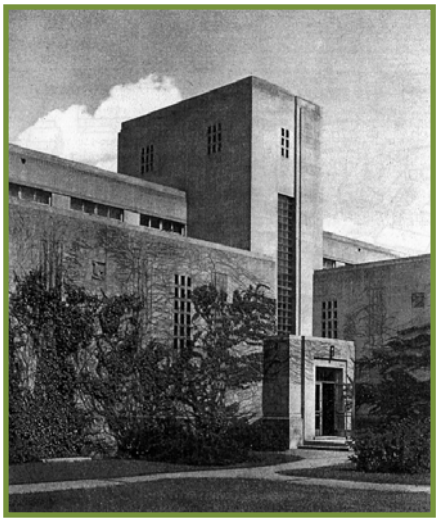

Figure 6: South Exterior Bell Museum. 1940. Courtesy of UMN Archives.

Each main section of the building is a separate rectangle or cube that intersects with each other. This is easily seen in Figures 7 and 8.

The building's massing creates a very solid feel that defines the site, and its setting.

The stairs to the main entrance, along with the verticality of the inset front double doors with upper bas-relief provides visual wayfinding ques and gives asymmetrical balance to the structure.

The roofline has no cornices or eaves, and the roof, itself, looks flat from the ground.

The south side of the building shows a very cube-like mass that again exhibits strong vertical and horizontal shapes through windows, material insets and scale and proportion. Projection of the south side entrance gives the effect of cubes laid over one another.

The limestone from a distance cannot be identified as individual pieces, but the material's color is neutral enough where it does not distract from the overall cube-like form.

The glazing looks charcoal to black, so the effect is rather like looking at cutouts out of a block.

The 1960s addition, located at west side of the building, next to Folwell Hall is similar in form, with strong vertical panels and horizontal ribbon windows. The cooling tower and other mechanical elements can be seen from the ground, but the form works well with the addition and the original building, and does not adversely affect the original 1930s building.

Figure 7: Southwest side of 1960 Addition to Bell Museum

Figure 8: Southside of Bell Museum Showing Cooling Tower

The landscaping in the current photo obscures the architectural features of the museum, and is not part of the original design intent. Much of it is overgrown, and requires some thinning out to make the front area feel like an enhancement to the building, and not an overwhelming feature.

The original landscape is meant to soften sharp edges, yet still provide a cohesive picture. The vines, in the summertime, hide most of the exterior walls, but during fall when the leaves fall off, the vines leave clusters of blue-purple berries, giving texture to the building.

The setbacks to the building are somewhat generous, as seen in Figure 1, and its location connects the building to the main thoroughfare of University Avenue, the Amory, directly across the street, and Church Street. Its urban setting ties well with its modern style.

Identifying Arm's Length Visual Aspects

As you stand at arm's length of the building, you begin to see material types, how materials are put together, and decorative elements.

The first thing you see is the individual pieces of Buff Bedford Indiana Limestone.

Architect, Clarence Johnston, Jr. and the University Advisory Architect, Prof. Roy Childs Jones, requests that the building exterior initially be clad in Mankato stone, but due to cost, Buff

Bedford Indiana limestone is used. The stone creates the horizontal lines typically found in Art Moderne style.[35]

Figure 9: Bell Museum, 1942. Courtesy of Minnesota Historical Society

The exterior doors are made of stainless steel which gives the front entrance a strong rectilinear presence all the while providing a bit of whimsy and fluidness through the Art Deco style metalwork grill that detailed pelicans and geese.

The pilasters on either side of the door with the vertical flutes reinforce visually the entrance's strength, and grandeur. The chiseled lettering "James Ford Bell Natural History Museum" is found often in the Art Deco Style.

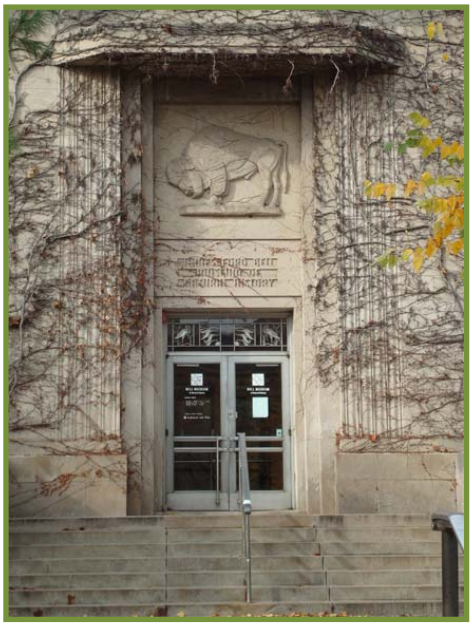

Figure 10: Bell Museum Front Entrance, 11/2009

Figure 11: Transom Window with Metalwork Showing Pelicans and Geese Above Front Entry Door of Bell Museum.

The granite stairs to the main entrance and to the auditorium again provide another strong horizontal line, reinforcing the Art Moderne style.

[35] Letter dated 1/4/1939. Written by W.T. Middlebrook, UMN Comptroller to Frank. G. Babcock, Treasurer, Breen Stone & Marble Company, Kasota, MN.

Figure 12: Sculpted Bas-Relief of Buffalo, Designed by Samuel Bell, Located Above the Front Door.

Samuel Bell, son of James F. Bell, designs and sculpts the buffalo found above the front entry door, and the animal motifs found at the top on all four sides of the exterior building facade.[36] The sculptural reliefs help designate this building from the exterior as a natural history museum. See Figures 12 and 13.

Figures 13: Owl and Bear Bas-Reliefs Located on West Side of Bell Within the Green House Addition.

Attention to detail of how materials are put together does not go unnoticed.

Stone joints are tight due to stone masons' craftsmanship.

Metalwork is handmade, and detailed. Some of it is in a streamlined fashion, while other metalwork is delicate.

Figure 14: Font Style

The exterior lighting fixtures are placed on rectangular supports that fit with the architectural style of the stairs.

Lighting is placed on the ground and directed upward to showcase the architectural elements of the exterior walls. Door and window frame connections to the building rough openings fit snugly, and their scale and proportion are appropriate to the scale and proportion of the building.

[36] "Museum Sculptor Samuel Bell Dies." Imprint. Vol. V, No. 2. Spring 1988.

Identifying Interior Visual Character

Indentifying interior visual character can be done at both large scale and in fine detail. The floor plans seen in Figure 16: The First Level, Figure 17: The Mezzanine Level and Figure 18: The Second Level suggests rectilinear shapes that have asymmetrical balance. You can also see how spaces flow from one to another, and indicate strong horizontal and vertical lines as well as some curved lines.

As one walks through the front lobby area, located at the bottom of Figure 16, towards the galleries located on the first floor and mezzanine levels, the stairs create a strong presence. The dioramas located on the sides and in the middle of the gallery space are combinations of rectilinear shapes with curved lines that are laid out vertically which creates a symmetrical balance between the overall rectilinear design of the space and the interior.

The auditorium, which is located to the left of the main lobby in Figure 16, is also a strong rectilinear presence, with interior curved lines found on the ceiling plane, and the layout of the auditorium seating that helps break up the rigidness of the horizontal and vertical lines.

The 1960s addition, in its simplicity, creates more asymmetrical balance when paired with the original building. It also reads well next to Folwell Hall when looking at a site plan.

The finer character details can be seen immediately as one enters any of the building entries. As you enter the front vestibule, there is grillwork and wood paneling on the left wall that hides the radiators.

The door handle detail is stainless steel, and shows strong horizontal and vertical connections that create the streamlined effect found in the Art Moderne style.

A white-veined green marble is the wall base which is found throughout the lobby and the more important public areas.

Figure 23, the green terrazzo floor, with the inlaid walk-off mat, and the stainless steel floor inlays can be seen through the interior vestibule doors.

The ceiling, painted a simple white, shows water damage in Figure 89. It has a fluted molding detail that is copied from the exterior pilasters.

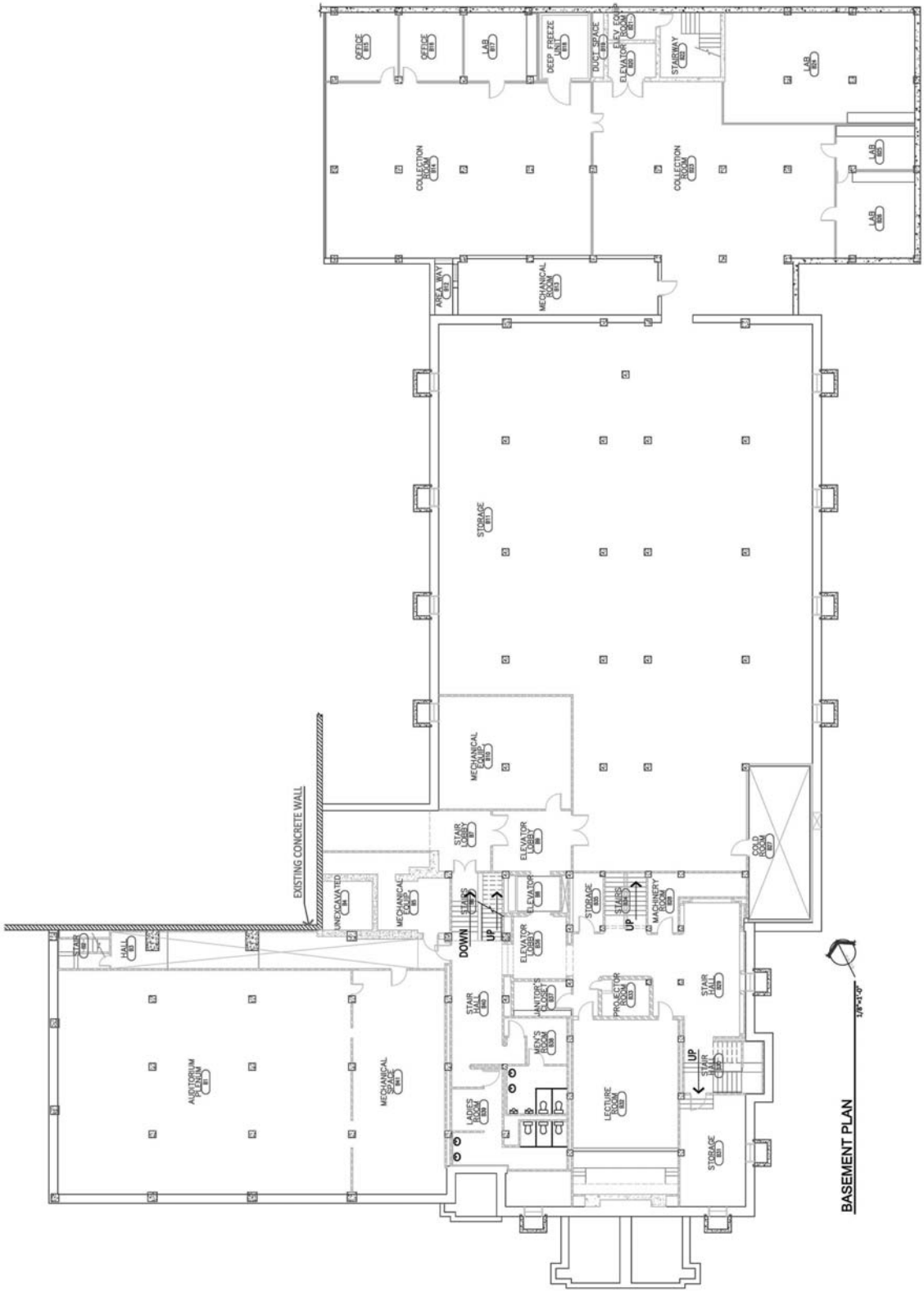

Figure 15: Bell Basement Level Floor Plan. AutoCAD plan by J.R. Friendshuh

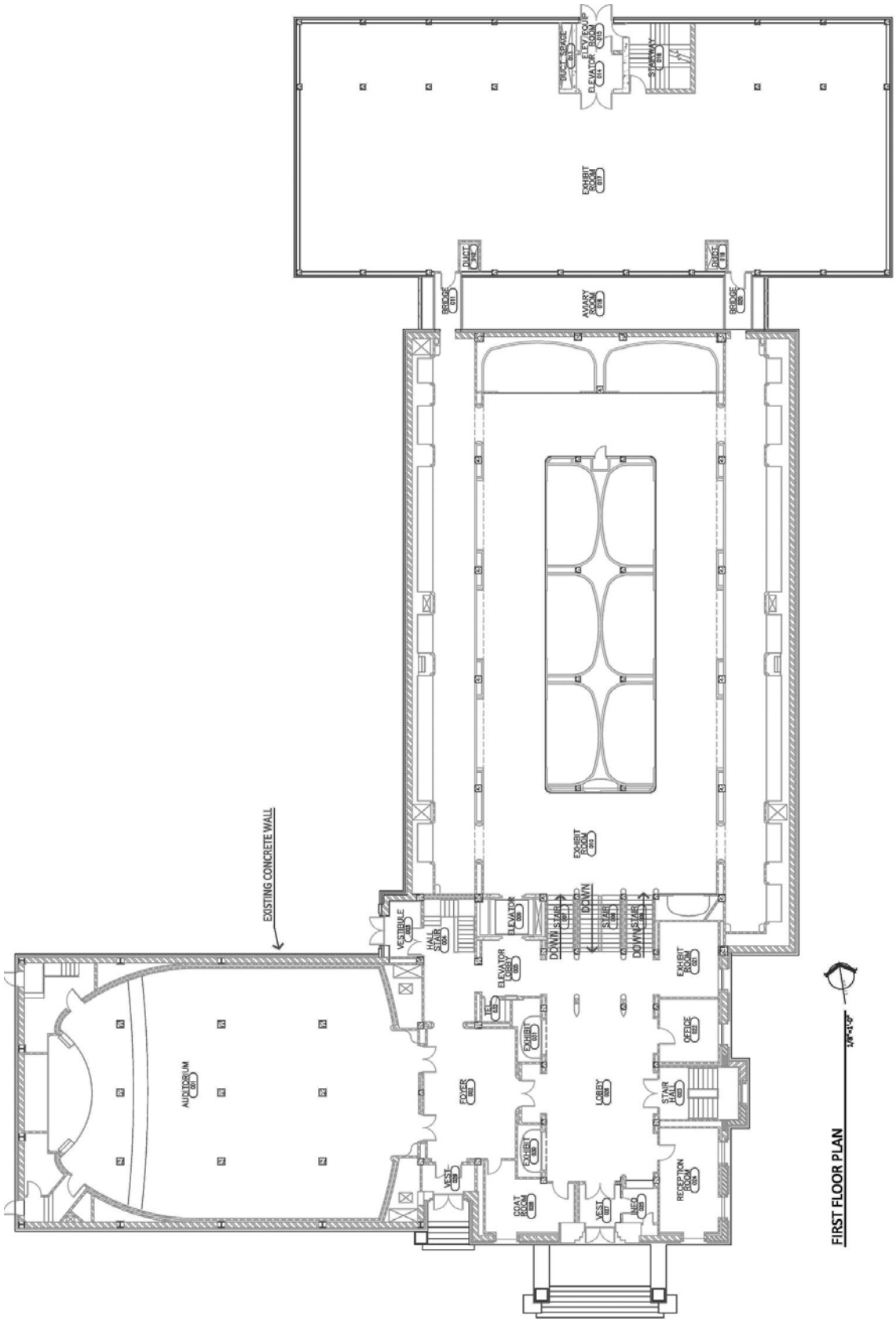

Figure 16: Bell First Level Floor Plan. AutoCAD plan by J.R. Friendshuh

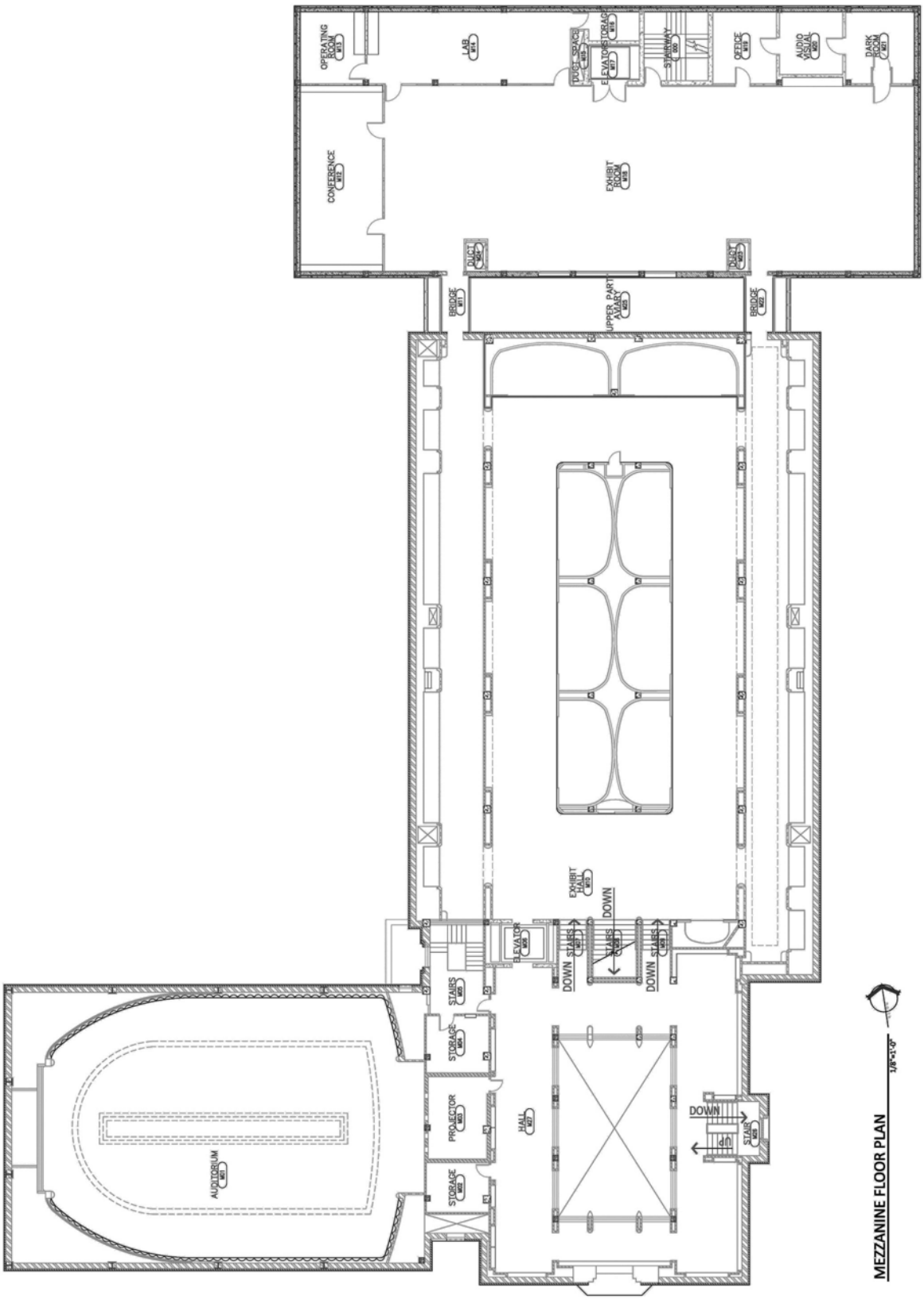

Figure 17: Bell Mezzanine Level Floor Plan. AutoCAD plan by J.R. Friendshuh

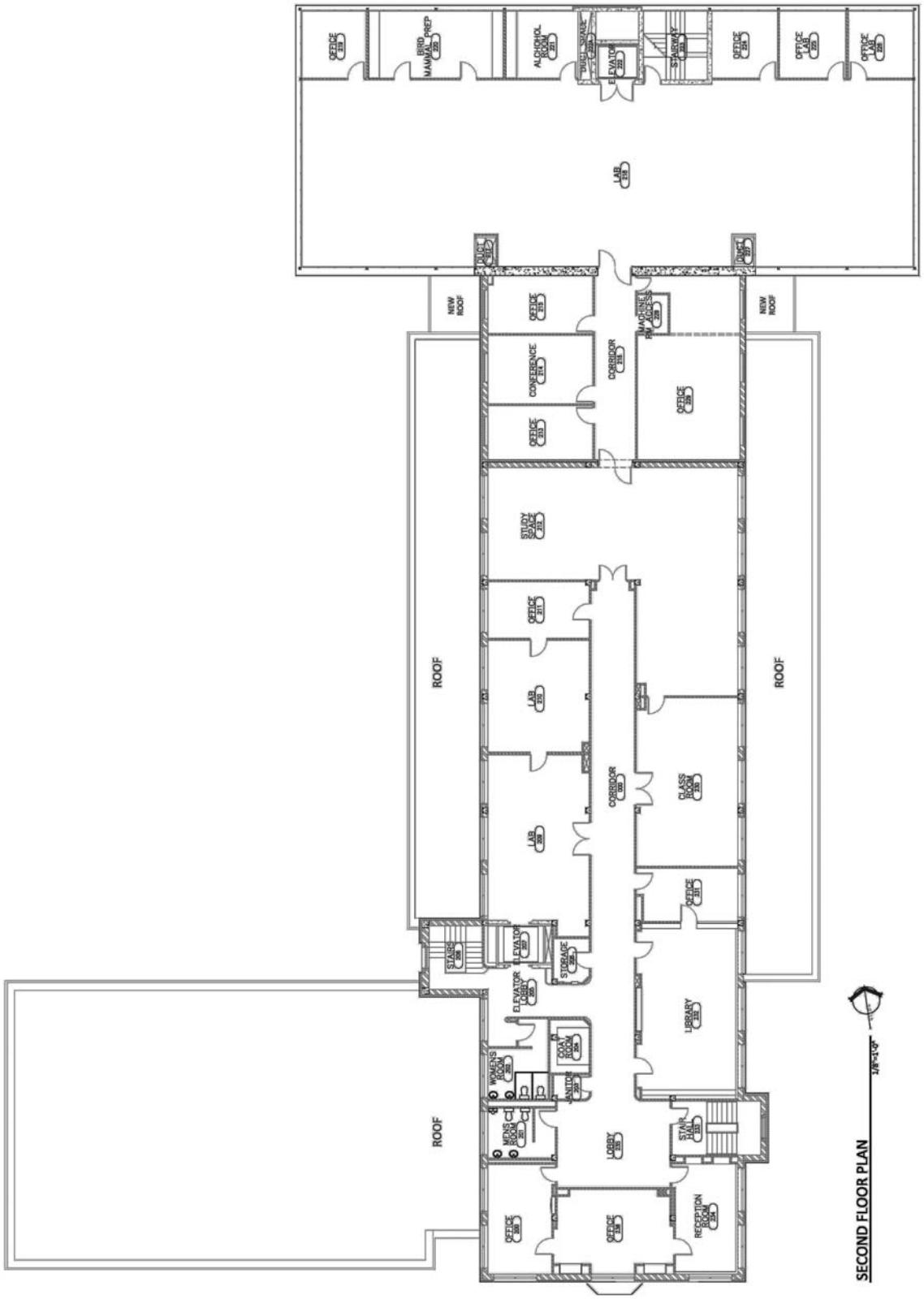

Figure 18: Bell Second Level Floor Plan. AutoCAD plan by J.R. Friendshuh

Figure 19: Green Marble Wall Base

Figure 20: Vestibule Grillwork Hiding Radiators, and the Green Marble Wall Base

Figure 21: Vestibule Door Handles in the Art Moderne Style

Figure 22: Auditorium Stage - Wood Stairs

Figure 23: Vestibule Floor Seen Through Interior Vestibule Door.

Figure 24: Auditorium Wall and Ceiling Details

Figure 25: Auditorium Ceiling Detail

The vestibule opens up to the interior lobby which originally has an open mezzanine which is seen in Figure 26. The Art Moderne style is shown through the vertical lines of the columns and the horizontal lines of the terrazzo floor pattern, the metal inlays along the perimeter of the mezzanine, the mezzanine handrails, light fixtures and the cove ceiling above. The green terrazzo floor and marble wall base continues through the lobby to the stairs.

Figure 26: Interior Lobby in 1940. Courtesy of University of Minnesota Archives.

The auditorium holds roughly 500 people, but does not have the original seating. The walls are a scalloped plaster with a wood panel dado. At the ceiling there are scalloped plaster moldings. The cove lighting layout is original to the space, and provides good ambiance. The auditorium also has a projector room, located on the mezzanine level and a stage area that still has the original flooring and millwork.

Furniture, hardware and accessories exhibit an Art Moderne/Art Deco feel through clean lines, shapes and forms, materials like steel, wood and leather creating a streamlined, sleek and modern affect. See Figures 27 and 28 for examples.

Figure 27: Lobby Clock in the Art Moderne/Art Deco Style. Designed by C.Johnston, Jr.

Figure 28: Lobby Bench Designed in the Art Moderne

Walls have rounded edges, which were a typical Art Moderne design aesthetic. You can see several examples in Figures 29, and 30.

Figure 29: Rounded Wall Corners and Soffit Per the Art Moderne /Art Deco Style

Figure 30: Rounded Paneled Wall Corner Per the Art Moderne /Art Deco Style.

Stairway metal handrail systems also show an Art Moderne/ Art Deco aesthetic through material usage and style. The handrails by the stairs between the lobby, the first floor and lower level are stainless steel that matches the simple design of the front door hardware. Note the curved style of the handrail connections. The side stairwells in the back of the building are painted metal that have a curved design vs. a rectilinear. See Figures 32, 34 and 35 for examples.

Figure 31: Lobby Terrazzo Floor

Figure 32: Stairway Stainless Steel Handrail Detail

Figure 33: Decorative Glass Block Window in Stairwell

Figure 34: Back Stair Curved Metal Handrail

Figure 35: Curved Handrail Detail

The windows are original to the building, and add to the Art Moderne feel. Unfortunately they are limited to several of the stairwells, and to the offices and classrooms located on the second level. Several window styles are found throughout the building, which include decorative glass block windows found in the stairwells, and metal frame casement windows with single-pane glass are found in the administrative offices and classrooms. See Figures 37A and 37B. The casement windows leak, and allow drafts in during the winter, but during the summer, provide fresh air from the outside. The original building does not have central air conditioning to cool the spaces, but various administrative and classroom spaces have air conditioning units.

Figure 36: Elevator Door with Art Deco / Art Moderne Stainless Steel Geometric Design.

Figure 37A & B: Original Classroom Windows and Their Hardware

The elevator doors are painted steel with a stainless steel geometric stripe pattern on the front that also reflects the Art Moderne/Art Deco style.

The interior of the addition is not as significant as the original building, but does not adversely affect the original building either. The new addition interior design uses more concrete walls, but keeps the very rigid rectilinear form, scale and proportion developed by the original architect, Clarence Johnston, Jr. A glass conservatory connects the original building to the Page & Cavin wing and the design tends to focus mostly on the utilitarian needs of the scientists and researchers working at the museum. There are some solidly constructed, functional built-ins and millwork in the addition's spaces, but nothing that stands out. Some of the space is converted to public space in the 1980s, which now houses a children's learning area. The addition costs more than the original, yet the attention to architectural and interior detail is not as strong.

Through this analysis, the researcher can show that the Bell Museum can be considered an Art Moderne/Art Deco style specifically that the building exterior is Art Moderne and the interior design, accessories and building embellishments are more Art Deco.

History of Dioramas

Dioramas have a very interesting history, and there are three specific types that have been documented. The first example goes back to the 6th Century in Japan where the Japanese would design and build *bonkei,* or miniature landscapes.

The second example is a theater as a moveable device. They become popular in the early 1820s due in part by Louis Jacques Mandé Daguerre, the inventor of the daguerreotype. He designs a large theater space, and paints natural scenes on transparent linen backdrops which are then lit from the front and behind.[37] This proves so popular that in 1823, he opens another theater in London.

The third example is the life-size dioramas showing three dimensional spaces. This type can be credited to Frank Michler Chapman, a curator at the American Museum of Natural History in Manhattan, New York. These dioramas have always been a great way to tell a story and to provide a visual representation of nature. They are not only considered a teaching tool; but a work of art.

Dioramas at the Bell Museum – Criterion "C"

The Bell Museum pays attention to what other larger museums in more cosmopolitan areas are doing, and in turn, continues to develop a product that people come to see.

The curator at the Bell Museum makes sure that the materials used, and the artisans hired are of the highest quality. The most challenging pieces to the artists are "constructing the bases, fabricating rocks, trees and plants, imitating water and disguising the edges where wall and the floor meet."[38]

The dioramas are to be a tour through major Minnesota habitats, showing species, seasonal changes, environment and biological history.[39]

---

37 http://www.ehow.com/about_5445468_history-diorama.html

38 Luce, Don, Pelley, Janet, Williams, Kevin. The Making of the Bell Museum Dioramas. Exhibits Division. University of Minnesota Press. 1987, MN.

39 Luce, Don, Pelley, Janet, Williams, Kevin. The Making of the Bell Museum Dioramas. Exhibits Division. University of Minnesota Press. 1987, MN.

The oldest diorama, The Woodland Caribou, is considered an early form of today's dioramas. Dioramas constructed between 1911 and the late 1960s represent surreal styles in the evolution of diorama development.[40] The dioramas are developed by Walter Breckenridge and Charles Corwin, artists who excel at painting natural landscapes and are the foremost diorama painters of their day. Many of the backdrops seen at the Bell today are the original dioramas painted by these two artists, and taxidermist and preparatory, John Jarosz, as well as Francis Lee Jaques.

Figure 38: Caribou Diorama

Francis Lee Jaques is an artist who works at the American Museum of Natural History (AMNH) as a background painter beginning in 1924. He stays in New York with his wife, and works for the AMNH for 25 years before returning to Minnesota, where he begins his work at the Bell Museum.[41] Born in Illinois, his family moves to Aitkin, MN where he learns to hunt and fish all the while taking notice of nature through his sketchbook. His ability to capture nature with oil paints and paper are a gift. His work can still be seen at the American Museum of Natural History (AMNH), as well as the Jaques Gallery, located at Aitkin, MN.

---

40 Luce, Don, Pelley, Janet, Williams, Kevin. The Making of the Bell Museum Dioramas. Exhibits Division. University of Minnesota Press. 1987, MN.

41 http://www.jaquesart.com/biography.html

James F. Bell's Background – Criterion "A"

Figure 39: James Ford Bell. ca. 1915. Courtesy of the Minnesota Historical Society

James Ford Bell is born to James S. Bell and Sallie Montgomery O'Neil Ford Bell in 1879 in Philadelphia, PA. The family moves in 1888 to Minnesota when his father is recruited to join the Washburn-Crosby Company by none other than William Hood Dunwoody, a prominent Minneapolis businessman, who also founds the Dunwoody Technical College. As a young man, James F. Bell attends Lawrenceville School in New Jersey, a private boarding and prep school prior to attending the University of Minnesota.

While attending the university, he sets up a flour testing lab at the Washburn-Crosby Mill. This is one of the first testing labs within a flour mill in the country. He graduates from the University of Minnesota in 1901 with a Bachelor of Science in Chemistry. The same year, he joins the Washburn-Crosby Company permanently as a salesperson covering the state of Michigan. This position allows him to learn the flour mill business from the ground up, which proves to be beneficial in later years.

A year later, he marries Louise Heffelfinger, and they have four children: James Ford Jr., Charles, Samuel and Sally.

Bell seems to be somewhat of a renaissance man. Not only is he interested in selling flour; he is interested in the entire process starting with the farmer to the miller and then the baker. The more he learns, the more he wants to know.

He continues his personal studies by acquiring and reading books in the 1920s. Economics, business strategies, and agriculture intrigue him, which in turn, piques his interest in nature and wildlife. His interests in nature are also influenced by the social circle in which he grows up. The businessmen his father interacts with, like James J. Hill, William Dunwoody and the Crosby's are all avid hunters and fishermen.

As his professional life flourishes in the early 1900s, Mr. Bell becomes involved in philanthropy through the Natural History Museum at the University of Minnesota. He donates several animal groups to the museum beginning in 1911, and continues to provide funding up until his death.

In 1915, he becomes vice-president of the Washburn-Crosby Company, and in 1917, he is asked by the Wilson Administration to run the Milling Division of the US Food Administration, which is now known as the US Food and Drug Administration. He leaves Minneapolis and the Washburn Crosby Company for Washington. When World War I ends, he comes back to Minneapolis, foregoing the political life, to reorganize the Washburn-Crosby Company.

In 1925, he takes over his father's role of president at the Washburn-Crosby Company, and in 1928 works with four other flour mills in the country, consolidates them and creates the company General Mills. This company is now the 6th largest food company in the world and its net sales in fiscal 2010 is $14.8 billion.[42]

In the 1930s, during the Great Depression, he becomes a member of President Hoover's Advisory Committee on Relief for Unemployment. In May 1931, Bell initially offers $125,000 in funds for a new museum if the state matches the amount. It is at this time, that Hoover's Emergency Committee is providing federal funds to states, and local governments to build public buildings in order to get people back to work. The state declines and Bell's offer is rescinded.

By the late 1930s, the Natural History Museum at the university is still seeking funds to build a new building on campus. With Bell's donation of $150,000, and the remainder of the funds provided by the Public Works Administration in 1938, the new Natural History Museum is underway. It is interesting to note that during the construction phase of the museum in 1939, Bell becomes a Regent of the University of Minnesota.

Bell not only provides funding for the Natural History Museum; he continues his philanthropic work by becoming a trustee to the Dunwoody Institute of Minneapolis, now the Dunwoody College of Technology, a trustee of the Carnegie Foundation in Washington, a trustee

[42] http://phx.corporate-ir.net/phoenix.zhtml?c=74271&p=irol-newsArticle&ID=1442782&highlight=

of the Minneapolis Society of Fine Arts and a patron of the Minneapolis Institute of Arts. He also establishes the Delta Waterfowl Research Station in Manitoba, Canada in 1931. [43]

And with a collection of approximately $185,438.78 worth of ancient manuscripts and books he amasses over time, he sets up the James F. Bell Library Room, located at Wilson Library at the University of Minnesota.

James F. Bell plays a prominent role in Minnesota's local history through his professional work with General Mills and his philanthropic work at the University of Minnesota, and various other non-profits. He also plays a role our nation's history with the US Food and Drug Administration during the end of World War I, the Advisory Committee for the Relief of Unemployment and the Public Works Administration during the Great Depression. Finally, due to his support, natural history studies and research in Minnesota is able to grow and has been preserved over time. All this work he continues until his death in 1961.

Public Works Administration – Criterion "A"

As previously mentioned, the Bell Museum is a Public Works Administration (PWA) project. The Public Works Administration, (PWA) is created by President Franklin Roosevelt as a New Deal government agency in 1933 in response to unemployment during the Great Depression. It is implemented by Congress as the Federal Administration of Public Works after passing the National Industrial Recovery Act. PWA projects consist of public buildings, bridges, dams, and housing developments that are funded by the federal government in order to provide jobs for unemployed Americans.

It also provides loans to states and municipalities to build similar public projects. It is later reorganized in 1939 and falls under the supervision of the Federal Works Agency. The program stops in the 1940's.[44] The Bell Museum is one of the last projects built under the support of the PWA. The PWA follows Hoover's Emergency Committee which is established in 1931 as an attempt to provide monies for public works projects which includes waterway, harbor, public

[43] James Ford Bell Library History, University of Minnesota.
[44] Columbia Electronic Encyclopedia, 6th Edition; 10/1/2009, p1-1, 1p

buildings, and flood control, highway and airway improvements. Monies also are provided for merchant ship builders, the Navy, and military aviation. Government spending that year for such projects surpasses $520,000,000 and Hoover expects spending to continue upwards of a billion dollars annually.[45] Even though Hoover's Emergency Committee initiates the idea of putting Americans back to work through federally funded construction projects, it is deemed a failure due to its more conservative approach.

Argument for the Bell Designation

Based on the research above, the Bell Museum meets the evaluation criteria required by The National Register of Historic Places. The Bell Museum falls under the "building" category as discussed in Bulletin #15, and comes closest in description as a "library."[46]

The building is associated with a turbulent time period in this country's history through the Public Works Administration implemented by President Roosevelt. James Bell, one of the museum's main patrons is an affluent Minneapolis businessman and philanthropist who creates The General Mills Company. His influence in Washington D.C. during World War I, World War II, and the Great Depression in regards to wheat is felt throughout the entire world. Bell's interest and commitment to nature and natural habitats help support scientists in their endeavor to learn and research more about the natural world. The Bell Museum's history begins in1872, and continues through the renaissance of the natural history museum.

The Bell Museum is of the Art Modern/Art Deco architectural style. Today it is one of the few examples remaining intact in the Twin Cities from this time period. The dioramas, which are inherently part of the museum, are also a pivotal element in the designation because they represent a past teaching method that is widely used nationally and internationally. The backdrops and foregrounds are designed and painted by national artists and taxidermists in the

[45] Congressional Digest; Jan1931, Vol. 10 Issue 1, p8-31, 2p
[46] http://www.nps.gov/history/nr/publications/bulletins/nrb15/nrb15_4.htm#building

field. They cannot be considered an object separate from the museum because without them there would be no museum.

It can receive local designation due to its local history, architectural style and artistic significance of the dioramas. Placing it on the national list, however, may be a stretch because the building is competing against other buildings with stronger historical backgrounds.

Possible nomination for a UNESCO World Heritage Site designation, however, is questionable. Even though the structure has definite local merit and maybe even national merit, its international merit, I think is weak. UNESCO's position on their website states that "sites must be of outstanding universal value and meet at least one out of ten selection criteria." First, the museum has played no part internationally when compared to other older natural history museums mentioned earlier in this paper. Second, when searching through UNESCO's Site List and an advance search was completed in search of museums, the researcher found no museums had been listed as a World Heritage Site.[47]

Precedence – The Frist Museum

The Frist Center for the Visual Arts, located in Nashville, Tennessee, is an excellent example of precedence when making the argument that the Bell is historically significant and can be reused for another purpose. Its story is slightly different, as it did not start out as a museum, but there are other similarities that I think tell a compelling tale.

Figure 40: Frist Center for the Visual Arts - Exterior.

Figure 41: Frist Center for the Visual Arts - Exterior

[47] http://whc.unesco.org/en/list

he building is originally Nashville's main post office. It is constructed in 1933-34, during the Hoover administration where federal dollars are appropriated by Congress. This is what James Bell tries to do initially in the early 1930s to receive funding through the federal government. Unfortunately, he is not successful until almost 10 years later.

The building design style is deemed classic and Art Deco and in 1984, the post office is listed on the National Register of Historic Places. [48]

As times change, however, a new post office distribution center is constructed near the airport, and the main downtown post office becomes a branch of the new center, and only a portion of the building is being utilized.[49]

The city of Nashville realizes that this building is historically significant, and that it should have a new purpose. In the early 1990's, a community "visioning" meeting is held, and it is determined that a visual arts center is wanted.

Thomas F. Frist, Jr., M.D., as well as his family, provides the initial commitment through the Frist Foundation. They collaborate with the U.S. Postal Service, the City of Nashville, and the Metropolitan Development and Housing Agency to purchase the building and its surrounding land.[50] In 1998 the ownership of the building falls to the City of Nashville. The museum is built out in the majority of space, while the post office branch moves to the lower level of the building.

Figure 42: Frist Lobby Doors

Figure 43: Frist Lobby Floor Pattern

[48] http://www.fristcenter.org/site/about/building.aspx
[49] http://www.fristcenter.org/site/about/building.aspx
[50] http://www.fristcenter.org/site/about/building.aspx

The Frist building materials are very similar to the Bell Museum. The exterior is faced with white Georgia marble with gray-pink Minnesota granite.

The cast aluminum doors are more intricate than the Bell Museum's interior doors, but and lobby door's grillwork are similar in style to the Bell Museum's.

Figure 44: Interior Aluminum Doors with Marble Walls and Floors

Figure 45: Interior Door Grillework

The Frist stairway in Figure 28 has a similar wall base pattern of dark marble like the Bell and the round-edged stairs are also seen in both buildings. The stair railing is almost identical to the ones found in the Bell Museum.

The scalloped ceiling details found in the Frist are reminiscent of the lobby ceiling detail in the Bell Museum Lobby and Auditorium, although the Frist embellishment is more extravagant than the Bell.

Figure 46: Frist Lobby Stairs and Stair Rail

Figure 47: Frist Interior Stair and Ceiling Details

Figure 48: Frist Interior Ceiling Detail

Figure 49: Frist Vestibule Details

Figure 50: Frist Lobby Console Table

Figure 51: Frist Stairway and Railing Detail

PART II

Why Reuse A Building?

Adaptable reuse of a building is a complicated issue that has yet to be fully analyzed. It further complicates the issue when the building potentially is on a local, state or national preservation list, like the National Register of Historic Places, or UNESCO.

Both qualitative and quantitative data is required in order to determine if a building can be saved. However, both are not always easy to document. Quantitative data is becoming more available as we study the issue, but it still seems to be a moving target.

Right now, the biggest source of quantitative data we have is the construction cost estimates used by developers to access whether to tear a building down versus rehabbing a building. In a 2006 article, "Does Adaptive Reuse Pay?" the writers find that 16 developers interviewed do not always feel comfortable sharing the numbers for construction costs.[51] Therefore, their study is not as accurate as it could be.

The second part is qualitative data which is also important, but this is even more difficult to ascertain than quantitative data. Developers in that same article indicate that when thinking about a building, they look at four categories: the building's special qualities, building location and site advantages, return on investment (ROI) and government assistance.[52] Qualitative data of this nature tends to be a bit fuzzier than the quantitative, and typically requires market knowledge, financial and marketing creativity and the plans are not always bullet-proof. However, as one developer states, the renovated building inefficiencies do not keep the business plan from working.[53]

---

51 Shipley, Robert, Utz, Steve, Parsons, Michael. Does Adaptive Reuse Pay? The Study of the Business of Building Renovation in Ontario, Canada. International Journal of Heritage Studies. November 2006. Vol. 12, No. 6, Pgs. 505-520.

52 Shipley, Robert, Utz, Steve, Parsons, Michael. Does Adaptive Reuse Pay? The Study of the Business of Building Renovation in Ontario, Canada. International Journal of Heritage Studies. November 2006. Vol. 12, No. 6, Pgs. 505-520.

53 Shipley, Robert, Utz, Steve, Parsons, Michael. Does Adaptive Reuse Pay? The Study of the Business of Building Renovation in Ontario, Canada. International Journal of Heritage Studies. November 2006. Vol. 12, No. 6, Pgs. 505-520.

For a developer or homeowner, cost is the biggest issue when determining if a building can be readapted. No two projects are alike.

There are benefits to reusing either a partial or whole building versus demolishing it. These benefits include: 1) Sustainability through energy savings, materials savings and waste elimination, 2) Direct cost savings through labor expenditures, material expenses and disposal costs, 3) Indirect cost savings through scheduling, heave / settlement remediation, and construction delays and liability, 4) Miscellaneous construction benefits like site noise reduction, controlling construction related pollution, utility interruption, and constructability.[54]

A good example of this is comparing costs between demolition and building new versus retrofitting a foundation and basement of a building. According to the article, "Building Reuse Assessment for Sustainable Urban Reconstruction," the cost for demolishing the foundation and basement, removing the debris to a landfill, bringing in equipment and building new cost $5,655,834. The cost for foundation enhancement, basement improvement, improving structural capacity and new construction was $1,946,922. [55] This is a significant difference in cost.

Every building will be different, but a thorough cost analysis can determine in many cases the best approach.

Why Reuse The Bell Museum?

When or if the museum moves out, the university faces some challenges finding new uses for this building. It is important to state that there is nothing wrong with the structure; it is still viable and being that the university has publicly stated they will continue working with current building stock, there is no reason why the building could not be retrofitted. The building has some wonderful qualities that can be used to its benefit; historic background, original space

[54] Laefer, Debra F., and Jonathan P. Manke. "Building Reuse Assessment for Sustainable Urban Reconstruction." *Journal of Construction Engineering & Management* 134.3 (2008): 217-227. *Academic Search Premier*. EBSCO. Web. 31 Jan. 2011

[55] Laefer, Debra F., and Jonathan P. Manke. "Building Reuse Assessment for Sustainable Urban Reconstruction." *Journal of Construction Engineering & Management* 134.3 (2008): 217-227. *Academic Search Premier*. EBSCO. Web. 31 Jan. 2011

layout that gives the building interest, good structural bones, and a high profile location on the East Bank.

The building also has some issues that need to be addressed. The four main challenges that come to mind when looking at the Bell Museum are;
1) Choosing which historical aspects to preserve, 2) Evaluating and updating building energy efficiency 3) Evaluating and implementing building codes without damaging key historic elements, 4)Finding an appropriate college program that is suited to the space.

Preserving the Character Defining Features of the Bell Museum

Preserving the Bell Museum's is a challenge, but not one that is a lost cause. Based on the analysis done in Part I of this paper, I believe there is a strong argument that the building can have a historical designation on the local level. But in a building reuse project, it is important to determine what sections, spaces, or details of a building are significant enough to keep.

The building's exterior is worth preserving because first, the materials used directly relate to the Art Moderne/Art Deco style and the late 1930s, and second, the cost to remove and replace those materials is astronomical.

The sculpture bas-reliefs, designed by Samuel Bell, the exterior Art Moderne/Art Deco lighting fixtures, designed by Clarence Johnston, Jr., and metalwork grilles are also pivotal elements that depict the Art Moderne/Art Deco style, making this building interesting to look at, and historically significant as previously discussed.

The exterior Buff Bedford limestone stairs are also another pivotal element because the stairs are original, the material is expensive to replace and in fairly good condition. The stairs require re-pointing on many of the joints.

The building's windows which include both glass block and casement are also features that exhibit the Art Moderne/Art Deco style and should not be changed out with new windows unless the windows are beyond repair. I recommend making seals more airtight and leak free. Where replacement windows are required, they shall match the originals.

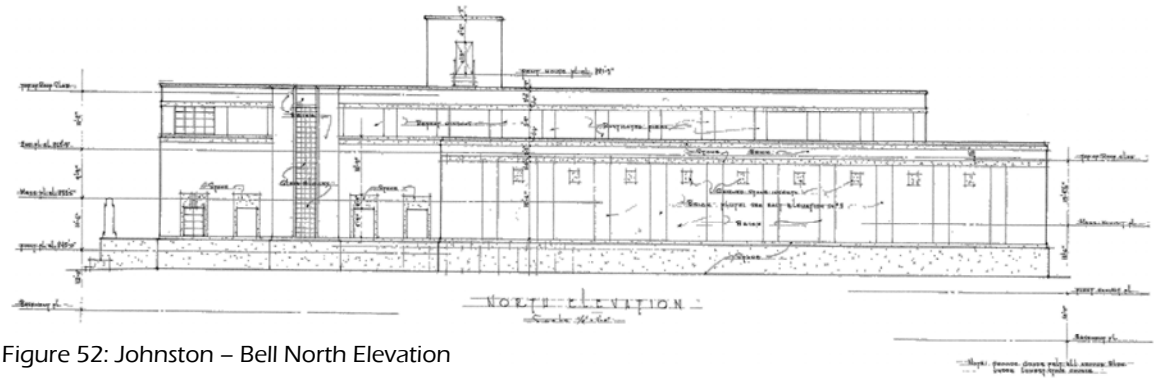

Figure 52: Johnston – Bell North Elevation

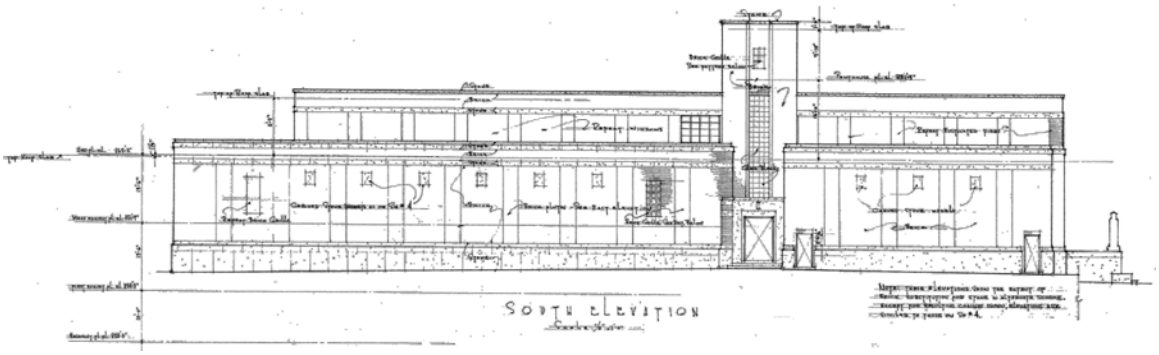

Figure 53: Johnston – Bell South Elevation

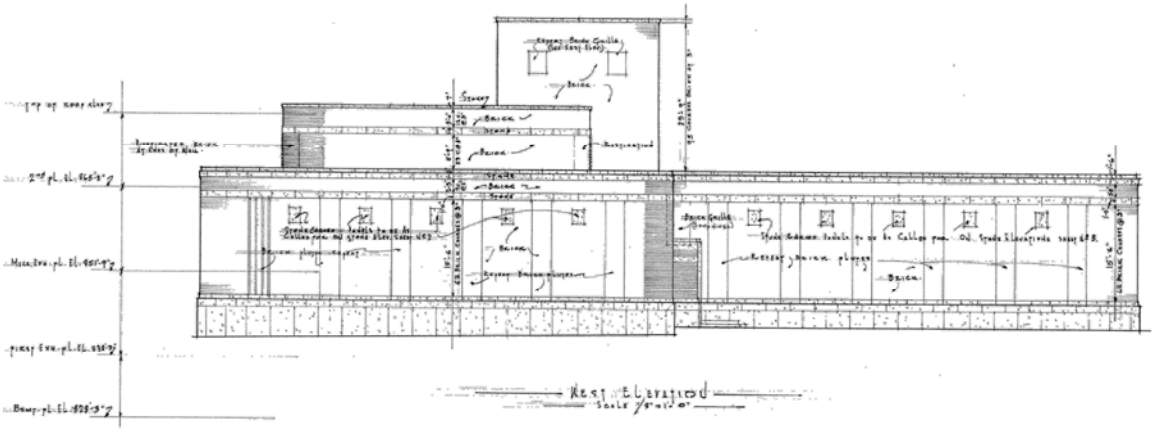

Figure 54: Johnston - Bell West Elevation

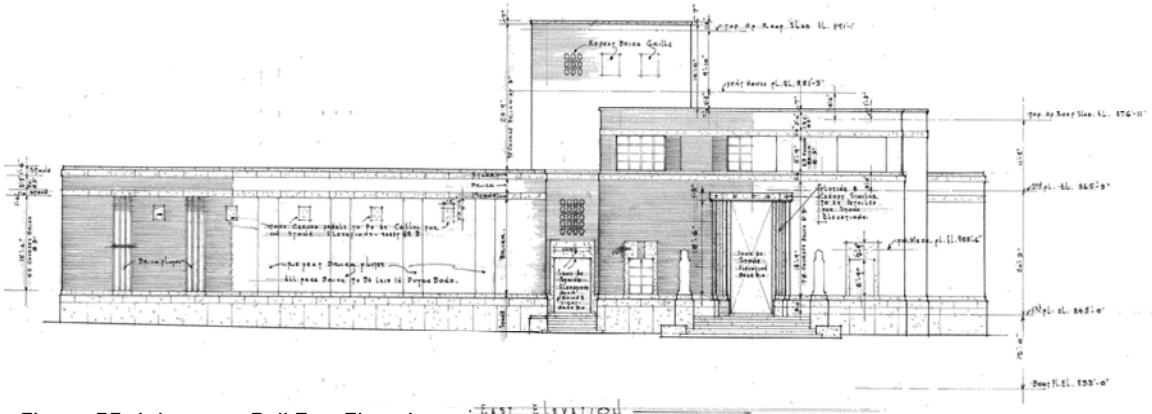

Figure 55: Johnston - Bell East Elevation

Figure 56: Bell Exterior Lighting Fixture

Figure 57: Bell Exterior Auditorium Stairs

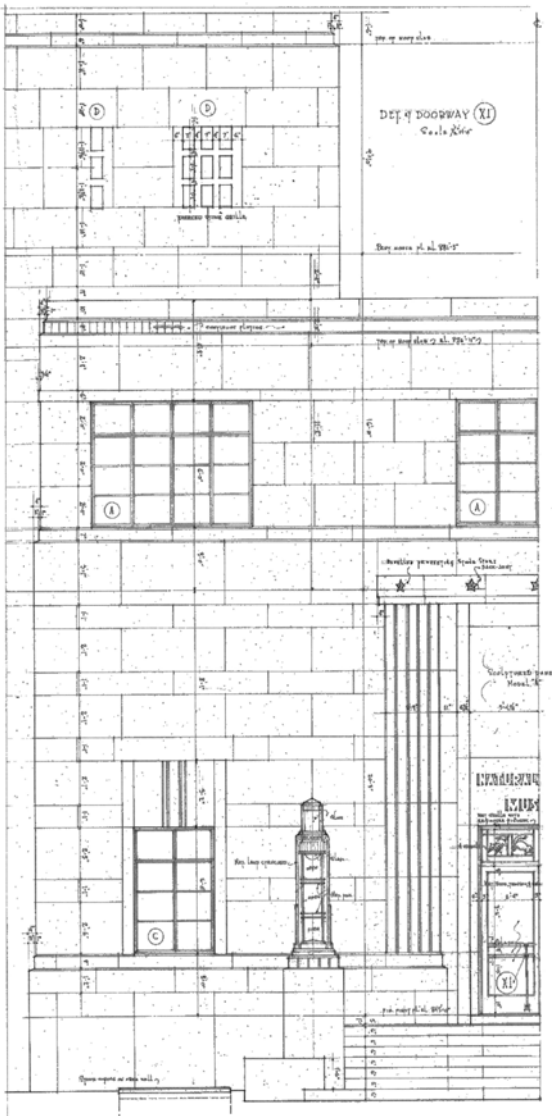

Figure 58: Johnston - Bell East Exterior Elevation

Figure 59: Bell Exterior Glass Block Window

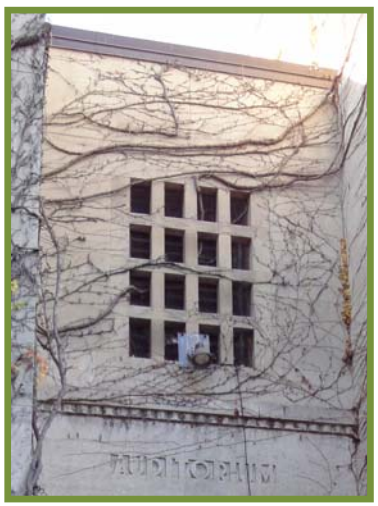

Figure 60: Bell Exterior Window

Figure 61: Bell Exterior Casement Window

The landscaping along the entrance also needs to be re-evaluated. Over time, the trees and vegetation have overtaken the building. The entrance is barely recognizable, and difficult to see when driving a vehicle. By carefully thinning out the trees and vegetation, the building may again stand out prominently on the corner.

The building's interior has spaces that are also worth preserving, specifically the auditorium, the front lobby area, stairways and main gallery spaces where the dioramas are located; while there are other spaces that require some "unmuddling" like the upper mezzanine located above the lobby which is enclosed for some exhibits.

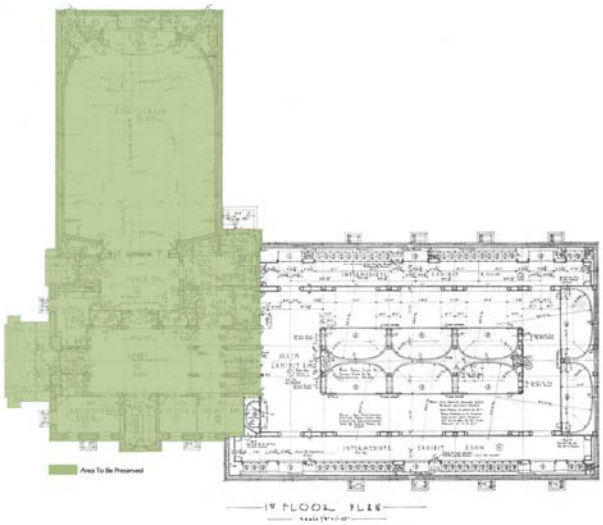

Figure 62: Johnston - Bell First Floor Area To Be Preserved

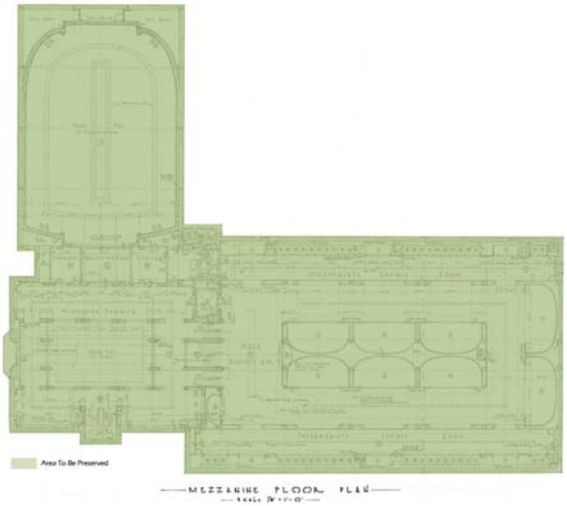

Figure 63: Johnston - Bell Mezzanine Area To Be Preserved

Figure 64: Johnston - Bell Second Floor Area To Be Preserved

Figure 65: Johnston - Bell Roof and Mechanical Room To Be Preserved

The auditorium is significant because of the scalloped plaster walls and wood paneling. The stage area and ceiling moldings along with the cove lighting also are original, therefore should stay in place. The auditorium entrance doors have their glass panels covered over and changed slightly, and they should be restored back to their original condition.

The lobby should be saved because of the Art Moderne/Art Deco styles found in the custom millwork, terrazzo floor design, and ceiling molding details. The clock is also a good example and adds a decorative element to the space.

The front stairways and back stairwells should also be saved if possible. The front stairways have terrazzo poured stairs, original handrails, and marble wall base, while the back stairwells have painted original iron handrails, flooring and stairs.

The upper mezzanine area located above the lobby has seen the most change. Gypsum board walls have been installed between the columns to enclose a gallery space that uses a sound system. It should be restored to its original condition as seen in Figure 26 based on the original plan designed by Johnston which incorporates a metal rail in the Art Moderne/Art Deco style. It can still be used as a gallery space, and its openness can reconnect it to the lobby below through materiality, lighting and form.

Figure 66: Current Mezzanine Gallery Area

The exhibit areas and the diorama cases, located on the first floor and mezzanine levels, hold a particular challenge, and it is one that needs to be addressed. Dioramas have been pivotal in the past for teaching people about nature. But they are outdated, and as previously discussed, natural history museums are being forced to reevaluate their space to keep people coming in the front doors.[56], [57]

The Bell Museum staff, at this moment, is having conversations amongst themselves to discuss what options they have in regards to their exhibit space. The outdated dioramas and the amount of space they take up inhibits the space from being more flexible and does now allow for more up-to-date methods to educate the public about natural history.

There is also the "sense of place" that the dioramas provide to the space. Dioramas although from today's standards are probably not the best teaching tool for students, they do provide a window into our past, which we cannot ignore either. The dioramas serve a purpose in respect to artistic quality, construction materials and methods, as well as interpretation of the past. Without the dioramas, these key factors are lost.

The cases and millwork are original to the building and beautifully crafted, and they help make the case for eligibility to the National Register of Historic Places. Taking them out completely potentially hurts the designation, but leaving the cases in place makes the space less flexible.

There are three options to be considered. Option 1: The museum takes the built-in diorama cases with them, which opens up the first floor and mezzanine levels to more flexible space. Option 2: The diorama cases stay, but the internal pieces such as the painted backdrops, foreground staging and taxidermy go with the museum. Option 3: Save some of the diorama cases as a tribute to the past, and take down others.

These options raise a question in regards to continued eligibility to the National Register. One of the main reasons the Bell can be considered for a historical designation is the dioramas.

---

[56] Benton, Thomas H. Preserving the Future of Natural-History Museums. Chronicle of Higher Education, 00095982, 10/30/2009, Vol. 56, Issue 10

[57] Benton, Thomas H. The Decline of the Natural-History Museum. Chronicle of Higher Education, 00095982, 10/13/2006, Vol. 53, Issue 8.

As previously discussed, they are developed during the turn of the century using artists, and construction means, methods and materials that are in some cases very expensive to re-create today. The dioramas also represent the interpretation of the times. What happens if they are taken out of the building, as the case in Option 1? Would the Bell lose its heritage and sense of place? If they stay, such as in the case of Option 2, there is no problem at all with the historical designation, but the space is completely inflexible for any future use. Option 3 also raises the question about designation for the same reasons as Option 1, but there is a compromise that could meet the needs of the many versus the few.

There is a precedence example that could provide an answer to these questions. The Frist Museum, as previously discussed in Part 1, is still on the National Register, but it has been converted from a main office post office to a museum with a small post office. The most pivotal design elements located in the vestibule, lobby and stairwells have been saved.

No matter who occupies the building; be it the museum, or another program, this researcher recommends saving some of the dioramas if removal of others does not jeopardize its eligibility to the National Register of Historic Places. Specifically, I choose the dioramas in the main lobby area and the mezzanine level to be preserved. The reason I choose these areas is the site lines. The staircase going up to the mezzanine shows more of the casework, and seems a better transition than the first floor. The first floor level dioramas are taken out, but the casework and millwork are reused, since the wood is still good. This allows for a good compromise between preserving the past, and providing new flexibility in the space for whoever lives in the space. The backdrops, foregrounds and taxidermy can be displayed in other ways, or are sent to another museum for temporary exhibits, or are destroyed after being documented.

The custom lighting fixtures located in the main lobby, auditorium and exhibit areas are a key historic building element that also faces a challenge. The lighting is beautifully detailed and fits the Art Moderne/Art Deco style of the building. However, the fixtures use multiple incandescent bulbs or T5 fluorescents that are extremely energy inefficient. So there are some choices to consider. The light fixture innards can be retrofitted for more efficient lamping as long as it does not jeopardize the eligibility to the National Register of Historic Places. The incandescent

bulbs from the drawings look like standard size, so either replace the bulbs with more energy efficient, high color index fluorescent or LED, or keep the current bulbs. The T-5 fluorescent tubes can be changed out to T-8 tubes. The down side to choosing the higher efficient tubes is the initial cost. The down side to choosing a standard incandescent bulb or T-5 tube is energy cost over time and its life-cycle.

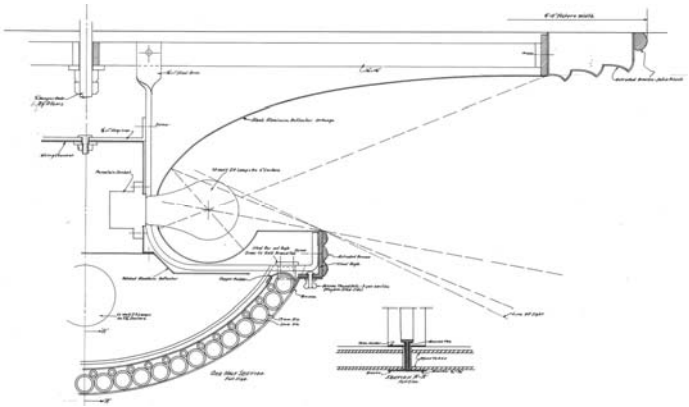

Figure 67: Bell Auditorium Light Fixture

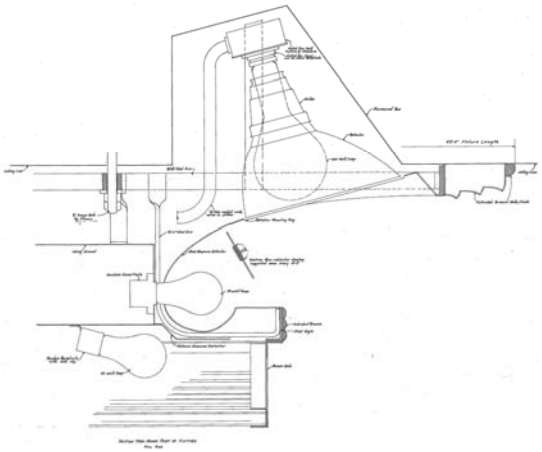

Figure 68: Bell Auditorium Light Fixture

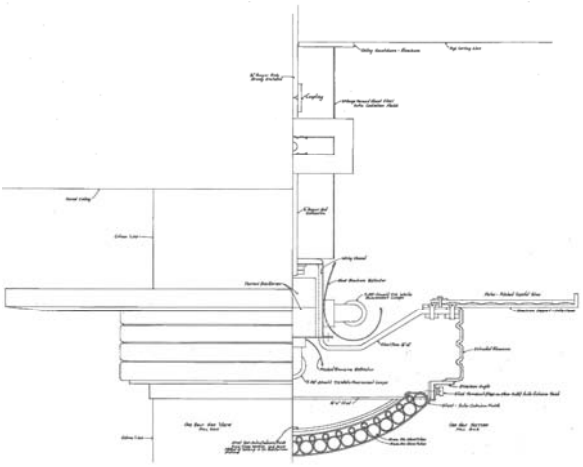

Figure 69: Bell Lobby Light Fixture

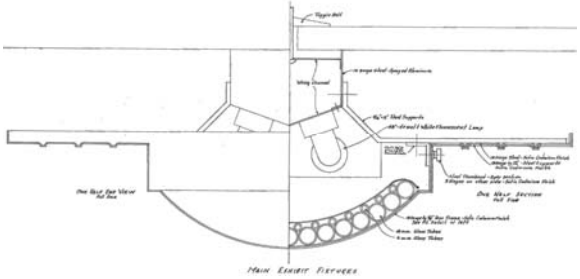

Figure 70: Bell Lobby Light Fixture

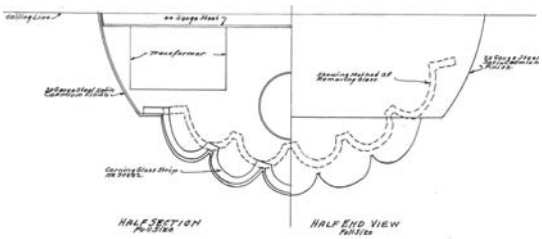

Figure 71: Bell Stair Light Fixture

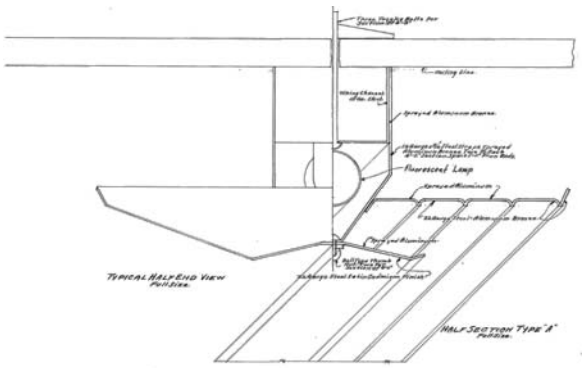

Figure 72: Bell Exhibit Light Fixture 'A'

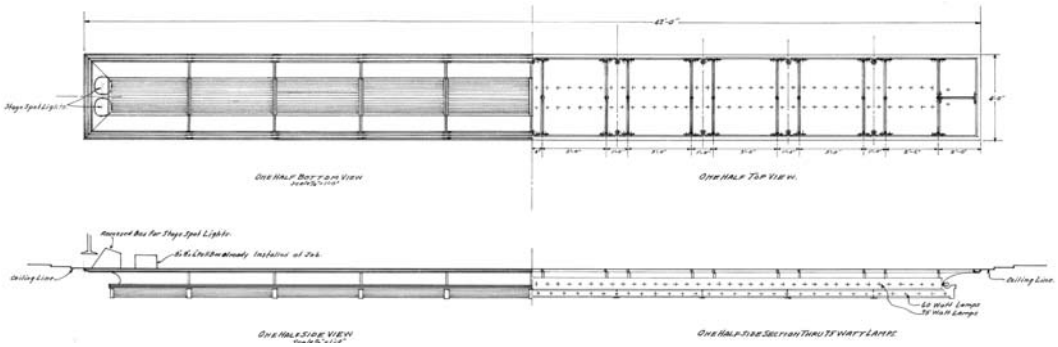

Figure 73: Bell Hall T-5 Fluorescent Lamp Fixtures

The addition, which is made of concrete block and glass, has very little detail. Because of its minimalist nature, the addition fits the original building without adversely affecting it. It is not meant to enhance the original building, but to just provide added space for the users. The materials and interior spaces fit well with the original building, but to say they have significant historic value is questionable. I think the only historical significance is the materials used, and the construction means and methods. I do not recommend designating these areas for preservation. However, they can be re-designed for better space efficiency.

By preserving and rehabilitation the Bell Museum, it can continue to be a viable, yet interesting building that firmly resides on the corner of Church Street and University Avenue.

The Bell Museum Building Spaces

The Bell Museum is roughly 84,970 square feet and has a wide variety of spaces within its walls. The areas that have not been called out for preservation or restoration from the previous section can be re-designed to fit the current museum program or a new program if the museum chooses to vacate the premises.

Figure 74: Basement Level

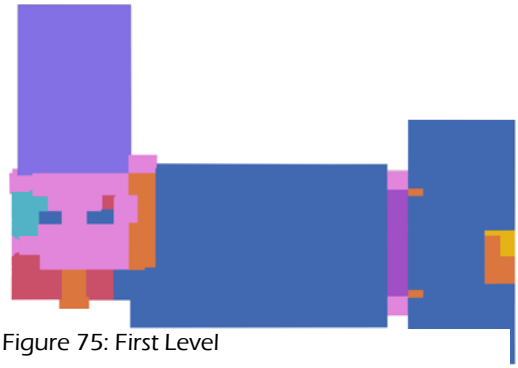

Figure 75: First Level

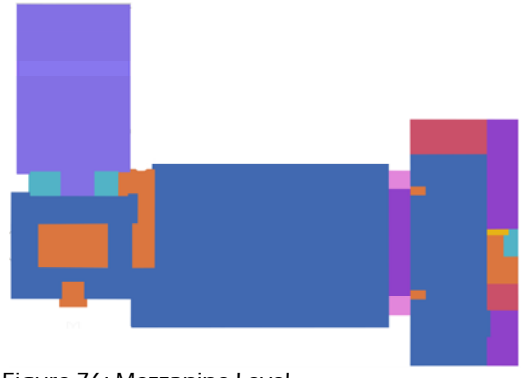

Figure 76: Mezzanine Level

The basement houses cold and dry storage, lab space, lecture space, some office space and restrooms. The main mechanical space, which consists of a steam heat system which feeds the radiators throughout the original building, is also located in the basement. The original building, at this time, is not set up for central air. There is also another steam heat system in the addition that does incorporate chilled water for air conditioning.

The existing foundation walls in the basement are from 1′-1″ to 1′-9″ thick and are made from poured concrete. The floor is also poured concrete. Most of the interior parts of the exterior walls are also lined in 4″ thick tile. The interior walls are plastered. The ceiling height in the basement is 12′-0″.

The first level has public space, administrative space, the auditorium, and exhibit space. The floor is terrazzo, while the interior walls are 4″ plaster. The ceiling height on the original first level is 10′-6″.

Figure 77: Second Level

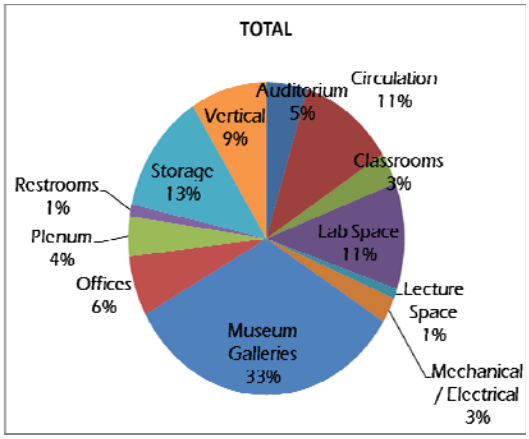

Figure 78: Space Percentages

The mezzanine is mostly exhibit space, with a little office and lab space in the addition. The interior walls are 4" plaster with the exhibit areas being a combination of plaster and wood paneling. The mezzanine ceiling height on the original building is 9'-9".

The second floor includes restrooms, administrative office space, classrooms, lab space and storage. Again, the interior walls are plaster, or in some areas where there have been changes, drywall. The second floor ceiling height on the original building is 16'-0".

AREA BREAKDOWN (SF)

BELL MUSEUM					
SPACE	BASEMENT	FIRST FLOOR	MEZZANINE	SECOND FLOOR	TOTAL
Auditorium	0	4070	4088	0	8,158
Circulation	3,623	2180		1626	7,429
Classrooms	0	0	0	2803	2,803
Lab Space	1,549	519	1602	5732	9,402
Lecture Space	872	0	0	0	872
Mechanical / Electrical	2,568	105	87	143	2,903
Museum Galleries	0	14067	14025	0	28,092
Offices	402	601	762	3546	5,311
Museum Plenum	3,641	0	0	0	3,641
Restrooms	712	0	0	352	1,064
Storage	9,972	268	512	135	10,887
Vertical	916	1021	1753	718	4,408
TOTAL	24,255	22831	22829	15055	**84,970**

Table 1: Bell Museum Square Footage Information

Occupancy Schedule

The Bell Museum is open Tuesday, Wednesday and Friday from 9am-5pm, open on Thursday from 9am-9pm, open Saturday from 10am-5pm and on Sunday from noon-5pm. They are closed Monday and on some holidays. The auditorium and classrooms, however, are open for University of Minnesota classes during the fall and spring semesters.

Analyzing Building Energy Efficiency

Since the completion of the Bell Museum in 1940, building energy efficiencies have improved immensely through the use of updated technology, systems and materials.

In spring 2008, President Bruinicks signs the American Colleges and University Presidents Climate Commitment, making a pledge that the University of Minnesota takes an active role through its mission and operation in the effort of reducing carbon emissions.

Part II of this paper documents the findings of building energy efficiencies, and areas for improvement. It is important to note that the Bell Museum, to this date, has not had a complete energy efficiency study done, and many of the systems are original to the building and need to be updated. Part II also provides criteria for determining what programs would work well for the Bell Museum

The documentation process used is as follows:

1. Define the Bell Museum's objectives, goals, strategies and measures (OGSM) based on today's information.
2. Analyze previous reports for data and possible directives
3. Develop a list of Indoor Environmental Quality (IEQ) challenges and design solutions.

A feasibility study should be completed for the university that reports the findings of the mechanical and electrical systems, daylighting, materials and finishes, as well as a separate study that documents water usage. The study should also research and document how sustainable guidelines, such as B3, can be applied so that the building can have better energy efficiency.

By doing so, based on the Minnesota B3 Guidelines and LEED ratings, there can be a reduction in energy and water usage costs due to lower usages and less material waste in our landfills.[58]

All information is provided by Greg Berger at the University of Minnesota Facility's Management Department.

The Bell Museum's main objective is to reduce energy and water usage to meet or exceed B3 or LEED standards and to reduce their costs. The goal to meet these two objectives is to assess the key components that require usage which are listed below. Strategies analyze the current electrical and water usage reports from the university, and based then on research recalculate what the improved usage and costs are for HVAC, electrical and water consumption. The measures are completed through comparison reports between the original consumption reports and the new reports.

Energy consumption for the Bell Museum comes in three forms: electricity, steam and chilled water. This researcher, for this thesis, looks at several energy components when evaluating the Bell Museum's energy efficiency. Key components are: 1) HVAC system, 2) Electrical System, 3) Water. Building materials and daylighting are also considered.

The first area the researcher assesses is the HVAC system. The Bell Museum uses steam from the central university plant. The original building's heating system is located in the basement and uses pumps for the steam for the original radiators and domestic hot water, while the 1960 addition uses steam pumps to the updated variable air volume (VAV) system located in the basement and an air handling unit (AHU) that is located on the addition's roof along with a cooling tower for air conditioning. The original building does not have central air conditioning and this causes some cooling imbalances within the building, especially where the greenhouse connection is located between the original building and the addition. Humidity builds up and does damage to the buildings' materials and finishes because a water misting system is currently installed to hydrate the vegetation inside the glass.

[58] http://www.msbg.umn.edu/p_2.html

In spring 2011, the university plans to take down the cooling tower located on the Bell Museum roof, and tie the original building and the addition into the main chilled water system located at Northrup Auditorium. This allows the possibility in the future to install a cooling system.

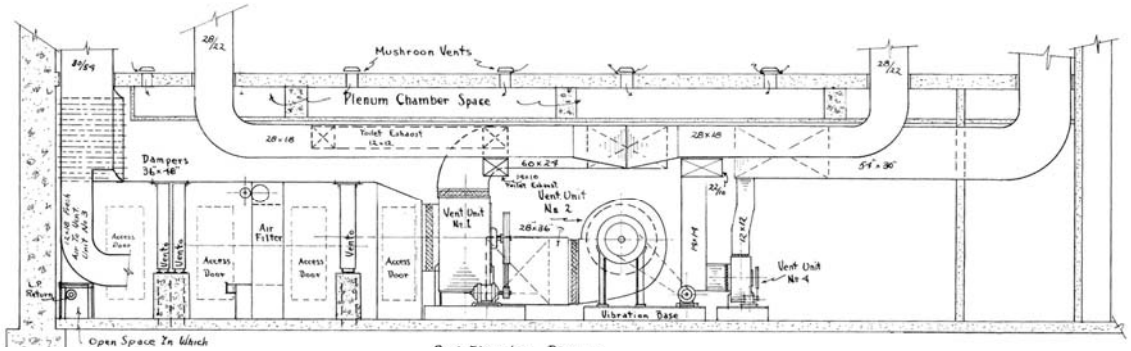

Figure 79: Bell Original Building Heating System

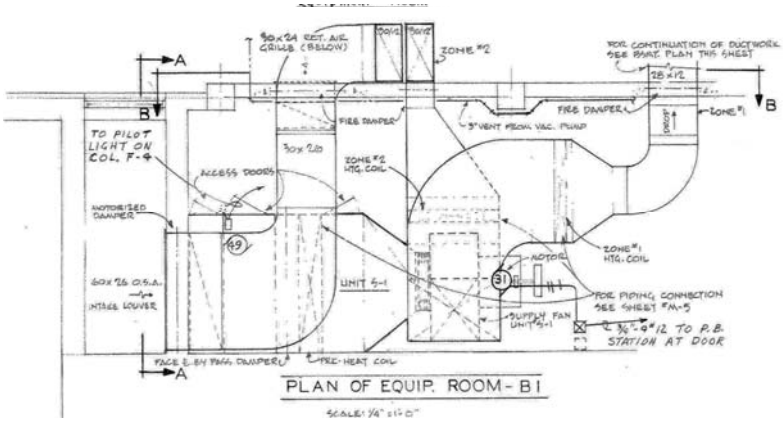

Figure 80: Bell Addition Heating System

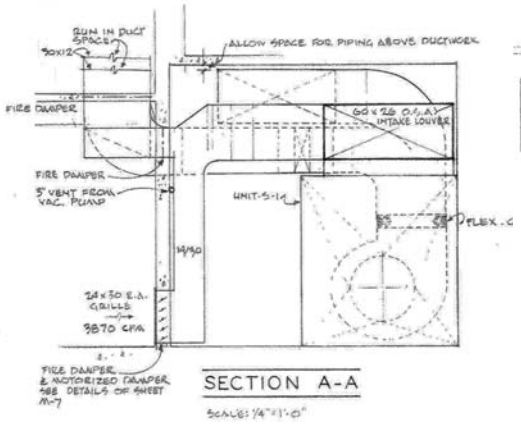

Figure 81: Bell Addition Section A-A Heating System

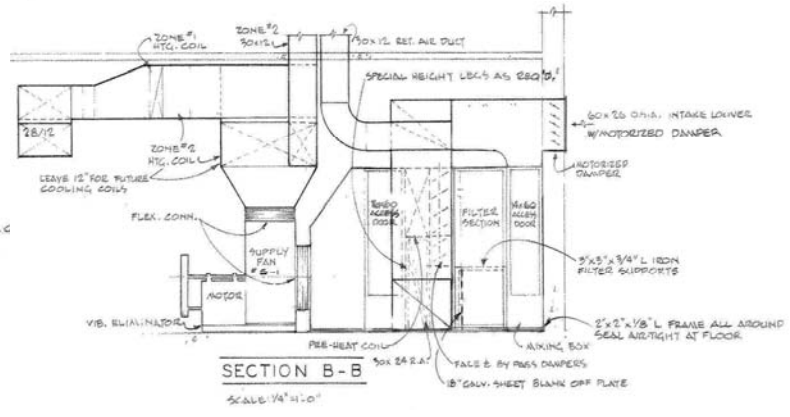

Figure 82: Bell Addition Section B-B Heating System

The air handling unit provides fresh air intake to the building.

Figure 83: Addition's Air Handling Unit And Cooling Tower

The current system has to be evaluated to determine if it is worth saving, or if an updated steam system or different energy system is a better fit from an energy usage and cost standpoint.

Heat and cold are lost through fenestrations, and in the case of the Bell Museum, this is an interesting study. There are windows located around the perimeter of the basement for ventilation, and a minimal amount of windows, (mostly decorative glass block), located on the first and mezzanine levels in the original building. There are no windows on the first and second levels in the addition. The only floor with windows is the original building's second floor which is connected to the addition's third floor which is where the classrooms, offices and some lab spaces are located. The addition has an exterior daylighting shelf which helps with glare. Little to no daylighting in spaces is not great for people, but can be great where energy loss is concerned. This can be a benefit as long as the minimal number of windows are well sealed, or in some cases replaced for improved energy efficiency, or placed appropriately throughout the building. There can also be a benefit if the work spaces that require good lighting are located on the second floor.

Alternative energy is to also be investigated to heat and cool the building. If the museum vacates the premises, the glass connection between the original and the addition can act as a heat collector. The glass during winter and summer can filter radiant heat from the sun that is then absorbed and held through the concrete floor and the exterior walls. The heat is then released at night. There can also be water storage tanks that when heated provides an added heat source to the building.

Another alternative heating and cooling device is a green roof, if the structural elements of the building can hold the added weight. Currently, the roof is asphalt over a rubberized membrane with an added layer of gravel. Although it is easy to take care of, it heats up easily

creating a heat sink which forces the heating or cooling system within the building to work harder. A green roof is beneficial for several reasons. First, the added depth of soil and vegetation actually provides more insulation to the building, making the heating and cooling systems work less because the temperatures are not so extreme.[59] Secondly, the vegetation provides a natural habitat for birds and insects, which in turn provides spread pollen which then in turn helps the vegetation to grow and flourish. The vegetation provides oxygen which is healthy for human beings, and creates a place for people to relax and congregate. The downside to a green roof is cost. The upfront costs are expensive, but if the university is looking for long-term payout and a cleaner, healthier environment, the costs are worth it.[60]

Finally, photovoltaic panels can be considered on the roof. They provide an alternative energy for heating and cooling and electricity. Because supply and demand have not caught up, however, costs for photovoltaic panels are still expensive and beyond most people's budgets. Because the university is a public entity, a way to pay for the panels is grants or energy credits provided by Exel Energy. Exel Energy has worked with the university in providing energy credits in the past for Nicholson Hall, and the Biomedical Building.

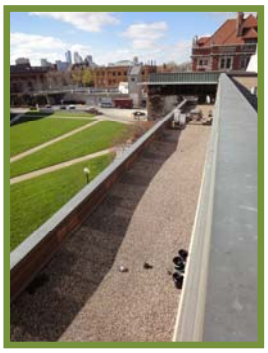

Figure 84: Southside Second Floor Rooftop

Figure 85: Main Roof Above Second Floor

Figure 86: Northside Second Floor Rooftop

59 Blackhurst, Michael, P.E., Hendrickson, Chris, Dist. M.ASCE2., Matthews, Scott H., A.M.ASCE3. Cost Effectiveness of Green Roofs. Journal of Architectural Engineering. Volume 16, Issue 4, 12/2010. pp. 136-143.

60 Blackhurst, Michael, P.E., Hendrickson, Chris, Dist. M.ASCE2., Matthews, Scott H., A.M.ASCE3. Cost Effectiveness of Green Roofs. Journal of Architectural Engineering. Volume 16, Issue 4, 12/2010. pp. 136-143.

The second area the researcher assessed is the electrical systems. Energy consumption electrical devices used by the Bell Museum include lighting, motors, fans and plugs.

Figure 87: Southwest View From Bell Museum Roof

BELL MUSEUM OF NATURAL HISTORY - ELECTRIC (KWHRS)

	2006	2007	2008	2009	2010
JAN	36,720	34,800	40,200	48,960	39,600
FEB	39,120	38,520	53,040	39,600	37,560
MAR	47,880	46,560	40,920	37,920	38,640
APR	39,120	40,920	47,040	39,720	48,960
MAY	47,280	47,760	42,840	43,680	40,560
JUN	56,640	67,080	47,760	45,720	44,400
JUL	70,200	56,640	68,640	75,480	87,240
AUG	60,600	69,120	57,240	69,960	56,539
SEP	62,160	44,280	44,640	65,760	58,089
OCT	39,120	42,360	48,600	56,760	
NOV	38,040	43,800	40,680	39,000	
DEC	45,360	38,400	40,200	48,360	
Sum:	582,240	570,240	571,800	610,920	451,588

Table 2: Bell Museum Electric Usage Report

As discussed in the *Preserving the Character Defining Features of the Bell Museum* section of this thesis, lighting is a key energy issue. Most of the lighting fixtures on the First and Mezzanine Levels are original to the building. Lighting is usually second in energy consumption only to motors and fans.

To improve electrical usage there are several things that can be implemented to improve energy efficiency. First, change out the old T-5 fluorescent tubes to updated, more efficient T-8's.[61] Second, change out any incandescent bulbs to either LED or compact fluorescent bulbs. This researcher's recommendation is to change out the incandescent to the ZetaLux 7Watt Light Bulb. It lasts 25,000 hours, and is equivalent to a 60 watt incandescent bulb. It comes in warm or cool colors and fits in fixtures where standard incandescent bulbs are used. The negative of using this type of bulb is the upfront cost of $34.95/per bulb, and they are not dimmable.[62]

Another energy saving solution is installing occupancy sensors for office, lab, restroom, auditorium, mechanical, and storage and classroom areas. Occupancy sensors are infrared sensitive so lights only turn on when they sense body heat. Costs for an occupancy switch can range between $40-$150/per switch, but can save energy costs further down the road.[63]

Another idea is to move light switches within a space so that people are forced to make a conscious effort to turn on the lights. This requires new wiring, and upfront labor costs, but can work because it makes people hunt for the switch and determine whether they actually need the lights on.

The highest percentage of electrical usage comes from motors and fans that typically include air handling unit fans, other fans, heating system pumps, heating coil fans, hot water systems, elevators and unit heaters. Out of all these types of motors and fans, on average, the air handling unit fans require the most electricity. Because there are two types of heating systems located within the Bell, a thorough investigation needs to be completed to determine how best to heat the building. For an older building, like the Bell, radiators are a good heating method because the heat is more evenly distributed and they work with the natural process of rising heat. Since radiators are placed near or underneath glazing, it provides comfort in most rooms.

---

[61] Liebel, Brian, P.E., and Brodick, James, Ph.D., Squeezing the Watts Out of Fluorescent Lighting. November 2005. Ashrae Journal. Pgs. 52-54

[62] Dirjish, Mat. *LED LIGHTING* WAITS IN THE WING. Electronic Design; 9/23/2010, Vol. 58 Issue 12, p26-33

[63] Guo, X, PhDa., Tiller, DK, DPhilb., Henze, GP, PhD PEc., and Waters, CE, PhD PEb., aDDP Engineered LED Solutions, 445 South Douglas Street, El Segundo, CA, 90245, USA, bArchitectural Engineering, University of Nebraska-Lincoln, Omaha, NE, 68182, USA, cDepartment of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder,Boulder, CO, 80309-0428, USA. The Performance of Occupancy-Based Lighting Control Systems: A Review. Lighting Res. Technol. 2010; 42: 415–431

There is some maintenance involved which includes making sure the boiler and radiator parts are checked yearly for failure and bleeding the radiators every fall prior to turning on the system. There is always a chance that a pipe can burst, but if well maintained, the system can be a benefit.

Because the original building does not have a cooling system, air conditioners are used in certain rooms. The current air conditioners are old, and not energy efficient. Since the building is being tied to the Northrup cooling system in spring 2011, perhaps there is an opportunity to re-evaluate installing a cooling system within the old building. The question then arises. How will a cooling system like this affect the exhibits? Testing needs to be conducted to see how cooler temperatures affect the main exhibit areas of the museum.

Plug loads are typically the smallest in energy consumption out of the three parts, but because of the equipment that uses the plugs, the energy cost is still substantial. The building is used mainly from 7:30am to 9:30pm, but depending on the program that utilizes the building certain equipment may have to be on all the time. This researcher recommends that when appropriate, all equipment used within the building have an energy star rating, and has an automatic "sleep mode" so that the equipment is not on all the time.

The third area of consumption is water. When evaluating water consumption, the interior water fixtures, and number of water fixtures are documented and analyzed. The university can also determine if captured water (precipitation) can be used or reused in grey or black water systems, or used to water the grounds, requiring less new water usage, therefore reducing costs on their monthly water bills.

There are several recommendations to be made to improve water efficiency. First low-flow toilets and faucets can replace any current fixtures. Much water is lost through leaky faucets or toilets over time.[64] The second recommendation is to capture precipitation that falls on the site through underground cisterns like what the Minneapolis Central Library has.

[64] Nortier, Richard. "Frugal Flow." *American School & University* 80.7 (2008): 34-36. *Academic Search Premier*. EBSCO. Web. 12 Dec. 2010.

The water captured by the cisterns could be used in the irrigation system and potentially the grey water system if the State of Minnesota would approve legislature allowing grey water systems to be reused.

BELL MUSEUM OF NATURAL HISTORY
WATER (CCF)

	2006	2007	2008	2009	2010
JAN	92	122	124	359	97
FEB	109	105	132	267	93
MAR	71	178	162	359	97
APR	123	226	57	330	97
MAY	121	156	213	253	134
JUN	323	297	186	344	366
JUL	402	448	301	525	520
AUG	387	369	392	569	545
SEP	221	281	237	498	438
OCT	129	188	135	205	
NOV	75	112	113	120	
DEC	61	118	243	106	
Sum:	2,114	2,600	2,295	3,935	2,387

Table 3: Bell Museum Water Usage Report

Materials and finishes also hold heat differently. The exterior walls are anywhere between 1′-1″ to 1′-9″ thick, and are made from concrete, have an exterior masonry veneer of limestone, and have an interior layer of wood studs with a layer of lathe and plaster in most areas or tile in the original building or concrete block in the addition. The layers of materials provide a good insulation factor, but there can be problems if there is not enough space for air to circulate.

It is important, then, to do a conservation study to determine where heat is escaping, and where air is not circulating well.

Building Maintenance

Building maintenance with short-term and long-term maintenance plans is also a key component to preserving a building. A building's biggest enemy is water. It is important to determine if water is infiltrating into the building and along with little air circulation making a space ripe for mold, mildew and other damage. Documentation and a plan to remedy the situation can help prevent future problems like what is seen in Figures 88 and 89.

Figure 88: Water Damage In Stairwell

Figure 89: Water Damage on Vestibule Ceiling

Analyzing Building Codes

In the process of a building remodel, building codes always need to be addressed. In the case of the Bell Museum, because the building has the potential for being designated on the National Register of Historic Places, we have two options when analyzing code. We can choose to use the Minnesota State Building Code which has adopted the 2006 International Building Code, or the Minnesota State Building Conservation Code. Both have positive and negative consequences. By using the 2006 International Building Code (IBC) and Minnesota State Building Code, a person can ensure that a rehabbed building is up to code in areas of fire safety, exiting, finish materials and accessibility. The downside is that the structure can be greatly altered because of door size, accessible restrooms, and number of restroom stalls, accessible

transportation routes, number of exits, and even certain materiality. If one chooses the Minnesota State Building Conservation Code, a designer has more control in saving the building design, but the building may not necessarily have easy accessibility to all people. The Minnesota State Building Conservation Code, however, does reference the most up-to-date Minnesota Accessibility, Mechanical, Electrical, Plumbing and Fire code.

For this code analysis the Minnesota State Building Conservation Code is chosen, as it provides the best measures for saving the architectural features and materials found within the Bell Museum, yet still provides strong measures for health, safety and welfare.

The Bell Museum has the potential to be listed as a local historic building. Chapter 3 of the Minnesota State Building Conservation Code defines *Certified Historic Structure* as a "building and its structural components that 1: is listed on the National Register of Historic Places, or determined eligible for listing in the National Register of Historic Places by the State Historic Preservation Officer, or designated by a certified local government; or 2) is located in a registered historic district and determined to be a contributing building as defined by the State Historic Preservation Officer or the certified local government."[65]

A *Historic Building* is defined as a "building or structure classified as historic by the federal, state or local government authority, or deemed eligible for such classifications."[66]

Chapter 4 of the Minnesota State Building Conservation Code discusses alterations and repairs, and there are several areas that need to be addressed for this thesis.

"401.2.1 General. Except as is otherwise allowed herein, work shall be done using like materials or materials permitted by the applicable code for new construction. The work shall not make the building less conforming with the building, plumbing, mechanical, electrical, or fire codes, or with any previously approved alternative arrangements, than it was before the repair was undertaken."[67]

---

[65] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 23.
[66] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 24.
[67] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 25

"401.2.3 When any water closet is replaced, the replacement water closet shall comply with all applicable regulations governing water conservation."[68]

As recommended in the previous section, low flow water fixtures are a good choice to improve water efficiency within the Bell Museum.

Minnesota Rules, Chapter 1311, Minnesota Rehabilitation of Existing Buildings specifically calls out that any floor area of more than 100s.f. in size and containing mechanical equipment in occupancies A, B and S need to be separated from the rest of the building by not less than a 1-hour occupancy separation.

In Section 501.4.1, it states minimum criteria for the entire building. It needs: "1) At least one accessible building entrance" (which is already provided), "2) At least one accessible interior route from an accessible building entrance to primary function areas" (which is provided), "3) Accessible parking where parking is provided" (Church Street and Nolte accessible parking provided), "4) At least one exterior accessible route from accessible parking to an accessible building entrance" (provided) and "6) At least one accessible unisex, or male and female toilet room for every three levels of the building" (we have technically three levels with one level of mechanical and storage, but the one bathroom on the second floor is not really accessible).[69]

The Bell Museum can be considered a Type II construction; meaning its exterior walls are comprised of non-combustible materials (concrete with a stone veneer), while the interior building elements are fire-resistive, which in this case are concrete block, or wood stud walls with lathe and plaster.

When several occupancy types are involved, there are several ways to calculate the space in order to come up with a total occupancy load. The Minnesota State Building Conservation Code states in Chapter 4, 403.10 that "the capacity of the means of egress in each work area and throughout the egress path of each work area shall be sufficient for the occupant load. Capacity shall be determined in accordance with the Minnesota Building Code. The occupant load of a

[68] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 25
[69] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL..

space shall be determined by whichever of the following methods provides the higher number: 1) Dividing the floor area by the occupant load factor for the use group as provided by the Building Code, 2) The actual number of occupants for whom the work area is designed."[70]

The Bell Museum Occupancy Types includes four areas: 1) A1 (Assembly) which includes theater, 2) A3 (Assembly) which includes art galleries, exhibition halls, lecture halls, libraries and museums, 3) B (Business), which includes educational occupancies above the 12th grade, office space and laboratories for testing and research, and 4)S-1 (Storage).

OCCUPANCY LOAD BY FLOOR	
FLOOR	OCCUPANTS
Basement	218
First Floor	2,798
Mezzanine	2,145
Second Floor	211
TOTAL OCC	5,372

Table 4: Bell Museum, Occupancy Load By Floor

SQUARE FOOTAGE BY OCCUPANCY TYPE	
OCCUPANCY TYPE	S.F.
A1	8,158
A3	29,631
B	36,294
S	10,887
TOTAL S.F. BY OCC TYPE	84,970

Table 5:Bell Museum Square Footage By Occupancy Type

The exhibit space occupancy load numbers are large because the space is considered Assembly standing space and without fixed seats which means the space's square footage is divided by 5 net. Even with subtracting out the diorama space, the occupant load numbers are still high on the first floor and mezzanine levels.

The Means of egress exit doors within the Bell Museum have doors that swing in the same direction as the exit, so there is no need to retrofit any of the exit doors.[71]

Exit signs in most cases within the building have not damaged the historic character of the building, however if there is such a case an alternate exit sign is permitted with the approval of the building inspector.[72]

[70] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 28.
[71] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 44.
[72] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 44.

Many of the doors within the Bell Museum are original to the building and do not necessarily meet the 1-hour fire rated assembly requirement. In these cases, the doors can remain as long as a sprinkler is installed on each side of the door.[73]

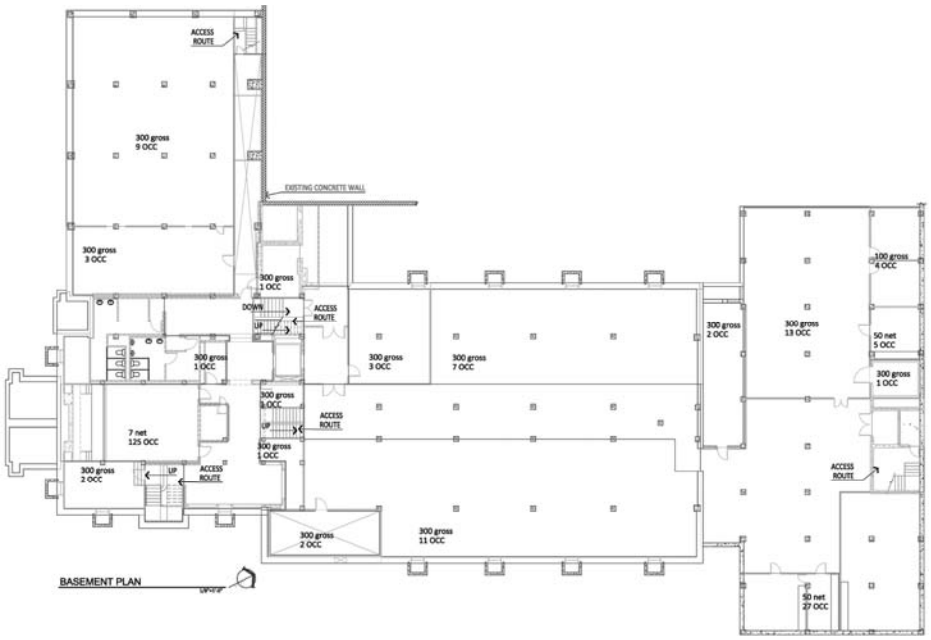

Figure 90: Basement Occupancies and Access Routes

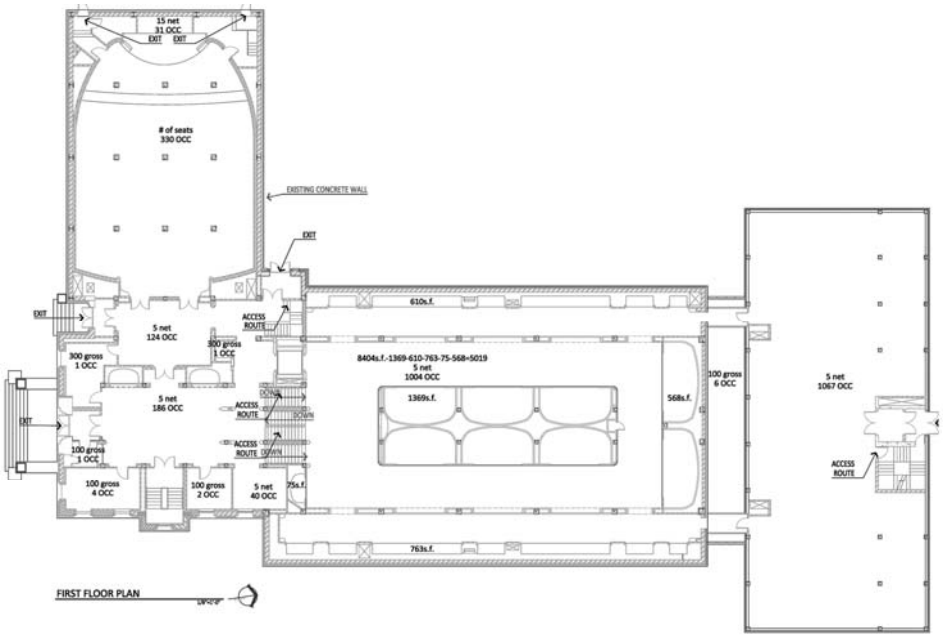

Figure 91: First Floor Occupancies, Access Routes and Exits

[73] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 44.

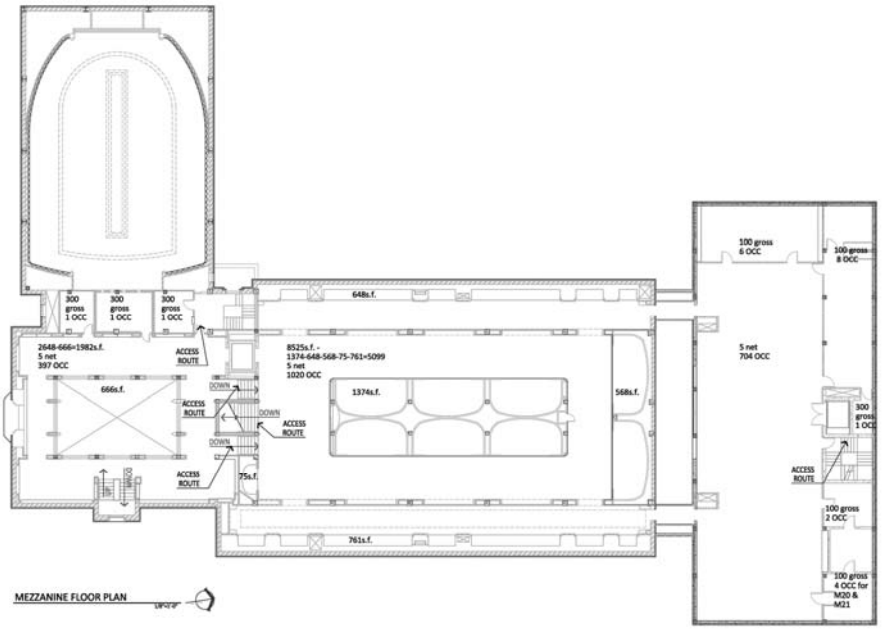

Figure 92: Mezzanine Occupancies and Access Routes

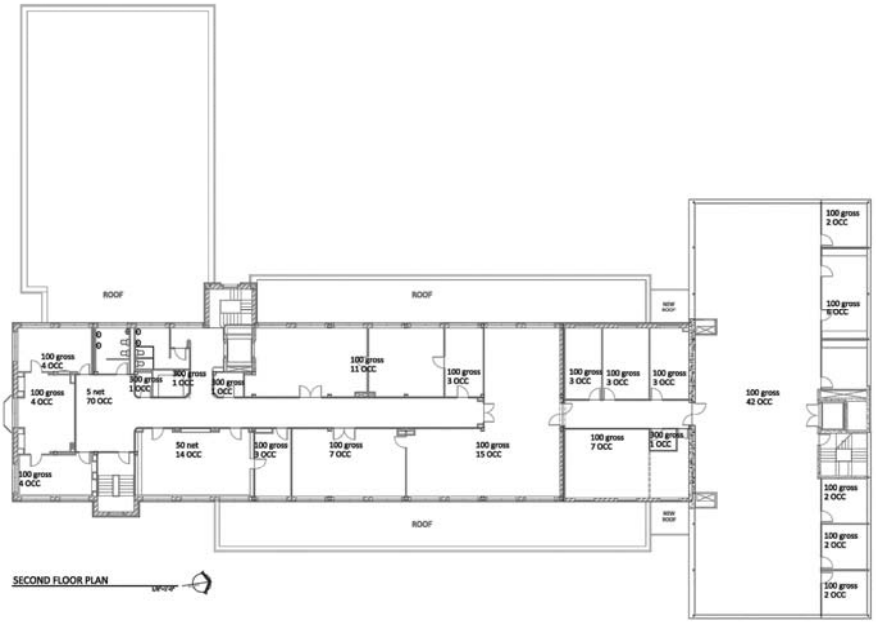

Figure 93: Second Floor Occupancies and Access Routes

The building is currently sprinkled which is a plus because it allows longer travel distances for Means of Egress. Means of egress, as described in the Minnesota State Building Conservation Code, needs to comply with the requirements of the Building Code, which in this case is the 2006 International Building Code, which is what the State of Minnesota is using at this moment. It also states that it should meet the "intent" of the Building Code for existing buildings as long as the exit system does meet minimum requirements under the current code.

In other words this allows the Exit Access Travel Distance to be 250ft. for A1, A3 and S, while it is 300ft. for a B. It also allows the Common Path of Egress Travel to be 100ft for the B and S, while the A1 and A3 can stay at 75ft.

At this time, the researcher checked both the Exit Access Travel Distance and the Common Path of Travel for each level, and even from the remotest point on the second floor, the exit access is at 257', and the common path is up to 50', so the building falls within current guidelines.

Another challenge is the stairs. Their width, in some cases is less than 36 and their tread depths and riser heights are less than 11" in depth and more than 7" in height. The handrails also pose another challenge due to size. The Minnesota State Building Conservation Code states that "existing winding stairways may serve as one means of egress from a building, provided that a complying handrail is located at the stairs' outside perimeter. Means of egress width shall comply with the Building Code. The largest tread run within a flight of stairs shall not exceed the smallest by more than 3/8". The greatest rise height within any flight of stairs shall not exceed the smallest by more than 3/8"."[74] But then in Chapter 6, which references historic structures, the code states that "grand stairways shall be accepted without complying with the handrail and guard requirements. Existing handrails and guards shall be permitted to remain, provide they are not structurally unsafe."

For Type II construction, the building height and area for an A1 is 3-stories and 15,500s.f. For A3, it is 3-stories and 15,500s.f. For a B it is 5-stories, and 37,500s.f. For an S, it is 4-stories and 26,000s.f..

Occupancy types that would not fit this building would be H1 – H5, hazardous group occupancies, and I1-I4, institutional group occupancies.

The corridor fire-resistance rating for A, B and S for an occupant load of more than 30 by a corridor for a sprinkled building is 1.

[74] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 27.

Mezzanines are also an issue discussed in the Minnesota State Building Conservation Code. 403.7 states that "if the mezzanine has an occupant load of more than 50, and the travel distance to an exit exceeds 75ft., there needs to be at least two independent means of egress."[75] The Bell Museum has two independent exits as seen in Figure 92.

Corridors as discussed in 403.14 of the Minnesota State Building Conservation Code specifically states that "with an occupant load of 30 or more in A, B, or S, existing walls and ceiling surfaces with wood lath and plaster or ½" thick gypsum wallboard may be permitted in lieu of 1-hr fire-resistant construction provided the surfaces are in good condition."[76]

One of the exits is also required to have an accessible route to the outdoors. There is a ramp on the south side vestibule,

Another accessibility issue is number of restrooms based on the occupancy load numbers. The Conservation Code makes a note in Chapter 1303 that "the ratio of water closets for women to the total of water closets and urinals provided for men must be at least three to two, unless there are two or fewer fixtures for men."[77] Currently, there are two women's restroom areas and two men's restrooms in the building, one in the basement and one on the second floor. There are a total of four lavatories, five water closets and two urinals in the basement, and four lavatories, four water closets and two urinals on the second floor. The current count essentially meets the ratio called out in the Conservation Code, but that does not mean that the number is adequate. This researcher recommends that more restrooms be added for the sake of ease and accessibility.

Finding an Appropriate College Program – Option 1: The Museum Stays

The fourth challenge is to either re-adapt the space for the current museum, or find university programs that can easily move in and adapt to the space. The departments need programming that includes museum or gallery space, lecture rooms, an auditorium, office space,

[75] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 28.
[76] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 29.
[77] International Building Code and Association of Minnesota Building Officials. *Minnesota State Building Conservation Code*. 2003. Country Club Hills, IL.. pg. 13.

lab space and storage. Another consideration is to find a program that does not mind living with the quirks of a historic, yet architecturally interesting building.

If the museum intends to stay within the space, there are some specific areas they can look at to help improve space efficiency.

During a tour, this researcher photographs areas of the building. It is clear that there are three floors that if redesigned can provide a better experience for both people who work within the building and people who visit.

The first area is the basement space. The entire space is given over to storage. Old lab rooms are now filled with bird pamphlets, and storage lockers are filled with 40 year-old rocks that no one claims. Like every household, the museum staff needs to go through and make three piles: things to donate to other programs, things to keep and things to throw away. Then and only then, can a designer sit down with the staff to adequately program the space.

Figure 96: Basement Locker

Figure 94: Basement Storage Area

Figure 95: Basement Storage Area

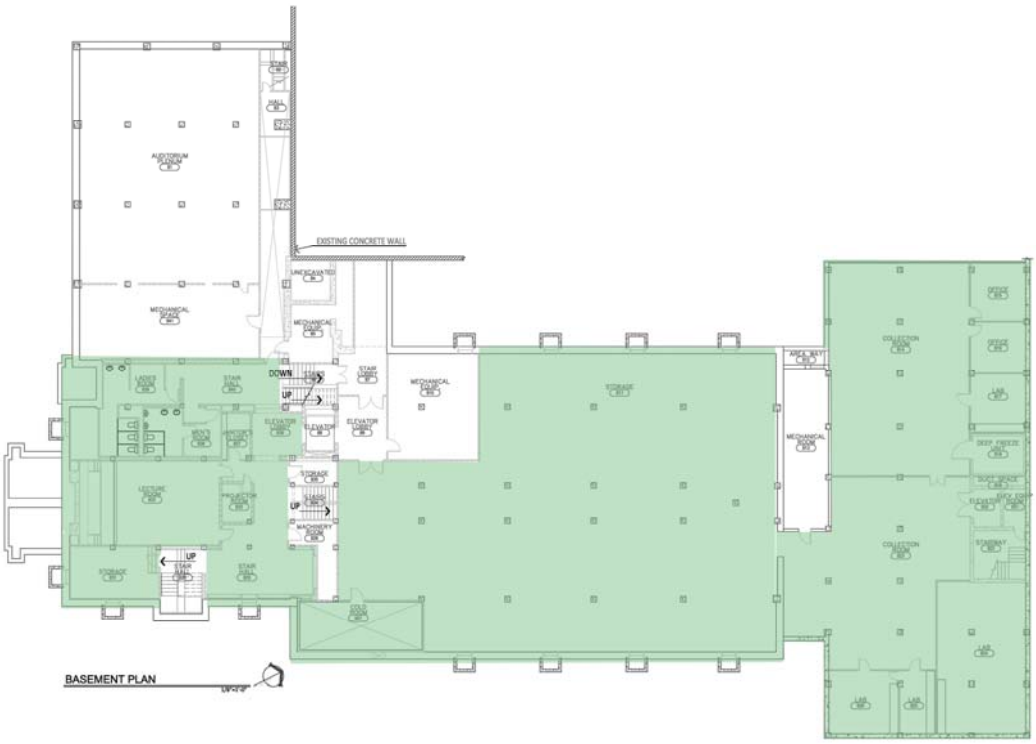

Figure 97: Bell Basement Change Areas

Some things the museum staff can think about is computer lab space. The basement is a good space to have a computer lab, or improved testing areas. The lab rooms already have sinks in them so re-designing them to be larger and more efficient to meet today's lab standards can be accomplished. There is also a lecture room with a projector room in the basement, which shall be utilized for showing films. This was done years ago to show documentary nature films. This area has to be reconfigured to have better accessible routes to the first floor exits.

The first floor level exhibit space can be reconfigured for more flexible space if the museum decides to remove the dioramas. As stated in a previous section of this thesis, removing the dioramas can affect the historic designation, but the museum is facing economic hardship, and like other museums, need to change with the times to bring in revenue from paying customers. Another space type that can bring in more revenue is a coffee shop for guests, students and faculty. At this time, the closest coffee shop with decent coffee is Starbucks which is located on Washington Avenue. Also, a gift shop that is similar to the one at the Science Museum in St. Paul can be an added revenue maker. These two spaces can be located on the First Level near the front lobby.

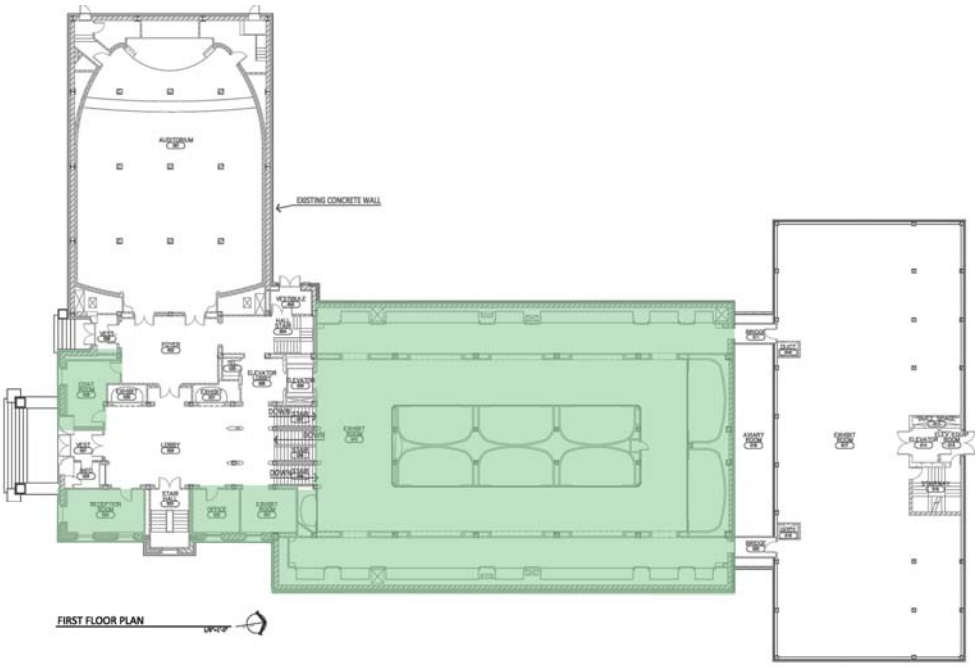

Figure 98: Bell First Floor Change Areas

The mezzanine space above the lobby should be restored to its prior layout if the recommendation is to designate the building for National Register status. This opens up exhibit space to the lobby. Also, installing another restroom is helpful on this level.

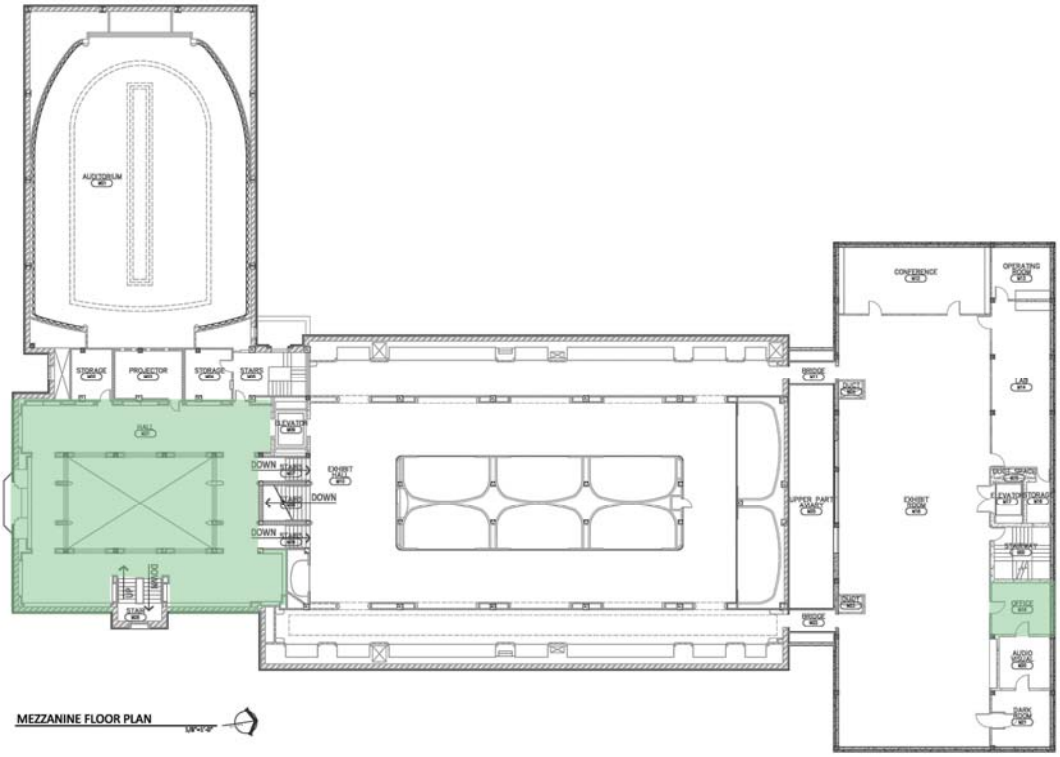

Figure 99: Bell Museum Mezzanine Change Areas

The second floor level is the third space for opportunity. The second floor, in both the original building and the addition, has wasted office and lab spaces. The addition, especially, can have more offices, storage and meeting spaces built out for staff, faculty and students. Accessibility routes to the first floor level exits are not a problem.

The classrooms need to be updated to incorporate 21ST century teaching technology and lab spaces have to be eliminated or re-laid out to bring them up to workable standards.

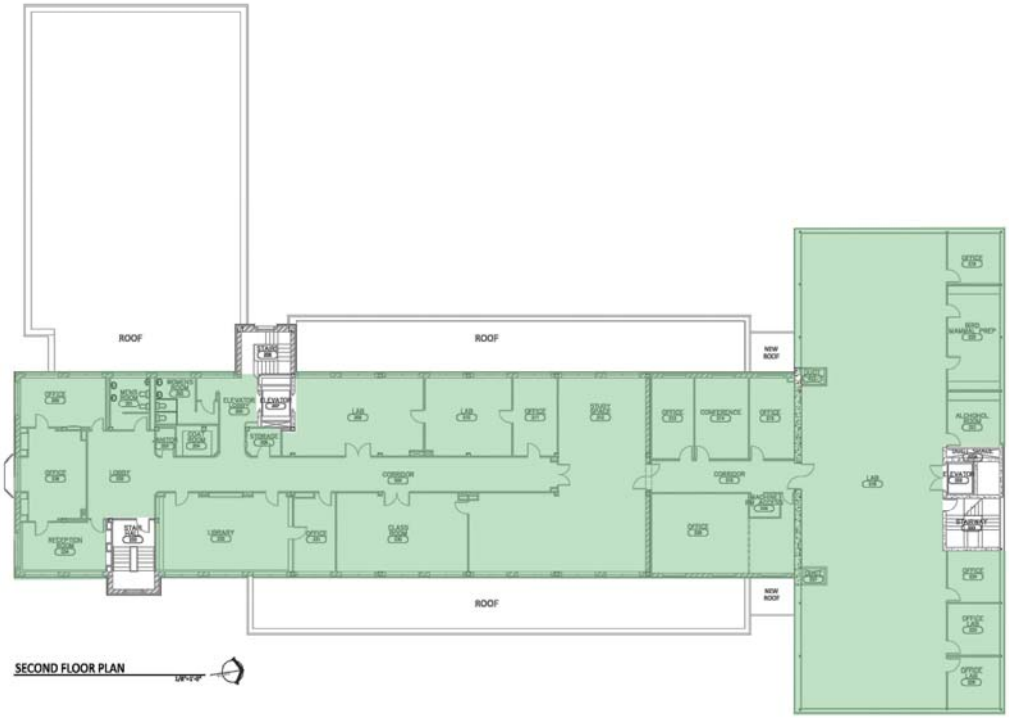

Figure 100: Bell Second Floor Change Areas

The final space that needs to be addressed is the restroom areas. There are only two male and female restrooms in the building, and they are located in the basement and on the second floor. This is not adequate for a building of this size, and neither is ADA compliant by today's standards.

Finding an Appropriate College Program – Option 2: Another Program

At this time, there is a college that is a fine candidate to move into the Bell Museum space. The College of Design currently has programs in various design disciplines. The architecture, landscape architecture, heritage preservation and sustainable programs are located in Rapson Hall, on the East Bank Campus while other departments are located in McNeal Hall, on the St. Paul Campus. They include retail /merchandising, apparel design, interior design, housing, and graphic design. The college also houses the Goldstein Gallery on the St. Paul campus. The former Design, Housing and Apparel programs merge with the College of Design in 2008, yet due to budget constraints, space availability and politics, the college continues to live on two separate campuses.

The St. Paul campus programs have outgrown their 58,408 square foot space, and if the St. Paul programs can find space near the East Bank Campus programs, the school can potentially consolidate administrative support and costs, share common resources, develop a more cohesive "brand", and in the process, build revenue.

The Bell Museum seems a likely candidate for three reasons: 1) It is located adjacent to Rapson Hall on the East Bank campus and 2) its 84,970 square feet allows for a 66% increase in space for the college, 3) The building space program fits the minimum requirements for the College of Design space program.

Programming

As previously stated, the College of Design St. Paul campus is currently housed in approximately 58,408 square feet, which has become outdated and cramped. Each department has very specific space program requirements, including technology-driven lab spaces. Information and numbers are provided by Paige Rohman, Laurie Gardner, Becky Yust, Steven McCarthy, Karen LeBat and Julie Vansteenburgen at the College of Design, University of Minnesota.

The Retail Merchandising department currently has three full-time faculty, one adjunct, nine graduate assistants and serves 188 students. Its special space requirements include a library and storage space, and a computer lab space.

The Graphic Design department, the largest out of the five, currently has seven full-time faculty, 12 adjuncts, 10 graduate assistants, and serves 253 students. Its special space requirements include a resource library, layout/cutting space with vented spray area, and storage space, and a computer lab space.

The Housing Studies department currently has five full-time faculty, one adjunct, five graduate assistants and serves 30 students. Its special space requirements include the Mid-West Radon Consortium, a library and storage space, and a computer lab space. This program is growing, and could potentially require more space in the future.

The Interior Design department currently has four full-time faculty, nine adjuncts, and six graduate assistants and serves 152 students. Its special space requirements include five studio spaces, a lighting/furniture lab, and a resource library, layout/cutting space with vented spray area, a computer lab and an office for InformeDesign.

The Apparel Design department currently has four full-time faculty, two adjuncts, and nine graduate assistants and serves 84 students. Its special space requirements include three studio spaces with sewing area, a computer lab, a resource library, a Wearable Product Design lab, and a Human Dimensioning lab.

The St. Paul Campus also has four full-time staff, a Student Affairs Office and space for the Goldstein Gallery and its staff.

There are several main areas that can be redesigned in the Bell, if these departments move into the building. They are the basement space, the first floor, the mezzanine and second floor.

Most of the basement area, minus the mechanical rooms and vertical penetrations, can be completely gutted to make way for lab space, computer space, storage space and perhaps some office space. The reason the basement is a good choice for certain lab, computer and storage areas is because they don't necessarily need daylighting in order to do the work involved

within the space. The cold storage can be taken out to make way for regular storage. Lab space can include The Human Dimensioning Lab, the Wearable Product Design Lab, Photography Labs, and program storage, Goldstein Gallery storage and labs, and computer labs.

The first floor areas affected by redesign are the main exhibit space, the addition space, and the reception, office and coatroom area which are located in the main lobby. The lobby spaces can be used for more guest friendly spaces, like a coffee shop, a supply/bookstore featuring design books. The exhibit space can be used for classroom space, storage and some studio space not requiring a lot of daylighting. The addition area can be completely gutted and turned into more classroom, studio, a library space, restrooms or faculty, adjunct or graduate student office space, but because there are no windows on this level, there is an opportunity to put them in, since the addition does not have historically significant features.

The mezzanine area affected by redesign is the area right above the lobby. This space can be restored to its original historic layout, and can be exhibit space for the college. The other area affected is the second floor addition space. This can be gutted, minus the vertical penetrations, to provide classrooms, studio space, restrooms, or faculty, adjunct and graduate student office space. Again, there are no windows on this level of the addition, so there may be opportunity to install appropriately designed windows to enhance natural daylighting.

The second floor is completely affected by redesign, as the spaces are inefficient. This floor is used for administration, storage, classrooms, studio space, restrooms and faculty, adjunct and graduate student office space.

This researcher also recommends that the glass connection between the original Johnston building and the Page & Cavin addition be redesigned to implement passive solar energy. It has the right materials of glass and concrete and faces south. This area can showcase some mechanical systems that use passive solar technology which then help the main mechanical system to heat, and cool the building, as well as provide heated domestic water and electricity.

MCNEAL HALL - COLLEGE OF DESIGN
TOTAL DEPARTMENT, AND STAFF NUMBERS

STAFF NUMBERS		
Retail / Merchandising	# of Full-Time Faculty	3
	# of adjuncts	1
	# of grad students / TA's	9
	# of UG students	188
	requirements	Merchandising Library, Computer Lab
Graphic Design	# of Full-Time Faculty	7
	# of adjuncts	12
	# of grad students / TA's	10
	# of UG students	253
	requirements	Computer Lab, Layout Space, Storage
Housing Studies	# of Full-Time Faculty	5
	# of adjuncts	1
	# of grad students / TA's	5
	# of UG students	30
	requirements	Midwest Radon Consortium, Computer Lab
Interior Design	# of Full-Time Faculty	4
	# of adjuncts	9
	# of grad students	6
	# of UG students	152
	requirements	InformeDesign, Lighting Lab, Resource Library, Computer Lab, Studio Space
Apparel Design	# of Full-Time Faculty	4
	# of adjuncts	2
	# of grad students / TA's	9
	# of UG students	85
	requirements	Human, Dimensioning Lab/ Wearable Product Design Lab (Shared), Computer Lab, Apparel Library, Studio Space
Undeclared UG		32
UG Housing Minor		8
UG Retail / Merchandising Minor		67
TOTAL Grad/Prof/PhD	70 (including TA's)	31
Staff	Full-Time Staff	4
TOTAL FAC/STAFF		**937**

Table 6: DHA Faculty, Staff and Student Count

MCNEAL HALL - COLLEGE OF DESIGN
TOTAL SQUARE FOOTAGES NUMBERS

FLOOR	ROOM TYPE	SQUARE FOOTAGE	DEPARTMENT
Fourth Level	Classroom	3,055.00	Interiors
First Level	General Purpose Classrooms	1,898.00	Multi
Ground Level	General Purpose Classrooms	3,702.00	Multi
Third Level	General Purpose Classrooms	617.00	Multi
SUB-TOTAL CLASSROOMS		**9,272.00**	
Fourth Level	Interiors Library	1,676.00	Interiors
Second Level	Multiple	18,593.00	DHA
Third Level	Multiple	12,312.00	DHA
SUB-TOTAL SPECIAL		**32,581.00**	
First Level	Networking & Telecom	15.00	Multi
Ground Level	Networking & Telecom	11.00	Multi
Second Level	Networking & Telecom	15.00	Multi
Third Level	Networking & Telecom	28.00	Multi
SUB-TOTAL NETWORKING		**69.00**	
Fourth Level	Offices	1,864.00	Interiors
Ground Level	Offices	8,108.00	CDES Admin
Ground Level	Offices	839.00	DHA
SUB-TOTAL OFFICES		**10,811.00**	
Basement Level	Storage	4,947.00	Multi
Fourth Level	Storage	31.00	Interiors
SUB-TOTAL STORAGE		**4,978.00**	
Ground Level	Student Affairs	697.00	CDES
TOTAL S.F.		**58,408.00**	

Table 7: DHA Square Footage Numbers

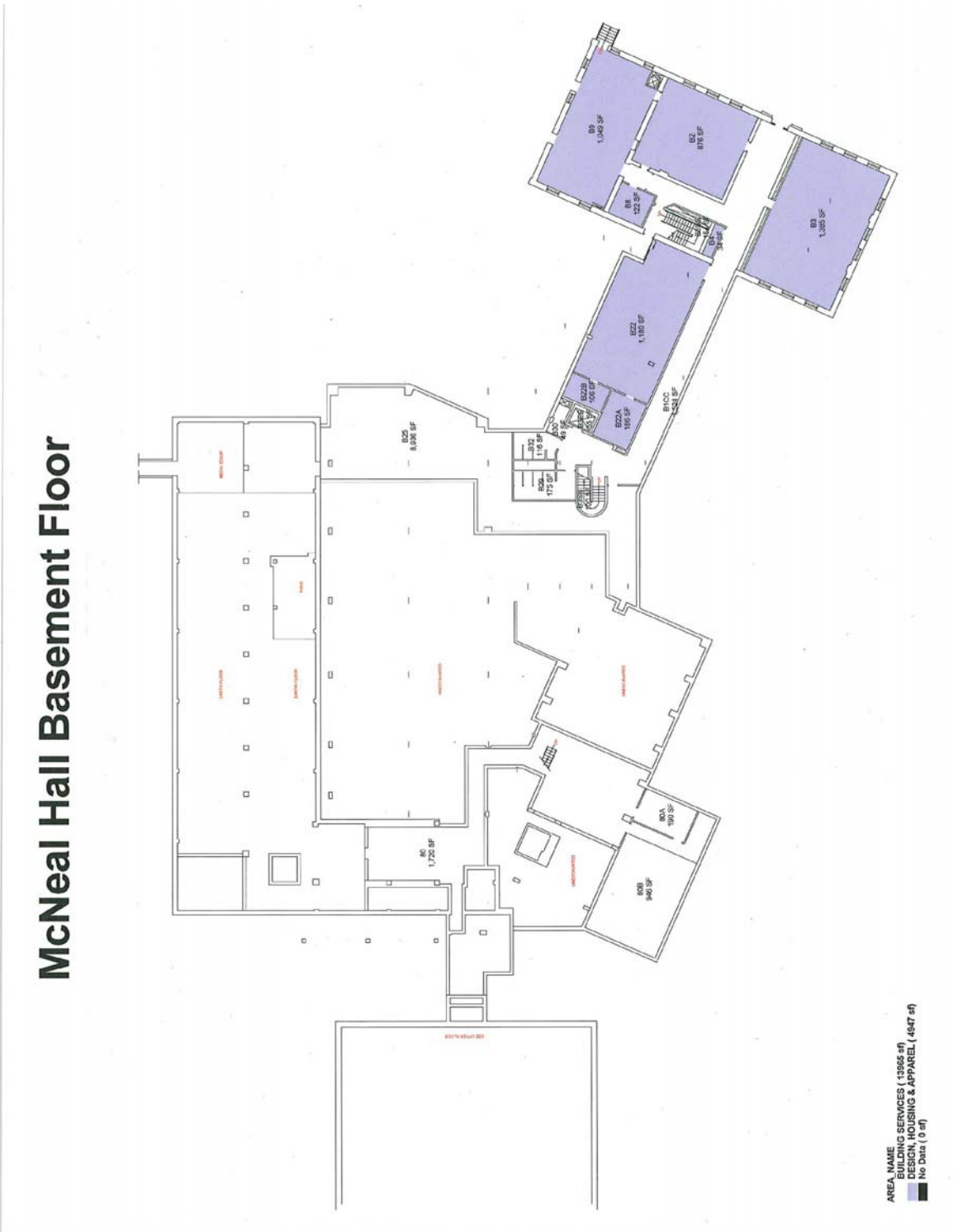

Figure 101: McNeal Hall Basement Level

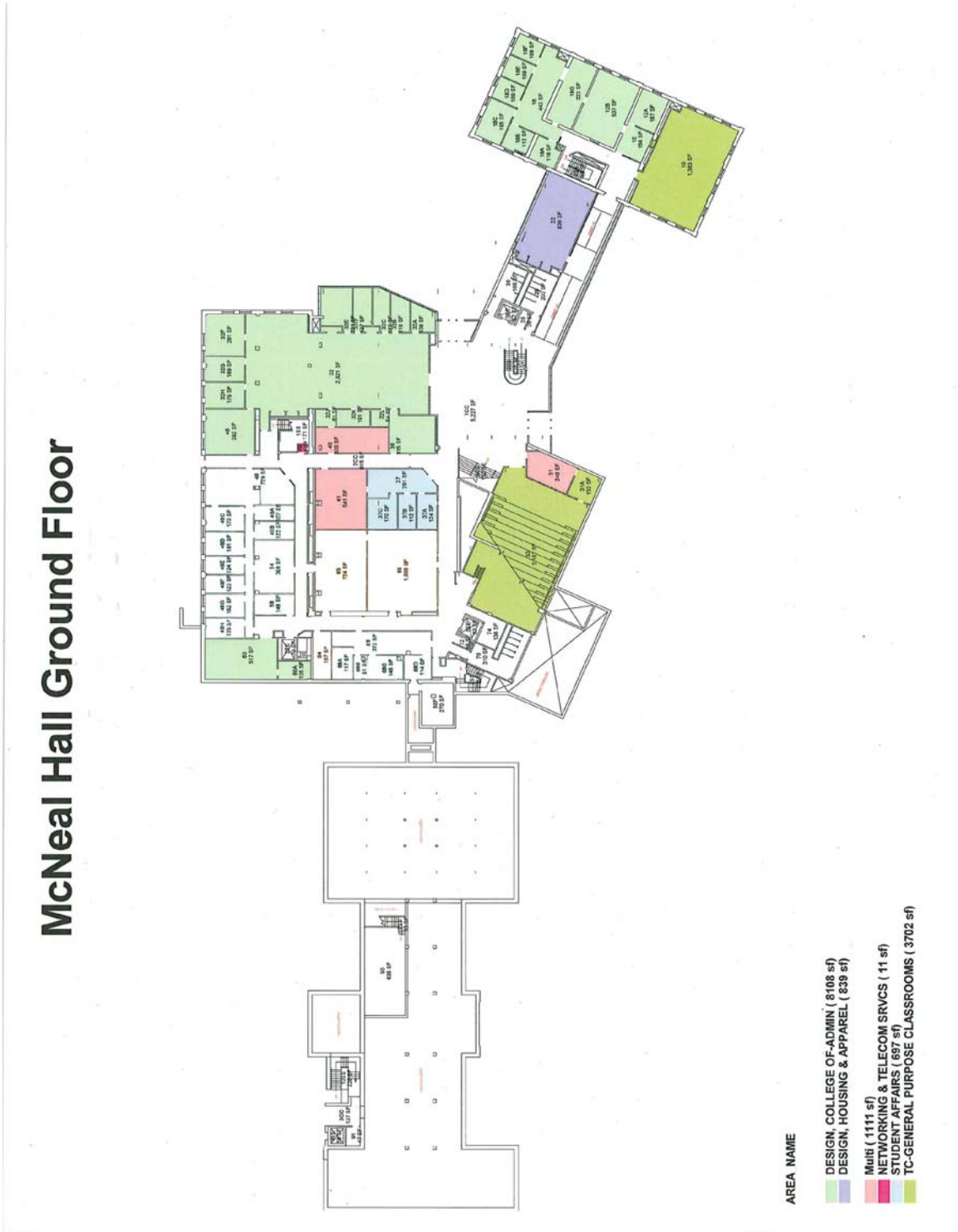

Figure 102: McNeal Hall Ground Floor

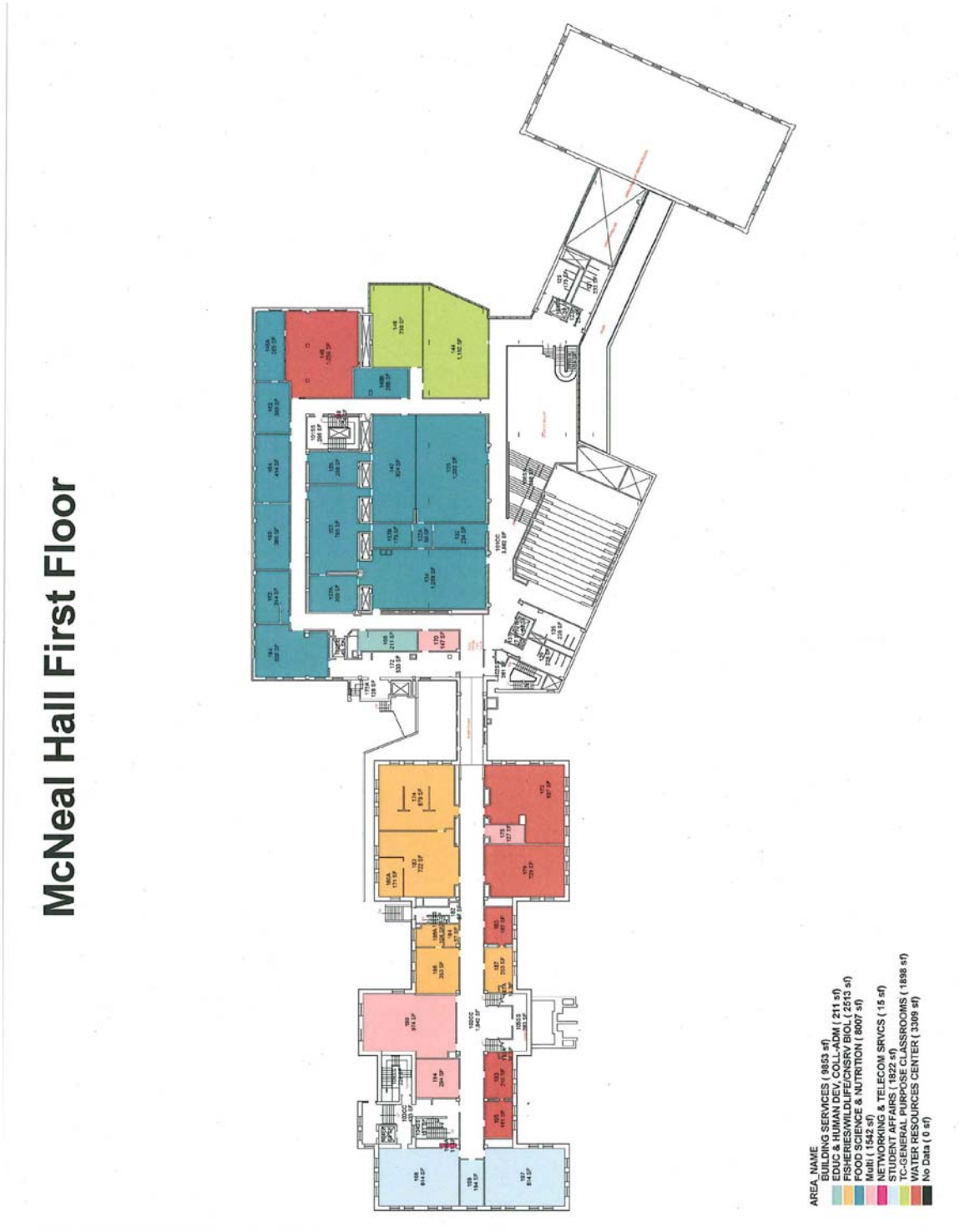

Figure 103: McNeal Hall First Floor

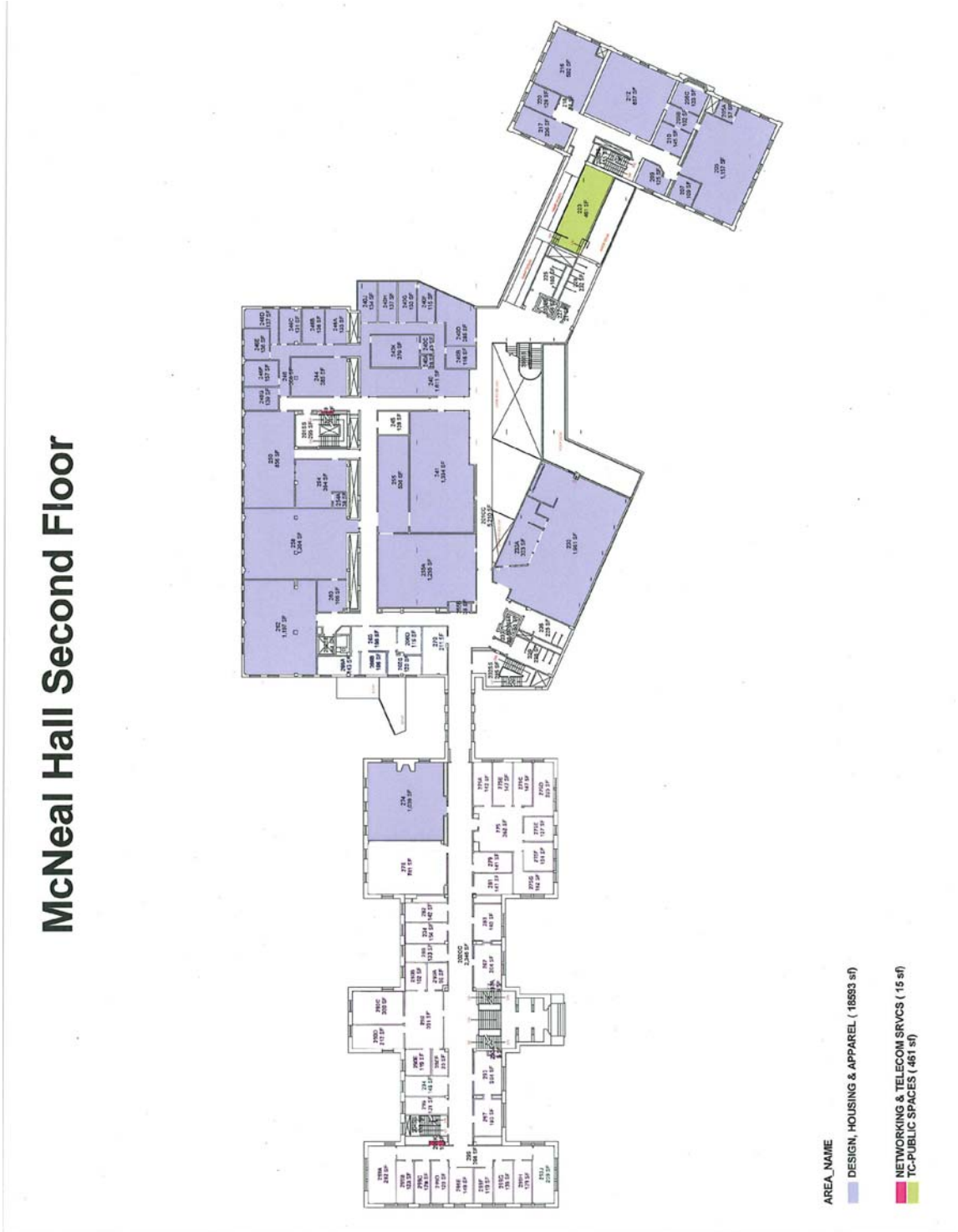

Figure 104: McNeal Hall Second Floor

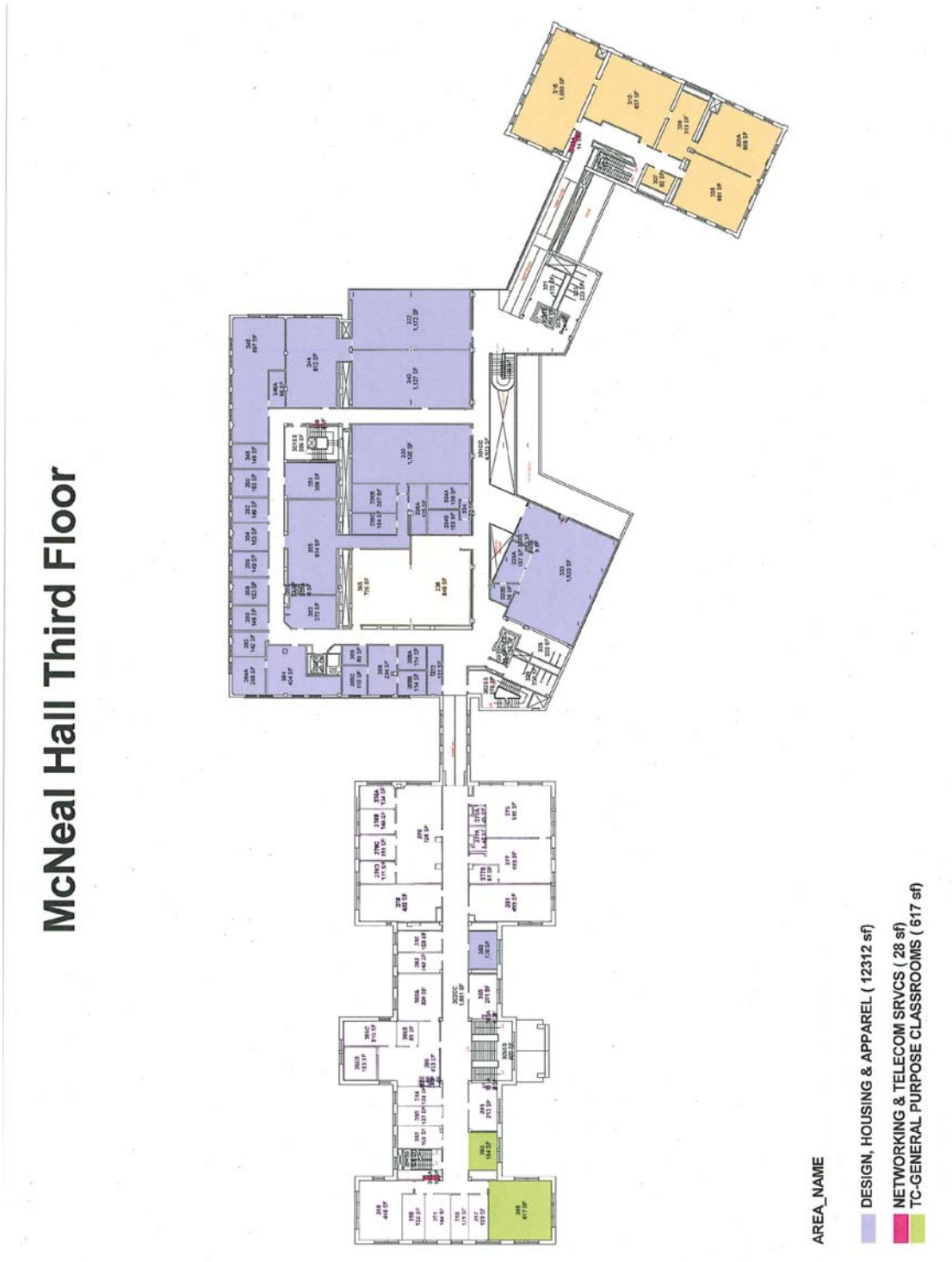

Figure 105: McNeal Hall Third Floor

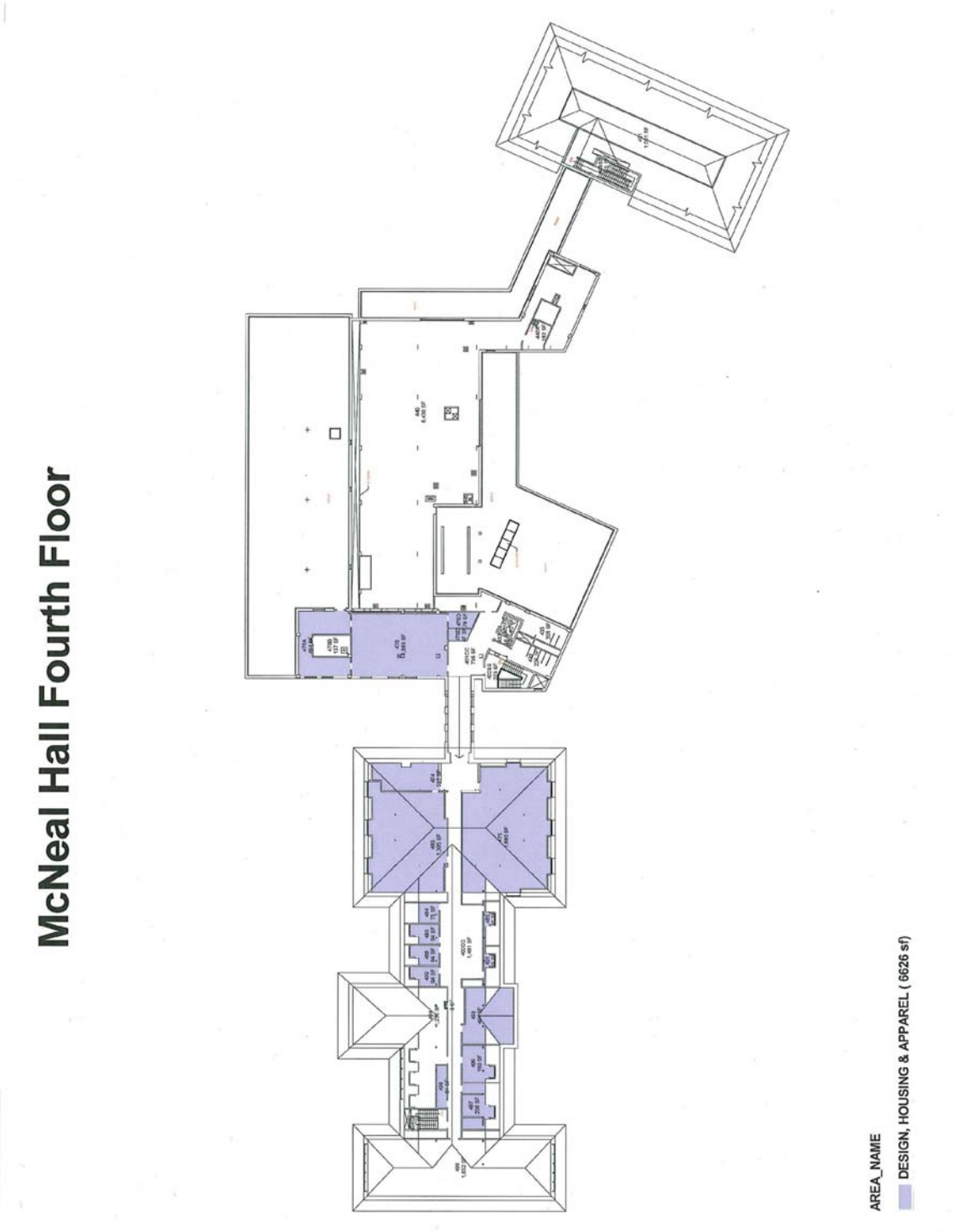

Figure 106: McNeal Hall Fourth Floor

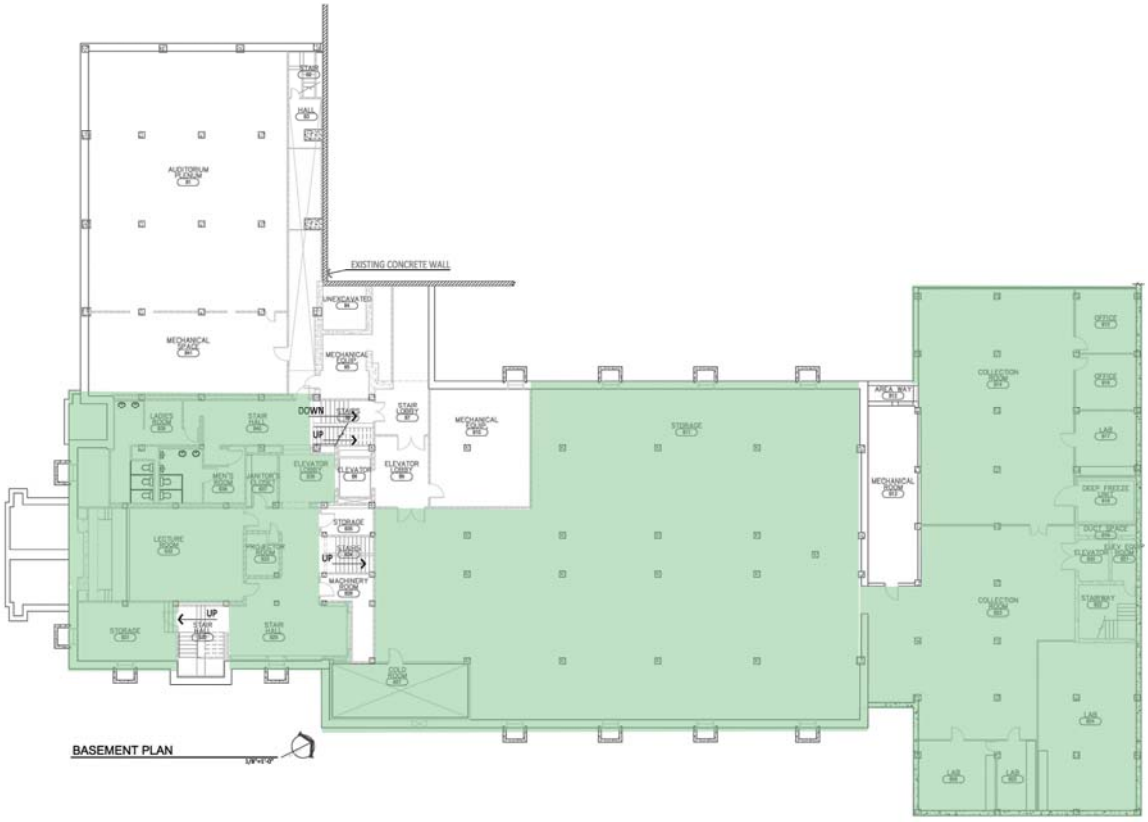

Figure 107: Bell Basement Changes for DHA

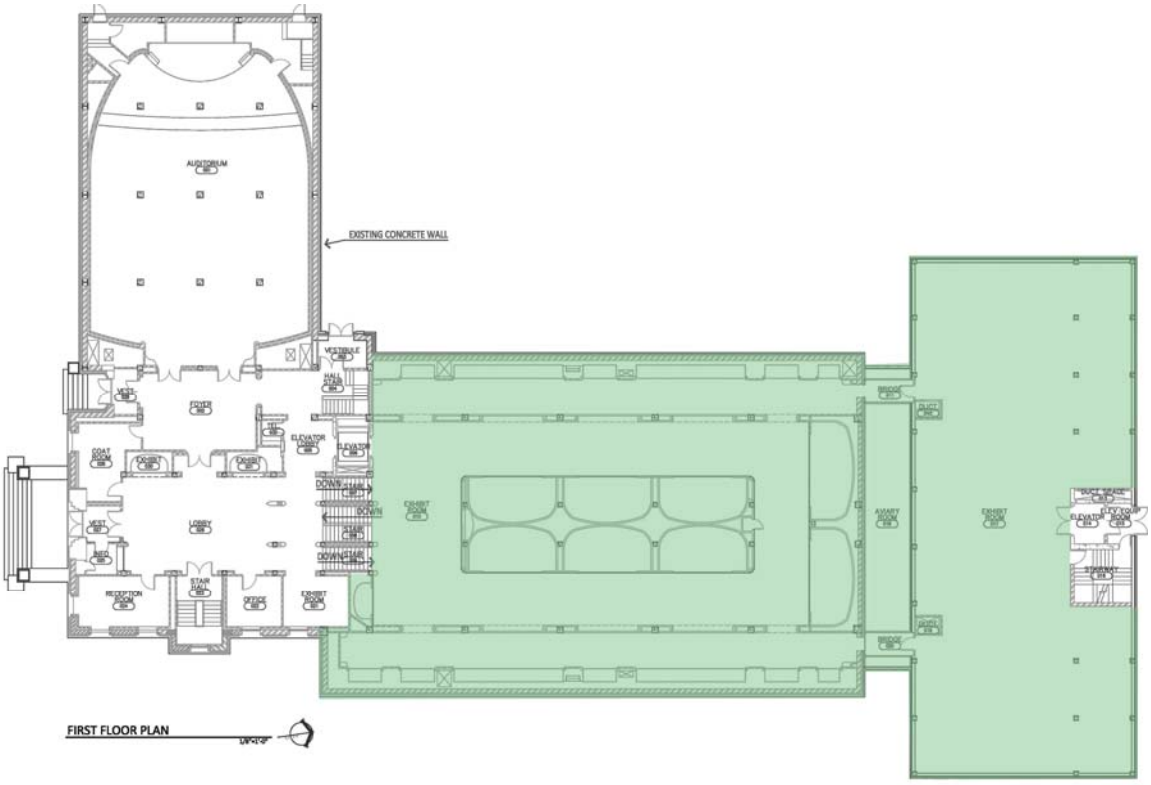

Figure 108: Bell First Floor Changes for DHA

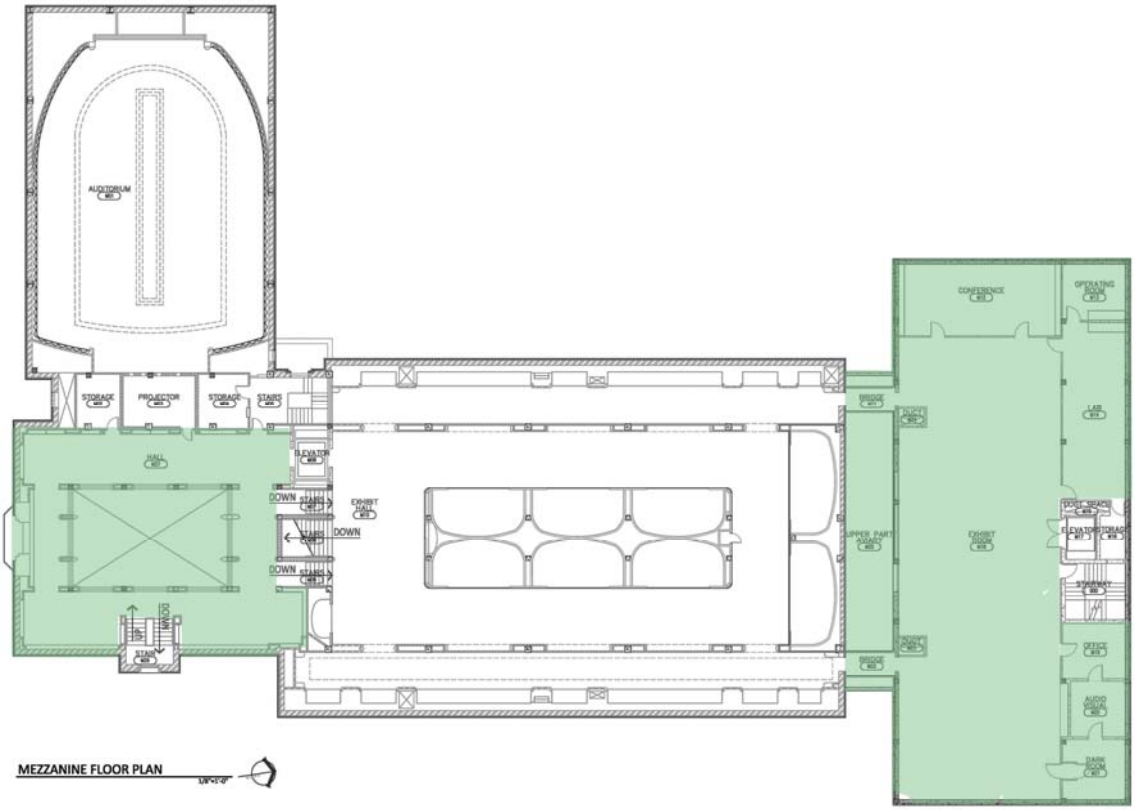

Figure 109: Bell Mezzanine Floor Changes for DHA

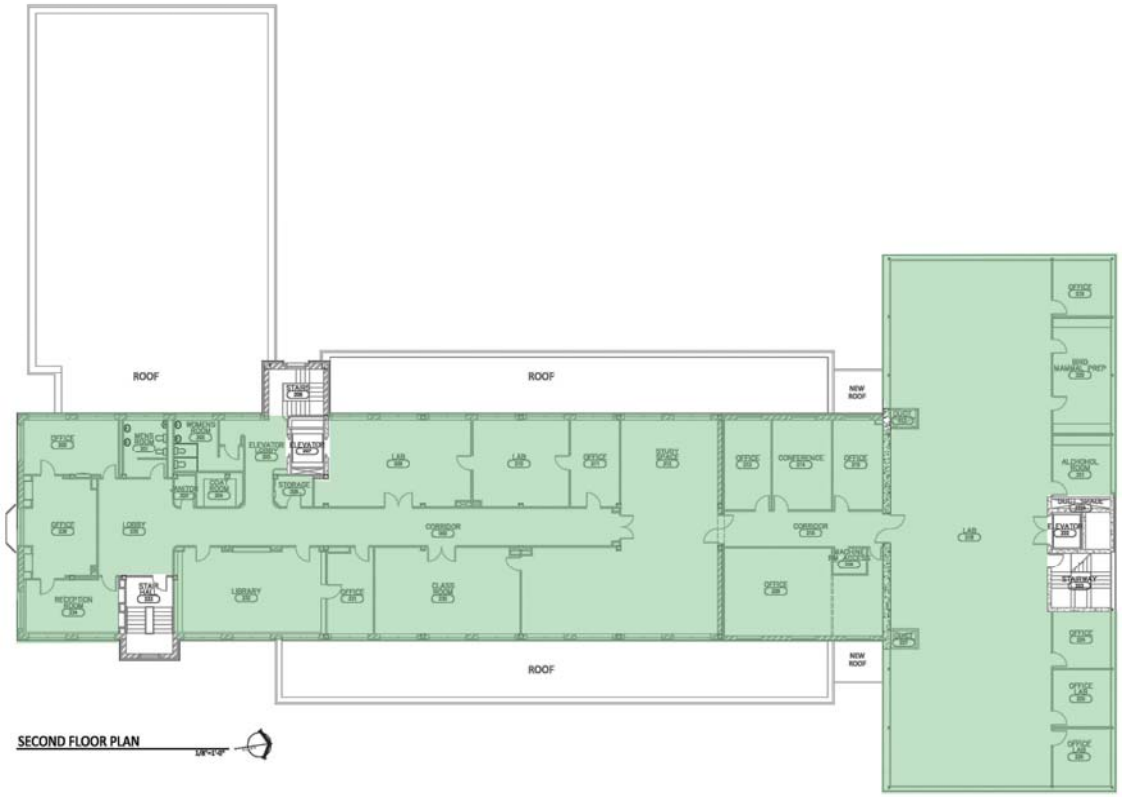

Figure 110: Bell Second Floor Changes for DHA

Closing Summary

The Bell Museum can be considered a historic building based on criterions "A" and "C" which are provided by the National Register of Historic Places. The building shows the Art Moderne/Art Deco style that is designed by a prominent, local architect. The building is monetarily supported by wealthy philanthropist and businessman, James F. Bell, the founder of General Mills, as well as the person who sets up the James F. Bell Library on the University of Minnesota campus. The building also receives funding through the Public Works Administration, a federal agency during Franklin D. Roosevelt's presidency that works with local government to provide work for people during The Great Depression. Finally, the museum dioramas document a learning method, and artistic style of the early 20th century that is quickly disappearing in many natural museums today.

Areas to be preserved are the original building's exterior, minus the glass connection space, the first floor auditorium and lobby space, and the mezzanine space in the original building.

The building is still viable stock, and is structurally sound so it should be preserved and maintained, but it has potential to be more flexible.

Because the building can be deemed historically significant, the building code of choice is the Minnesota State Building Conservation Code, but there are some stipulations that can state certain areas are not part of the preservation and can be redesigned for better efficiency and flexibility.

The museum staff requires a feasibility study to be completed that documents analyzes and recommends solutions in regards to energy efficiency of the building. The specific areas are HVAC, updating water fixtures, looking at rainwater collection, and updating light fixture bulbs.

If the museum is to stay in the building, there are spaces within the building that can be redesigned. These areas include the basement, the first floor exhibit space and addition, the mezzanine addition, and the complete second floor.

If another program moves into the space, the areas to be redesigned include the basement, the lobby area of the first floor, plus the exhibit space and the addition, the mezzanine space above the lobby and the addition, and the entire second floor.

By documenting, analyzing and coming up with design solutions, the Bell Museum can continue to be a worthwhile, historically significant building that if programmed correctly can be more flexible, energy efficient and functional going into the 21st century.

BIBLIOGRAPHY

"About The National Register of Historic Places." The National Register of Historic Places, National Park Service. Retrieved 10/24/2010 from < http://www.nps.gov/nr/about.htm>

"Architectural Character." The National Register Preservation Brief #17. Retrieved 9/25/2010 from <http://www.nps.gov/hps/tps/briefs/brief17.htm>

Association of Minnesota Building Officials and the International Code Council. 2007 Minnesota State Accessibility Code, Chapter 1341. 2007. Minnesota.

Association of Minnesota Building Officials. Minnesota State Building Conservation Code. 2003. MN

Minneapolis Star Journal. Bell Museum. 10/28/1942. St. Paul. MN. Minnesota Historical Society Photograph Collection. Location no. FM6.813 p156 Negative no. 44538. St. Paul, MN.

"B3 Guidelines." The State of Minnesota Sustainable Building Guidelines. Retrieved 10/24/2010 from < http://www.msbg.umn.edu/p_2.html>

Bell, James F. Regent. "Corner Stone Ceremony." 9/14/1940

Bell, James F. Regent. "Dedication of Museum of Natural History." 9/28/1940.

Benton, Thomas H. "Preserving the Future of Natural-History Museums". Chronicle of Higher Education, 00095982, 10/30/2009, Vol. 56, Issue 10

Benton, Thomas H. "The Decline of the Natural-History Museum." Chronicle of Higher Education, 00095982, 10/13/2006, Vol. 53, Issue 8.

Blackhurst, Michael, P.E., Hendrickson, Chris, Dist. M.ASCE2. Matthews, Scott H., A.M.ASCE3. "Cost Effectiveness of Green Roofs.". Journal of Architectural Engineering. 12/2010. Vol. 16 Issue 4, pp. 136-143.

"Bonding Bill Finalized." University of Minnesota. Retrieved on 1/3/2011 from <http://www1.umn.edu/twincities/faculty-staff/features/2008/UR_180309_REGION1.html>

Clapp, Warner and Hollis, V.P.. Interior Lobby of Bell Museum. 1952. University of Minnesota Press. University of Minnesota Archives. Minneapolis, MN.

Clapp, Warner and Hollis, V.P.. South Exterior of Bell Museum. 1952. University of Minnesota Press. University of Minnesota Archives. Minneapolis, MN.

Congressional Digest. Jan1931, Vol. 10 Issue 1, p8-31, 2p.

Corwin, Charles. Woodland Caribou. 1911. The Bell Museum. Minneapolis. MN.

"Cubism." Wikipedia, The Free Encyclopedia. Wikimedia Foundation, Inc. Retrieved 10/24/2010 from <http://en.wikipedia.org/wiki/Cubism>

Dirjish, Mat. "LED Lighting Waits in the Wing." Electronic Design. Vol. 58 Issue 12, 9/23/2010. p26-33

Duncan, Alastair. American Art Deco. 1986. Harry N. Abrams, Inc. New York.

Falk, J. H., et. al., "Forum: Communication About Science in a Traditional Museum—Visitors' and Staff's Perceptions." Cultural Studies of Science Education. December 2006. Vol. 1 No. 4. p. 821-9

Franci, Giovanna, Mangaroni, Rosella, Zago, Esther. A Journey Through American Art Deco. 1997. University of Washington Press. Seattle.

"Francis Lee Jaques." The Jaques Art Center. Retrieved 10/24/2010 from <http://www.jaquesart.com/biography.html>

"General Mills 2010 Quarterly Report." General Mills Inc. Retrieved 7/28/2010 from <http://phx.corporate-ir.net/phoenix.zhtml?c=74271&p=irol-newsArticle&ID=1442782&highlight=>

"GIS Map Bell Museum." 8/9/2010. Retrieved from http://gis.co.hennepin.mn.us/HCPropertyMap/Locator.aspx

Gropp, Robert E. "Expanding Access to Natural History Museums." Bioscience. May2004. Vol. 54 Issue 5, p392-392 1p.

Guo, X, PhDa., Tiller, DK, DPhilb., Henze, GP, PhD PEc., and Waters, CE, PhD PEb., aDDP Engineered LED Solutions, 445 South Douglas Street, El Segundo, CA, 90245, USA, bArchitectural Engineering, University of Nebraska-Lincoln, Omaha, NE, 68182, USA, cDepartment of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder,Boulder, CO, 80309-0428, USA. "The Performance of Occupancy-Based Lighting Control Systems: A Review". Lighting Res. Technol. 2010; 42: pgs. 415–431.

Harmon, Robert B. 1983. The Art Deco Style in American Architecture: A Brief Style Guide. 1983. Vance Bibliographies, Monticello.

Harmon, Robert B. The Art Moderne Style in American Architecture: A Brief Style Guide. 1983. Vance Bibliographies, Monticello.

"How to Apply the National Register Criteria for Evaluation. The National Register Bulletin #15. Retrieved 9/25/2010 from <http://www.nps.gov/history/nr/publications/bulletins/pdfs/nrb15.pdf>

"History of the University of Pisa." University of Pisa. Retrieved on 10/24/2010 from <http://www.unipi.it/english/university/history/history.htm_cvt.htm>

International Codes Council, Inc.. 2006 International Building Code (IBC). 2006. VA.

James Ford Bell Library History, University of Minnesota.

Johnston, Clarence, Jr. Original Bell Museum Floorplans and Elevations. 1938. Facilities Management, University of Minnesota. Minneapolis, MN.

Johnston, Clarence, Jr. Original Bell Museum Lighting Fixture Sections and Details. 1938. Facilities Management, University of Minnesota. Minneapolis, MN.

Johnston, Clarence, Jr. Original Bell Museum Heating System Elevations. 1938. Facilities Management, University of Minnesota. Minneapolis, MN.

Laefer, Debra F., and Jonathan P. Manke. "Building Reuse Assessment for Sustainable Urban Reconstruction." *Journal of Construction Engineering & Management* 134.3 (2008): 217-227. *Academic Search Premier*. EBSCO. Web. 31 Jan. 2011

Lee Brothers. James Ford Bell. 1915. Minnesota Historical Society Photograph Collection. Location no. por 7223 p2, Negative no. 83514. St. Paul, MN.

Liebel, Brian, P.E., and Brodick, James, Ph.D., "Squeezing the Watts Out of Fluorescent Lighting". Ashrae Journal. November 2005. Pgs. 52-54

Luce, Don, Pelley, Janet, Williams, Kevin. The Making of the Bell Museum Dioramas. 1987. Exhibits Division. University of Minnesota Press. Minneapolis.

McNeal Hall Floorplans. Facilities Management, University of Minnesota. Minneapolis, MN.

Middlebrook, W.T. Letter to Frank. G. Babcock, Treasurer, Breen Stone & Marble Company, Kasota, MN. 1/4/1939.

"Museum Sculptor Samuel Bell Dies." Imprint. Spring 1988. Vol. V, No. 2.

"Natural History Museums on the Web." The University of California, Berkeley. Retrieved on 9/25/2010 from <http://www.ucmp.berkeley.edu/subway/nathistmus.html.>

Nortier, Richard. "Frugal Flow." American School & University 80.7 (2008): 34-36. Academic Search Premier. EBSCO. Web. 12 Dec. 2010.

Norton & Peel. Bell Museum. 7/27/1940. Minnesota Historical Society Photograph Collection. Location No. Norton & Peel 134965, Negative no. NP134965. St. Paul. MN.

PWA Form No. 175. 11/10/1938.

Reaser.Willbur. Minnesota Museum of Natural History. 1940. University of Minnesota. Bell Museum. Minneapolis, MN.

Robert, Thomas S. Annals of the Museum of Natural History, University of Minnesota, 1872-1939. 1939. University of Minnesota Press. Minneapolis. pgs. vi, xi.

Rubenstein, Doris. "Fact Sheet: Bell Museum of Natural History." 1989. University of Minnesota Archives.

Shipley, Robert, Utz, Steve, Parsons, Michael. "Does Adaptive Reuse Pay?" The Study of the Business of Building Renovation in Ontario, Canada." International Journal of Heritage Studies. November 2006. Vol. 12, No. 6, Pgs. 505-520.

Straube, John and Burnett, Eric. Building Science for Building Enclosures. 2005. Building Science Press, Inc. Westford.

"The Bell Museum." The Bell Museum, University of Minnesota. Retrieved 11/27/2010 from <http://www.bellmuseum.org/about.html>

"The Bell Museum and CFANS." College of Food, Agricultural, and Natural Resource Science, University of Minnesota. Retrieved 1/22/2011 from <http://www.cfans.umn.edu/DepartmentsCenters/index.htm>

"The Frist Center." The Frist Center. Retrieved 10/24/2010 from <http://www.fristcenter.org/site/about/building.aspx>

"The History of Diorama." Ehow. Retrieved 12/4/2010 from <http://www.ehow.com/about_5445468_history-diorama.html>

"The UNESCO Heritage Site List." The World Heritage Centre. Retrieved 9/25/2010 from <http://whc.unesco.org/en/list>

University of Minnesota-Twin Cities. Map. University of Minnesota Press. Minneapolis, MN. 1940.

University of Minnesota News Service. "Ground Will Be Broken Thursday for Bell Memorial Wing of Museum." July 21, 1964. MN

University of Minnesota News Service. "Dedication of the New Wing." May 8, 1971. MN