A design thesis submitted to the Department of Architecture and Landscape Architecture of North Dakota State University by

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# Table of Contents

## 1 // Introduction
- 1.1 Abstract
- 1.2 Narrative

## 2 // Research
- 2.1 Research Process
- 2.2 Typological Research Danish National Maritime Museum
- 2.3 Typological Research Jewish Museum Berlin
- 2.4 Typological Research Westerbork Commander’s House
- 2.5 Typological Research Sachsenhausen Baracke 38
- 2.6 Literature Review In Praise of Forgetting // David Rieff
- 2.7 Literature Review ENGAGE: The Future of Museums // Gensler
- 2.8 Literature Review Memorial Architecture... // Danijela Dimkovic
- 2.9 Research Study Visitor Driven Museums

## 3 // Project Justification & Context
- 3.1 Project Justification
- 3.2 Site Justification
- 3.3 Site Analysis

## 4 // Program & Performance Criteria
- 4.1 Program Requirements
- 4.2 Adjacency and Interaction Planning
- 4.3 Performance Criteria

## 5 // Design Solution
- 5.1 Process Documentation
- 5.2 Project Solution Documentation
- 5.3 Performance Analysis
- 5.4 Digital Presentation
- 5.5 Project Installation

## A // Appendix
- A.1 Supplemental Materials
- A.2 References
- A.3 Studio Experience
- A.4 Personal Identification
INTRODUCTION
The design of museum and gallery spaces are typically done by different designers with a mutual understanding of the scope of work for each. In the best possible scenario, these processes will take place congruently, with cooperation from both designers to realize the complete museum. In many cases, these processes take place in isolation from one another, with little to no collaboration between the building designer and the curator.

Agent-Based Simulation, or ABSim, is a process often used to analyze the flow of pedestrians in a designed space. Most commonly used to optimize evacuation patterns and transit terminal layout, the same process of simulated occupancy can be used in the process of designing and curating a museum. By utilizing ABSim in the design phase, architects and curators can work together to identify and minimize problem areas, enhance high-traffic regions, and avoid dead-zones. This project relies on simulation analysis in the design process to better understand and control how hypothetical occupants will use and understand the building and its galleries in order to create a comprehensive museum design.
OVERVIEW

Our country is currently facing a crisis of how we view our history. As society continues to evolve and adopt more progressive moral and ethical ideologies, we are beginning to see a renewed interest in the values of historically important figures and their actions. During this new awakening, the question of how we address our past is an extremely divisive and well recognized issue. This question is not reserved for political pundits or media debates but is being considered in every state and every jurisdiction as the issue of false memorials comes to a head. But arguably more urgent is the discussion we aren’t having, the issue not of false memorials, but of the ones that have never been built, memorials for events we shy away from remembering, memorials to events in our history where we were the perpetrators of tragedy and division.

This thesis project will seek to develop an architectural solution that can help recognize the troubling actions of our past, and aid in healing the communities most affected by these acts and lack of awareness surrounding them. More specifically, the thesis seeks to create a design solution encouraging pilgrimage to and engaging visitors at the Heart Mountain Relocation Center site in rural Wyoming. Through a process of research and design, the history and accounts of the Heart Mountain Relocation Center and its internees will be recognized and an attempt will be made to atone for the sins of our past. Through thoughtful intervention to the site in order to create a new memorial and museum experience, a new framework for accepting shared responsibility of the faults in our history and its figures will attempt to be developed.

At this politically volatile and rhetorically divisive point in time, it is imperative that we move towards a more objective observation of our history. No longer should we blindly accept that figures and events throughout our history were completely necessary or just. No longer should we refrain from questioning history in a form of pseudo-patriotism. For the progress of our nation, we must recognize that figures and events throughout our history are as deeply flawed as any in our present time, and to do so publicly, with memorials and museums representing the key mediums in that effort.

TYPOLOGY

This project will consist of both museum and memorial typologies designed to interact as a single, unified solution to remembering what happened at Heart Mountain Relocation Center in rural Wyoming. It will also include some level of historic preservation or adaptive reuse to incorporate fixtures of the site that are still present from the time of the camp.

EMPHASIS

The emphasis of this project will be to provide an architectural solution that expresses a steadfast recognition attempt to heal from injustices committed by the United States on its people through various points in our history and ongoing. We are often reserved in our judgment and acceptance of past injustices and by making recognition the focus, a renewed engagement with our own history may be created. The emphasis on recognizing the specific injustice of interning people of Japanese ancestry may also bring a broader recognition to the public that such a thing even happened in this country at all.
GOALS

The primary goal of this project is to validate the use of ABSim in the design process. The project seeks to showcase how ABSim can be utilized to prevent unintentional bottlenecks, dead space, and other wastes of square footage in a gallery, and to predict the way people will actually interact in the exhibition zones. A successful project will present a variety of layout options with analysis of each one conducted through careful and honest interpretation of the results of the simulation. The project may find an optimal layout or may be approached to demonstrate the process as a means of finding a correct option.

SITE

The site chosen for this project is located in rural northwestern Wyoming. Located roughly halfway between the towns of Cody and Powell, the site is the former home of the Heart Mountain Relocation Center. While rather isolated, the former relocation center is located between several other places that are commonly visited, these include Billings, Montana to the north, Yellowstone National Park, and Custer Gallatin National Forest to the west, and the Bighorn National Forest to the east. The site currently is home to the Heart Mountain Interpretive Center and is maintained by the Heart Mountain Wyoming Foundation, a private organization. The site is registered as a National Historic Landmark under the National Park Service.

USER // CLIENT

The clients for this project would include the Heart Mountain Wyoming Foundation and would likely be in cooperation with the National Park Service. Other groups or organizations important to the process may include Ben Sho: The Japanese American Legacy Project, former Heart Mountain internees and their families, as well as national, state and local officials.

The user group for this project is unrestricted because of the nature of the project. The target audience of this memorial and museum is left open as the hope would be that anyone may visit and experience the site in order to recognize it’s history. People who will use the site most often would include museum staff, archives and site preservation staff and researchers, and members of the Heart Mountain Wyoming Foundation among others.

JUSTIFICATION

As design technology improves our ability to construct and analyze our designs, opportunities for greater exploration of design options become available. ABSim is a proven tool used by designers to analyze pedestrian movement in transit terminals and safe egress. As a methodology that is already tested and trusted, additional opportunities exist with the technology to better understand occupant movement in space, particularly in the museum design and curating process. Through the course of this project, a research study examining the validity of ABSim in the museum sector will be conducted, and followed up by a design study of how the technology can be implemented in process.

DESIGN METHODOLOGY & PROCESS

The methodologies implemented for producing this project include a focus on research-based design. Research methods utilized over the course of this project include precedent studies, observation, and simulation in order to determine what design elements will provide the best opportunity for recognition, education, and healing.

The design process for this project will consist of four phases: research, schematic design, design development, and final production. These phases will occur over two semesters, with each phase including multiple sub-elements and tasks that will be completed during their respective periods. An preliminary outline of the design process schedule can be found in Table 1.2.2 below.
Figure 2.0.1

RESEARCH
The background research for this thesis project was done through the study of various projects with a similar typology and use of historical sites, literature review, and the completion of a research study on visitor interaction patterns at the Hjemkomst Center in Moorhead, Minnesota. In order to provide the biggest breadth of knowledge on the subject of memorialization and museum design, a process that included a wide variety of research sources was utilized. Because of the unique combination of the site context and project typology the typological case studies chosen are more representative of individual goals and methods for this thesis project, rather than a single complete approach. The research study also focuses on a single aspect of the larger thesis project: designing exhibit spaces for improved user experience. Overall, the research was meant to be as wide-ranging as possible to give the best possible variety of knowledge to bring into the thesis project.

**Typological Case Studies**

- Danish National Maritime Museum
- Jewish Museum Berlin
- Westerbork Commander’s House
- Sachsenhausen Concentration Camp Baracke 38

**Literature Review**

- In Praise of Forgetting // David Rieff
- ENGAGE: The Future of Museums // Gensler Research
- Memorial Architecture as the Symbol of Remembrance and Memories // Danijela Miodrag Dimkovic

**Research Study**

- Visitor Driven Exhibitions: Curating Museums Based on Visitor Behavior Patterns // Brady Laurin
The Danish National Maritime Museum is designed in and around one of the dry docks in Helsingør, Denmark. Opened in 2013, the museum is the work of Danish architecture firm Bjarke Ingels Group (BIG) and features many of their trademark geometric design styles. The museum is unique because of its use of the existing dry dock to frame gallery and gathering spaces that cross the open slot. One technical feature that is particularly interesting in this project is the use of the existing dry dock walls with new below grade space in the previously filled earth. The entire museum takes place below the grade level, with only glass panel railings visible across the existing landscape.

Entry to the museum occurs by walking over the sloping spaces of the museum down into the dry dock area, with an entry on the first below ground level. The museum doesn’t strongly follow typical paradigms of flat levels with connecting circulation between them. Instead, the museum utilizes sloping floor areas that connect between individual flat areas, often isolated from other spaces that share the same elevation (Figures 2.2.3 - 2.2.5). By sloping many of the gallery and circulation spaces, movement between exhibitions was given a priority in the form building process. This creates a striking display of movement in the visible portion of the museum from the exterior, tying both sides of the dry dock to one-another and creating a dynamic form that seems to float in the negative space of the sunken dock floor (Figures 2.2.1, 2.2.6, 2.2.7). The museum also incorporates a variety of open space suitable for events and other gatherings. Specifically, a seating area at the east end of the dry dock (Figure 2.2.8) and a fully detailed auditorium in one of the central sloped spaces. The alignment of the lower museum level with that of the dry dock floor also allows the museum to open up onto the dock floor itself to host various events throughout the year. Providing a versatility to interact with the historical architecture in a way most other museums can’t.
PROGRAM AREAS

- MUSEUM GALLERY
- SUPPORT & CIRCULATION
- AUDITORIUM
- FLEX
The Danish National Maritime Museum is an extremely successful example of a historical and cultural museum that is designed on a site with existing contextual fixtures. Bjarke Ingels Group put an emphasis on utilizing the existing structure of the dry-dock in a meaningful way without allowing it to hinder the square footage of the overall space or limiting the form of the visible portion. Because of the museum’s location within a UNESCO Preservation Zone of the nearby Kronborg Castle, a level of care to preserve the aesthetic of the site as much as possible while also creating a unique and identifiable institution for the museum was imperative. Bjarke Ingels Group capitalizes on this premise by decidedly not competing with the castle above ground, and instead, creates striking form in the constrained space of the dry dock, while also allowing the dry dock to exist in its historical form nearly entirely.

The gallery spaces in the museum allow for a variety of permanent and flexible exhibits to take place throughout the space. Below grade, along the sides of the dry dock are more traditional gallery spaces, with greater control of light and interaction between spaces. Meanwhile, in the connecting strips within the dry dock, galleries give visitors the ability to experience the museum in the visible context of the site, with views into and outside of the concrete dock walls. A blend of the two experiences can be found in some below grade galleries where portions of the dock walls have given way to glass storefront.

An important lesson can be learned from the design of the Danish National Maritime Museum is that the museum itself can be designed in such a way that it exists as its own institution but without competing for attention in the context for which it is designed. Had BIG taken a different approach towards creating the form of the museum it may provide a similar experience to the user within it, but a more negative impression to those on the broader site. As it was designed and built, visitors to the site as a whole can experience the historic landscape and castle without feeling infringed upon by modern architecture, and yet, have the ability to still visit it. The form is very respectful of context and feels very natural where it is situated. In a similar fashion, a goal of this thesis project will be to create a museum as deeply rooted in its context and still provide an identifiable institution on the site.

The other key lesson to learn from is the emphasis put on visitor gathering spaces as both planned and flexible areas. The museum architecture does a very good job of creating spaces that the museum can use to host events, whether that is lectures in the auditorium, forums in the cafe space, or any number of things on the dock floor. The design provides ample space for planned and organized gathering without limiting too greatly the space suitable for gallery space. The incorporation of the existing dock floor is an extremely unique and intelligent choice by BIG to further contextualize the project. By allowing the museum to open up to the dry dock, not only does the museum allow visitors to touch and experience the formerly operational dock, but also allows the museum to greatly increase their square footage without the need to condition space or physically add on. Just as the formal design demonstrates, this shows an important recognition of context as a way of improving the architecture and creating opportunities rather than limitations.
The Jewish Museum in Berlin was designed by Daniel Libeskind as a competition entry for the expansion to an existing museum building after Germany was united in the 1990s. Completed in 2001, the striking geometric form appears foreign against the traditional stone building it connects to below grade. The building consists of sloped and pointed walls, zig-zagging across the site in an almost lightning bolt shape. In actuality, the plan is derived from the distortion of a six-pointed star, the symbol of the Jewish faith, just part of the metaphor that drives its design.

Libeskind is now known for his use of symbolism and metaphor, and as his first built work, the Jewish Museum forms the basis. Officially, the submission was titled “Between the Lines”, a name emblematic of the architecture. Because the museum authority did not play an active role in the design process during the competition, the design seeks to stand as a sculpture, telling the story of the Jewish people in Germany through its design. To do this, Libeskind uses metaphor to create that experience. The “lines” referred to by the competition title can be when viewing the museum from above, and form the boundary of the voids Libeskind cut through the gallery spaces (Figure 2.3.3). In describing the design behind the museum, Libeskind notes that the penetrating voids serve as physical manifestations of the Holocaust. He argues that much like the Holocaust disrupted Jewish history and is innately tied to any telling of the Jewish story, so too will these voids impact the museum, it is impossible to experience the museum without being confronted by the voids and them disrupting the exhibition. Through most of the museum these voids seek only to disrupt, with nothing happening inside the space of the removed floor section. This seeks to further the metaphor of lost space in history and does a great job at it. Where this differs, is in three unique cases. The first case is the void in the original museum building that houses the stair case descending below grade to the new museum, the second is the termination of one of the three axes at the lower level, and the third is an installation that
invites museum visitors to walk on the sculptural expression of the Jewish people (Figure 2.3.1).

Another way Libeskind uses the architecture of the museum to tell the story of the Jewish people is through the entry at the lower level. Upon entering the addition on the lower level, visitors are confronted with three divergent paths (Figure 2.3.4). These paths serve a symbolic purpose of illustrating the paths of Jews through history and end at sculptural forms that help further cement the emotion of the path. The Axis of the Holocaust ends at the isolated form of the Holocaust Tower (Figure 2.3.6). The Holocaust Tower stands apart from the form of the building in a shape not unlike those of the voids cut through gallery itself. The concrete from rises in darkness from the inside, with a single slit cut at the point, a single ray of hope in the darkness of the Holocaust. The Axis of Exile terminates outside in daylight at the Garden of Exile (Figure 2.3.2). The Garden of Exile is one of the only places in the entire museum where a visitor will experience orthogonal planning. The notion of familiarity and simplicity quickly diminishes however when they enter the garden. The towering planters and sloped floor disorient the visitor and create anxiety about what is around the next corner, mimicking the experience of many Jews exiled because of the Holocaust. The final axis is the Axis of Continuity. The Axis of Continuity takes visitors out of the lower level and into the museum via a long and monumental staircase, with structural members protruding through the chasm. The gallery space itself was designed after the completion of the building, a less than ideal scenario which seems to be rather successful where it otherwise may have been problematic. In the case of the Jewish Museum, the fact that disruption was designed into the gallery space helps to minimize any issues in the actual curating of the exhibits. The voids purpose of disrupting the exhibits actually helps mask any disruption caused by museum curators not being involved in the initial design process. The museum is actually overfilled with artifacts and displays, this may be a result of the abnormally shaped galleries placing restrictions on spatial planning, or the voids cutting away floor space that may have been better utilized as galleries. The overfilling may also be by design to create chaos emblematic of the Holocaust, or by pure necessity to fit that amount of information into a space not large enough for it. Regardless it is likely the result of the planning process and is something that should be noted for future museum competitions or general project design.

Speaking now as someone who has not only studied this museum but also visited it, I must say that it I found it far more successful than I expected to. Going into the design phase of the thesis project it will be important to find the right balance between an extremely metaphorical approach such as this one, and a more pragmatic approach. One commonality between the design phase of the Jewish Museum and this thesis is the speculative nature. In both projects, the design phase will be undertaken without the supervision of a museum curator. In the case of the thesis project, however, I will be acting as both the designer and to some degree the curator. While the thesis project will not encompass the same level of detail that a museum curator would afford to a project, in collaboration with the research study in the fall semester, a loose exhibit framework will be created.

The level of understanding conveyed through the Jewish Museum about its subject is commendable. To achieve as successful a design as the Jewish Museum, as deep an understanding of the history surrounding Japanese internment will also be necessary. What Libeskind has demonstrated through his design of the Jewish Museum is an understanding of the Jewish story and the emotion attached. The Jewish Museum is an emotional experience as much as it is an informational one. It provides the opportunity to learn both traditionally through the museum context, as well as understand, to whatever degree possible, the emotional experience of the Jewish people.
**Figure 2.3.6**

**EXISTING BUILDING**

**NEW CONSTRUCTION**

- **GALLERY SPACE**
- **CIRCULATION SPACE**
- **PENETRATING VOIDS**
  - Penetrating Void
  - Vertical Disruption in the Floor Plan
- **DESIGN ELEMENTS**
  - Designed Space within the Void
- **VERTICAL CIRCULATION**
  - Stairs // Elevators
- **LOWER LEVEL AXES**
- **HOLOCAUST // EXILE // CONTINUITY**
- **OPEN GALLERY SPACE**
  - Varies slightly by level
The Commander’s House Project at Kamp Westerbork in the Netherlands is a unique answer to preservation of historical structures. Designed by Oving Architekten, the project is an attempt to preserve the aging house without actually touching it. The house has long been fenced off from the surrounding area to prevent any further damage to the structure and as an added safety precaution for visitors to the site. When the new structure was completed in 2015, it provided a more permanent solution to protecting the house and visitors.

The solution created by Oving of essentially placing the house within a glass box accomplishes the most basic need to protect the building from aging as a result of its environment, but it also seems to solve a number of other questions about its place on the site. By enclosing the house and immediate surroundings in a conditioned space, it allows the site to host events in a structured space (Figure 2.4.2). This is an important decision by the architect to now only seek to preserve the house but to allow people to interact with it again. The museum group now has the ability to create specific programming for the commander’s house and use an indoor space to host it. Another important function of the design is that it creates a physical manifestation of the reason for maintaining the house. The obvious purpose of erecting the glass enclosure is to protect it, but the formal enclosure being a glass box can serve the additional purpose of helping to explain why.

The house now exists within a glass box as if to be on display. The architecture of the enclosure is essentially making an example of the house and making it the artifact, rather than the museum. Instead of going to the house to see what is inside, you now go to the camp to see the house. Enclosing the house in a glass box changes the context. This is important to understand because by changing the context...
you take control of the storyline. Instead of the house standing strong and independently, in essence still symbolizing some control at the camp, it now stands covered, appearing weaker and less ominous.

The ability to change the context when necessary is an important tool for an architect to utilize on a cultural site, especially one with a history as tragic and tumultuous as prison and extermination camps. Because this thesis is situated within a camp not unlike Kamp Westerbork, it is important to understand this method of re-contextualizing existing site fixtures and to know when it is desirable. In this case it successfully reintegrates a feature of the site back into the active museum and does so in a way that is impactful and beneficial to telling the story of the site.

Other contexts may be less accepting of this form however. The form is objectively obtrusive, it dominates the view. Though it is transparent glass, the structure and size of the covering are such that it must be acknowledged. As previously described, it works for this site and this story, but it is not universal. The method used by Oving to protect and display the commander’s house is properly contextualized making it successful and is to be commended. Only through proper understanding of the goals of the client can this type of project work so well and that is something that needs to be done in this thesis project to ensure a successful final design.
Baracke 38 is a museum built within the footprint of one of the few remaining barracks at Sachsenhausen Concentration Camp in Oranienburg, Germany, near Berlin. Following a visit by Israeli Prime Minister Yitzchak Rabin in 1992, a portion of the barracks burned in an apparent arson attempt (Figure 2.5.4). Seeing opportunity in the ashes, the concentration camp decided to continue utilize the remaining portion as an exhibit of camp life, but to build in the footprint of the lost portion a contemporary gallery space for other artifacts found in the surrounding area.

The exterior form of the museum addition finishes the form of the existing barracks in the footprint of what was lost (Figure 2.5.5). Contrasting the wood framed and sided original barracks, a more contemporary corten rain screen and glass facade. The entry to the new museum addition is through the existing building in a manner that pushes you first through the history of the place before experiencing the more modern construction of the museum. Because the building is experienced as a single element, rather than an existing building adjacent to a contemporary gallery, the connection is given special care. At the threshold from old to new, the charred wood remains and is displayed behind glass, with a skylight at the border revealing itself. The central floor area of the museum is open to gallery space below with artifacts displayed in glass allowing circulation only at the edges (Figure 2.5.2). Multimedia displays are incorporated in tandem with physical artifacts, text, and documents throughout the exhibit, ensuring continuity and relevance of the museum into the future.

The museum is extremely successful in the way that it incorporates not only the obvious history of its place within a Nazi Concentration Camp and Soviet Special Camp, but also the unfortunate history of an arsonist’s attempt at destroying it. The camp grounds are fitted out with metal edging and rock to mark the footprints of the barracks long destroyed on the site, and an easy and obvious choice for site administrators may have been to continue that manner of marking the destroyed portion of the barracks. Instead the administrators made a distinct choice to allow design experts to create a new experience within the language of the destroyed barracks, and they have done so with great success.
Perhaps one of the most unique decisions made in designing the museum addition was the material selection. The camp is located on a site that features many trees and has a color palette of greens and browns of the natural landscape juxtaposed against the drab colors of 1940s construction in concrete, wood and gravel. The remaining barracks are a desaturated shade of green and many buildings are painted white. The corten rain screen and glass provide a stark contrast against the otherwise plain surroundings. It would seem that the material choice, while obviously bold, may be a result of the context, that nothing built on this site could be designed to fit into the camp and its torrid history.

The museum is also extremely successful in its use of various means of conveying information. Other areas of the camp site rely heavily on emotion attached to a given location or storytelling and victim’s accounts. This area of the camp uses a more traditionally German approach to holocaust memorialization by relying exclusively on the artifacts and documentation to tell the story. Through the incorporation of various ways of exhibiting that documentation, the museum appears timeless, though it has been in operation for 20 years.

The elegant and successful addition to a historical structure to create expanded gallery space and provide greater context to the site makes this a valid and important case study in how to approach design at important historical sites with respect to the existing buildings that surround it. The ability to formally blend new and old while creating distinct and meaningful spaces will be of great emphasis for this thesis project.
In Praise of Forgetting by David Rieff is a book on the philosophy and ethics of remembrance, albeit, in a non-traditional sense. Rieff’s approach to collective and cultural memory is that in most cases it is detrimental, and nearly always misguided. While this may seem like the antithesis of what a museum and memorial project should look to as a basis of design, the belief that cultural memory in America is a flawed system definitely warrants consideration, especially when the process of designing the museum is with the goal of education and visitor attachment as a priority.

One of Rieff’s most profound and far reaching argument is that objective memory does not exist both personally, and in a collective sense. Much of my argument is that memory is more commonly used not as a preventative tool, but one to exact further crimes against humanity, stating that:

“Since, as the great French historian Jacques Le Goff once remarked, ‘memory only seeks to rescue the past in order to serve the present and the future,’ it is hardly surprising that exercises in collective historical remembrance far more closely resemble myth on one side and political propaganda on the other than they do history, at least as that is understood as an academic discipline - the kind of history that when done properly is always critical and whose insights, though they may from time to time be deemed useful to society as a whole, were not set out to instruct. In contrast, historical remembrance is generally considered valuable insofar as it is of service to society.”

In the historical context to which he refers, Rieff argues that knowing of the Holocaust did nothing to prevent the very people involved in the Serbian-Bosnian Conflict from enacting another, but rather, their memory of another injustice, perceived or otherwise, actually fueled it. In a sense, Rieff argues that memory is far more volatile and dangerous, than any preventative benefits it may have are worth. Personally, I believe that argument to be a bridge too far, and believe that the problem he describes is greater issue of political tactics than of actual remembrance. In each case, careful consideration of how memory is presented in the museum context is of great priority.
## 2.7 Literature Review

**Title:** ENGAGE: The Future of Museums  
**Author:** Gensler Research  

In 2014 and 2015, Gensler Research, part of the international design firm, began researching the future of museum design. Their research brought together recognized professionals in museum design and staffing from Chicago, New York, Los Angeles, Houston, London, and Costa Rica to participate in a study of the direction museum design was heading. Over the course of months, research and museum professionals discussed what they believe the direction they believed the future of museums were heading. The topics ranged from goal analysis and how success is evaluated, museum interaction with the community, architectural design, technology, and accessibility, among others. The report created and being evaluated in this review is the interim findings of Gensler’s research, as a full report has not yet been made available by the firm. The interim report touches on a variety of subjects, all worthy of consideration in approaching a new museum design project. The validity of these conclusions is extremely high, coming from real-world professionals who operate, manage, and curate museums as their career.

The primary consideration of any architect involved in the process of museum design is the creation of space and form in the physical building. As such this is the first input point that will be evaluated. Research from Gensler has determined that many museum professionals that the future will provide a greater push towards the equal design of active and contemplation spaces in the museum environment. Many museum officials believe that museum design could be pushed further into the experimental realm, stating, “participants emphasized that new museums should not unquestioningly repeat existing layouts and expressions. Instead, architects and institutions should closely consider what best serves collections, missions, staff, and constituencies – even if this leads in nontraditional directions.” This thinking in the exhibit space is driven by the idea that while it is important for people to feel like the exhibit is organized, museum officials don’t want this control to eliminate the possibility of random discovery and freedom to create your own tour through the collection. This point is especially important for retaining visitors for repeat visits. In contrast however, many professionals believe that the exterior architecture of the museum will become less iconic in nature. The report states this dichotomy of understanding the purpose of iconic architecture, and recognizing the limitations:

> “While some participants criticized overly demonstrative architectural design, most agreed that the museum building plays a major part in establishing institutional identity and should be seen, in commercial terms, as an integral part of the brand... While an iconic or historic building may [help] to draw visitors, participants noted that such buildings could be intimidating or uninviting.”

In a sense the report clouds the argument of how the museum should derive its form, as an icon – a symbol easily recognizable - or as a pragmatic solution – letting the collection leave the greatest impression on visitors. While a single direction cannot be found from the report, the conversation is important to consider in the planning of new museums, and serves a helpful purpose in its inclusion in the article.

Another major topic with great bearing on the future of museum design will be the incorporation of technology and other forms of new media as an educational tool. Indeed, technology will be a driving force in the design of museums in the future, with physical and digital interaction with the museum as an organization having a large effect on how people view the museum itself. The report sites that as digital archival of collection becomes more common and these collections are made publicly accessible, the way people experience these collections should rival that of actually visiting the museum. This logic seems counter-intuitive to the notion of designing a new brick-and-mortar institution but is understood when the museum is approached as an extension of their digital presence and vice-versa. While digital collections make museum artifacts greatly more accessible, visiting museums to view the physical piece remains important to viewers and visitors alike. Many professionals caution of an over-incorporation of digital fixtures in the physical museum though, stating that including technology and new digital experiences in museums are a necessity; however, they are to be weighed against the need to include opportunities for human interaction between groups, other visitors, and museum staff. This point is discussed heavily regarding wayfinding in museums and what draws people to come back. Contrary to what many people in the younger generation would tend to believe, “a personal welcome is often more important than the “wow” factor regarding human staff in place of digital navigation and signage in the exhibit space.

The primary takeaway from the report regarding architectural space can be understood as the museums place in the community it serves. Overwhelmingly, museum professionals believe that increased community interaction is beneficial for the growth of the museum. Community interaction of the museum should be viewed as a means of increasing exposure and creating opportunities for the public to utilize museum space for purposes beyond seeing the collection. Many believe that museums can serve as part of the “de-facto public realm” by proper planning of spaces and around the museum as gathering spots, encouraging lingering on the grounds in some sense. It is also important for museums to engage with other like-minded agencies that help further their reach into the surrounding area. Professionals point out that museums ought not be afraid of organizing and hosting events that are tangential to their mission, as these events draw in people that may later engage with mission-specific events hosted by the museum or visit the collection itself.

As technology and its place in our lives continues to evolve, so do our expectations of what a museum can and should be. If physical museums are to survive in the post-digital world, they must take certain steps to co-opt technology with their physical experiences. To do so includes a heavy reliance on creating spaces and organizations that engage wide audiences across multiple platforms. Now more than ever, the freedom to experience and educate one’s self has to be a part of the process, but not so much that the mission of museum organizations suffers. Museums can utilize new media in ways that broaden their base or effectively kill themselves off as physical institutions. Undeniably, the decisions museums make in their adoption of the themes and advice contained in this report will dictate what a museum even is in the next 20 years.

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“Museums are uniquely positioned to blend education and recreation in ways that can both challenge and catalyze communities.”

-Gensler Research
In the short paper titled Memorial Architecture as the Symbol of Remembrance and Memories, Danijela Dimkovic attempts to illustrate the connection between individual memory and cultural memory and the implications this had on the field of Architecture. In making their case, Dimkovic relies heavily on outside academic work and case studies of two prominent Holocaust remembrance sites. The connections and assertions made by Dimkovic bear great importance in the understanding of the inherent function of a memorial and remembrance site, and its place in the cultural and political landscape, beyond that of its physical one.

In citing extensively the works of various other academics, Dimkovic seeks to frame the definition of memory in terms of architecture, forming an innate bond between the two in the process of designing a place of remembrance. The first assertion made in the paper comes by way of Fernando Katroga and relates to what memory means in terms of remembrance. Katroga posits that “an archived memory stops existing as a memory, once separated from the only mediator able to revive it: the subject witness”. In drawing on this definition, Dimkovic begins formulating the notion that memory in the traditional sense of individually remembering something does not exist in the broader context of communities and architecture. This claim is furthered when Dimkovic again draws on outside authors, summarizing “in Asmaan’s study, such thinking is more linked to the communicative memory which is actually a memory that relates to the recent past – while the cultural memory comes to the distant past, which is reflected solely by means of symbols.” By including this passage, Dimkovic asserts that memory as an architectural concept has to be thought of and treated differently than a personal memory, because, as she goes on to state “a communicative memory lasts as long as its subjects, while cultural memory lives longer than it’s carriers.” This is possibly the single most important statement to understand when approaching the design of a site of remembrance. Any architect or planner tasked with designing a memorial must be aware that the remembrance they seek to create/exploit, is solely by means of symbols.

Another key point that is made throughout the paper is the innate bond between individual memory and cultural memory and the implications this had on the field of Architecture. In making their case, Dimkovic relies heavily on outside academic work and case studies of two prominent Holocaust remembrance sites. The connections and assertions made by Dimkovic bear great importance in the understanding of the inherent function of a memorial and remembrance site, and its place in the cultural and political landscape, beyond that of its physical one.

The push towards public remembrance of events formerly hidden and forgotten has caused controversy in many communities. As governments grapple with how to correctly remember the victims, they are faced with issues of who to blame and how, especially when they themselves are the perpetrators. This dilemma, while relatively new, is profound and far reaching, the solution perhaps still unknown. Nevertheless, the proper recognition of timing plays a key role in the success of such pursuits.

While Dimkovic does not provide any framework for designing places of remembrance in the traditional sense, the points made in her paper go a great length in approaching a new remembrance project. The recognition of what type of memory the site must draw upon is a necessity, as is the recognition of timing plays a key role in the success of such pursuits.
INTRODUCTION

Museums are facing a rapidly changing set of expectations from visitors regarding the presentation of information in the exhibit space. Technology is one of the largest factors driving the change from traditional printed and physical artifacts to more immersive mediums. Technology can also be a driving force in the design of museums, beyond the means of producing drawings to build from. Analysis of visitor behavior within exhibit spaces can assist planners in creating exhibits that better react to how people engage with museums with agent-based simulation of planned exhibits allowing evaluation of designs before a living person ever sets foot in the space.

KEYWORDS

Museum Design; Museum Exhibits; Architecture; Visitor Behavior; Simulation
The data collected for this study comes from the observation of visitors to the Hjemkomst Center in Moorhead, Minnesota. The Hjemkomst Center (Hjemkomst, meaning ‘homecoming’ in the Norwegian language), is home to the Hjemkomst Viking Ship, constructed in nearby Hawley, Minnesota and sailed to Norway in the 1980s. The primary function of the museum is as a cultural and educational center for not only the ship, but the city of Moorhead and Clay County, Minnesota. The museum’s function as an educational center was important to the study, as the goal of the exhibits were to convey information to the visitor, with exhibit pieces providing a far less subjective attraction than that of an art museum. The Wet & Dry exhibit, an exhibit about the prohibition era, was selected to be studied because of its range of exhibit pieces and the length of showing.

To study the exhibit, the target area was observed through minimally invasive means. To accomplish discrete observation, a Brinno TLC200 Pro time lapse camera was positioned in the exhibit space to allow adequate sightlines to various key exhibit pieces, and be fairly inconspicuous. In this study, the existing architecture and museum exhibition layout prevented the camera from being placed from a complete, top-down vantage point that may have better shown the visitor path through the museum plan. Working within the limitations of the space, the camera was placed in a manner to avoid identifying features from being recorded for most visitors, viewing the exhibit space from a vantage point that captured primarily the backside of visitors as they navigated the exhibit.

The nature of the research and what was needed to determine how visitors experience the exhibit heavily influenced the observational process. In this study, no audio was recorded due to privacy concerns and general lack of relevancy to the information being collected. As an added note, this feature is not available on the camera selected to record the exhibit space and thus, could not have been recorded under this exact methodology. The time-lapse camera was programmed to visually record from 9:00 AM until 5:00 PM each day, the museum’s hours of operation, and capture a still image of the exhibit space at one second intervals. The time interval allowed enough information to be recorded to determine the time and path of visitors in the target area, and allowed for simple data management and maximum life of camera batteries. For purposes of replicating or applying this study in other environments, the research may also be conducted using security camera footage if a participating organization utilizes such a system, and makes the recordings available to researchers, with some cameras available that include object tracking software.

Initial analysis of the video imagery was done through the use of a photo analysis code found freely on the internet. The code, provide by Kevin Lin (username LINKWI) on GitHub, uses the MATLAB interface to analyze jpeg images in a directory and create a heatmap image of the areas in the frame with the most motion occurring. The code works by analyzing changes across individual pixel areas to determine where motion occurs, with areas of high activity displayed in bright yellows and oranges, and areas with less activity in deeper blues. This code proved invaluable to quickly analyze multiple days’ worth of footage and determine patterns of behavior across different areas of the exhibit space. The code also enabled quick differentiation between stopping points across the entire exhibit, showing relative intensity of motion points graphically in addition to visually.

The method of analyzing the compiled video footage using Lin’s MATLAB code was to compile all of the video segments for a particular exhibit zone in Adobe Premiere. Once compiled to a continuous video, the videos were desaturated, and time-stamps were cropped out of the field of view. Desaturating the video enabled greater visibility of the heatmap overlay created by Lin’s code. Once the video was edited, the videos were exported to individual frame images in jpeg format. Each zone studied resulted in 100,000+ frames to be exported for analysis. Once exported, the frames were analyzed using the MATLAB code to create the heatmap overlay and graph images contained within this report. As previously described, there are some security cameras available that include object tracking and heatmap generation as an included software. If available, this method may be a good substitute.
Statistical data and analysis of visitor behavior is done through a combination of examining the path data from the previous step, and viewing of the original video files. To determine the engagement rate for individual exhibit pieces or clusters, the videos were replayed and manually counted. For the purpose of this study, engagement with the exhibit is considered viewing the piece in question beyond what can be seen as a passing look. This definition has been determined to provide as much benefit of doubt to viewers because impression beyond visual attention to the piece cannot be determined through the videos. This is more accurate that studying the paths for proximity to a piece, as physical proximity is not an indicator of what the person is engaged with in a space with many items in close range to one-another. This also prevents visitors from being counted when they are standing or sitting in one area but looking at a specific object beyond their immediate surroundings. The single deviation from this definition is in the analysis of Exhibit Zone B. The inclusion of an interactive digital display in the exhibit zone requires that the engagement definition be altered to only count people who physically engage with the tablet, or who engage with the display after it has been interacted with. This provision is to gain a better sense of how many people are genuinely engaging with this element in the way that museum staff have intended it to be.

Following the analysis phase of the research, the data derived from the visitor paths and engagement counts is used to simulate visitors using AnyLogic for agent-based simulations. The architectural plans for both exhibit zones are laid out in the software with visitor collection areas placed into the space to reflect the pieces studied in the analysis phase. Once the real-world design of the museum is accurately reflected in the software, the pedestrian logic definition is created. By utilizing the visitor engagement statistics from the analysis, probability can be assigned to each piece along the visitor’s path of travel. The simulation model can then be executed and analyzed to determine if the patterns found in the analysis phase can be reflected in computer simulations. For this study, comparison to the real-world observations is the primary function of creating the simulation model, though its application may be much farther reaching in the field of museum and exhibit design.
RESULTS & DISCUSSION

Analysis of the motion pathways extrapolated from the video and comparison with heatmaps of motion created provide telling evidence of patterns in visitor behavior when visiting museums. The evidence found can be seen clearly in analysis of both exhibit zones studied, and provides statistics of how often visitors engage with specific types of exhibits and how they navigate each area. To explain these findings, each zone will be discussed individually below, with key crossovers and aggregate data discussed at the conclusion of this section.

[EXHIBIT ZONE A]

Exhibit Zone A is the first distinct exhibition zone of the Wet & Dry exhibit and features a variety of distinct artifact types and clusters, it also includes seating in the form of exhibit-specific furniture, furniture themed to the information displayed, as well as museum furniture, universally designed furniture for any exhibit theme. The zone is laid out in a linear fashion that implies a single path of travel is defined through the exhibit. The zone is framed by movable museum walls along the axis of travel and a canvas tent structure that forms a room around five pieces of the exhibit. The depth from one exhibit wall to the other is substantial with open space around the museum seating, just one artifact is placed in the open floor space, a freestanding display case with protected pieces. All other artifacts and documents displayed in zone A are displayed along or in close proximity to walls or within the tent structure. The various pieces present in exhibit zone A include: protected physical artifacts in display cases, unprotected physical artifacts (in this case clothing displayed on mannequins and equipment presented on a stand), text documents and photograph clusters, and large-format printed pieces. The exhibit zone also features a multi-sensory digital display in the form of a continuously playing television with video and sound inside the tent structure. For the purpose of analysis, some items in close proximity will be examined as clusters of objects to determine visitor engagement statistics.

Analysis of visitor paths in exhibit zone A point to a number of patterns in the way people view the display, particularly in the order and direction that they follow. Visitors to this portion of the museum tend to stick to a specific path through the space, from which there is little deviation. While a small portion of visitors do enter the zone from what could be described as the interior of the greater exhibit area, the predominant path remains the same across all visitors.

The primary, and overwhelmingly standard path of travel through the exhibit flows through the exhibit in a linear fashion without any doubling back or looping around. The path moves through the tent structure on the front side, the area facing the greater exhibit entry area, visitors travel through center aisle of the tent structure, between the unprotected artifact and exhibit furniture on the open right side and the unprotected and protected artifacts along the inside tent wall. It is of note that the path moves through the center of the tent, under the canopy rather than along the exterior of the tent that borders the open floor area of the exhibit space. At the back of the tent the path turns at the multisensory digital display and exits the tent into the exhibit space. Once in the exhibit space, the path tightly hugs the movable walls that display the text and photograph clusters and both a protected and unprotected artifact. The path splits towards the unprotected artifact case that is floating in exhibit’s open space. After leaving the comfort of following the walls, visitor behavior is far less predictable than before. In entering the open space of the exhibit, the path options diverge significantly with some continuing in the open space to the neighboring exhibit area, turn back towards the entry point, sit at the museum furniture, or some combination. When turning away from the exhibit border and walking into the open floor area, visitors appear less certain of which direction they should go next. This path is much more loosely defined and direction changes and indecision is much more visible than the earlier portions of the path.
Visitors exiting the tent area after engaging with the multisensory display are relatively predictable in the rate of engagement with artifacts after the screen in their path of progression. Both visual and statistical analysis point towards visitors being more engaged with the exhibit after stopping at the digital display. Overall engagement with pieces in the display after the digital display remain in the minority of visitors across all pieces, but the rate is fairly consistent across them. Overall likelihood of a visitor engaging with any specific piece outside of the tent averages approximately 23% before the path splits. In the span of the four distinct clusters on that section of the path the cluster of large format documents and photographs and another standard size cluster of documents and photographs perform at the average, yielding 22% and 21% respectively. The cluster of standard size prints behind a protected physical artifact performs significantly above average, garnering a 32% engagement rate, while an unprotected artifact receives a lower rate of engagement of just 17%. These two figures are important to recognize and necessary to compare to other examples in zone A to give clarity on what this means for curators.

This zone includes three protected and three unprotected physical artifacts. Two unprotected physical artifacts are placed under the tent structure and one along the exhibit wall, while one protected artifact is placed under the tent, one along the wall, and one in the open floor area. Combined, the unprotected artifacts average 18.66% engagement, while protected artifacts average 21%. On the surface, these numbers reveal that protected artifacts have just a slight edge over unprotected artifacts in terms of overall engagement. However, the margin widens significantly when compared based on the actual placement of the artifacts. Between physical artifacts located under the tent, the protected artifact engages at a rate 1.38 times higher than unprotected artifacts, comparing at 27% versus an average of 19.5%. Along the wall, visitors are 1.88 times more likely to engage with the protected display, comparing at 32% versus 17%. Of note is the fact that just 4% of people engaged with the protected artifact in the open floor space, with its placement occurring after the path splits in direction and behavior. When looking at the comparable positions of protected and unprotected
While the layout and exhibit content of zone B varies from that of zone A, a number of behavior patterns can still be derived from the examination of video and path data. The patterns reveal that despite variation in layout and circulation through the exhibit from that of zone A, certain patterns remain consistent.

The entry and exit point proximity of zone B is greatly increased from that of zone A, allowing visitors to more easily pass through the exhibit zone without engaging any of the artifacts and clusters in the zone itself. The direction of entry is also much more split when compared to zone A where the majority of traffic flows in a single direction. In spite of these facts, the rate of engagement does not suffer, to the contrary, the rate of engagement is actually higher than zone A. In zone A, 27% of visitors passed-through the exhibit without engaging any of the pieces in it, meaning 73% actually entered the exhibit zone. When the engagement rate among all pieces in the zone are averaged, the rate of engagement for any individual piece sits at roughly 22%. This is lower, by comparison to the rate of engagement of zone B, where 89% of people enter the exhibit and just 11% pass-through. When averaged, the rate of engagement for pieces in zone B is approximately 35%, roughly 1.59 times higher by comparison. This stark difference may be because of the transition from entry point to display in zone B compared to zone A. In zone A, the visitor must leave the direct path of travel from entry to exit point to view the exhibit, whereas, the pass-through path in zone B is directly adjacent to the exhibit path, allowing visitors to peel off the path into the exhibit without crossing any open space.

The path through the exhibit itself is also very interesting. In Zone B, the path tends to flow through the exhibit in a right to left direction regardless of the visitor’s point of entry. Like in zone A the path follows the bordering walls of the exhibit with various pieces displayed in sequence. The contrast from zone A is the way in which visitors handle exhibits in the open floor area. Because the zone appears set up like an enclosed room instead of a corridor, the open space is surrounded by exhibit pieces, with the protected artifacts like islands in the open floor area, people appear much more likely to engage with the protected display than the unprotected one.

Other key figures of note from exhibit zone A relate to the furniture present in the space and the rate of pass-through visitors. Analysis of the video recordings shows that the third highest rate of engagement across the entire zone is with the exhibit-specific furniture in the tent structure. This feature provides seating in line with the historical period and style of the exhibit. When compared to the more flexible museum furniture, engagement is more than twice that of the latter. This may indicate that because the seating is not viewed as a piece of the actual display, there is little need to engage with it. The flexible museum furniture’s placement in the open area may also have an effect the rate of engagement. A surprising number found during the process of analyzing the visitor statistics was the 27% rate of visitors passing through the exhibit without engaging any of the displays in zone A. However, this number may be skewed by counting of non-visitor employees who passed through the zone without the intention of viewing the exhibit as museum employees wear no distinguishable clothing that designates their position.

[EXHIBIT ZONE B]

Exhibit Zone B is designed like a four-sided room, bordered by a permanent gallery wall on one side and movable walls on the other three. The entrance and exit to this zone are placed on adjacent sides at one of the corners in such a way that a visitor may travel through the zone without ever really stepping foot in the exhibit space. The zone is densely filled with informational pieces on all walls, with various freestanding display cases placed at in front of printed documents and photographs. At the permanent museum wall, a display of exhibit-specific furniture in the form of a bar and bartender in front of a banner-sized historic photograph is reaches into the open space of the exhibit. The exhibit also utilizes an interactive digital display feature in the form of a wall-mounted tablet loaded with various videos that visitors can select and watch. Three freestanding display cases are also placed in the open floor area of the exhibit zone, each featuring physical artifacts under protective glass. As before, some items in close proximity will be examined as clusters of objects to determine visitor engagement statistics.
area. Because there is no implied sequence to viewing the floating cases, visitor paths are much less densely defined, with decision making appearing erratic at times. The cases also perform at the low end of the spectrum of engagement rate for zone B, attracting an average of 25.66% of visitors. Like before it appears that people tend to prefer the comfort of following along the walls of an exhibit, rather than being in the open space.

As mentioned before, rate of engagement for pieces and clusters in zone B was much higher by comparison than those of zone A. The first cluster in sequence from left to right along the exhibit walls features standard size prints and protected artifacts. This cluster attracts a staggering majority of visitors at a 65% engagement rate. The placement of this cluster immediately off the entry to the zone makes it incredibly visible and accessible to visitors. Other high performing pieces in the exhibit include the exhibit-specific furniture along the sole permanent wall. The piece is a re-creation of a historic bar featured in the banner-sized print behind it. The arrangement provides a forced perspective of the bar coming out of the photo and into the exhibit, complete with a dressed mannequin behind it to serve as the bartender. This piece performs extremely well compared to the furniture and unprotected artifacts in zone A, attracting 44% of visitors to engage with it in some way. A number of pieces perform near 40% attraction with visitors as well, these include two clusters of large-format printed materials (38% and 40%) and another standard size print cluster (38%). Across the board, artifacts in this layout perform better than the previous.

One surprise in the findings was that the interactive digital display in the exhibit did not meet the same rate of engagement as the multisensory display in zone A. As was described in the methodology, the rate of engagement for this specific piece was determined by the number of people who physically interacted with the display, or who engaged after interaction by someone else. The interactive display only engaged 23% of visitors to the exhibit, compared with 40% of visitor engagement with the multisensory display in zone A. This is likely due to the small size of the display, the lack of auditory attraction before initiating the display, and potentially fatigue based on its placement at the end of the exhibit sequence.

[UNIVERSAL FINDINGS]

Analysis of both zones yields similar path results despite the differences in layout and placement in the exhibit at large. The presence of these key similarities is reassuring for the potential of predicting visitor behavior in museum exhibit design.

The biggest takeaway from the analysis by far is the path similarities between the two zones. In each zone visitors overwhelmingly prefer to view exhibits from along the wall. In each zone, the path flows in a predominantly left to right direction through the space regardless of the point of entry. The density of the path varies slightly between the two zones but is generally the same. The most visible path differences between the two is visible by apparent indecision in open space. In both zones visitors entering open space appear less predictable in direction, often wandering slightly as they determine their next destination. The location that this wavering occurs is the difference between the zones, while it occurs in both zones it is much more prevalent in zone B because of the placement of multiple artifacts in the open floor area, compared to just one at the end of the exhibit in zone A.

It also appears that given the choice, visitors appear more attracted to protected artifacts than unprotected artifacts. This is believed to be based on the implied value of placing artifacts behind protective glass. As described in the zone A analysis, this is true across varying placements of the artifacts in the exhibit space.

Finally, statistics point to digital displays providing high rate of attraction when properly sized and providing multisensory stimulation. Interactive digital displays out to be positioned in a manner that demonstrates their functionality and sized to communicate its information well with visitors. Once again, placement in the exhibit
space remains an important determinant in the success of the display.

**[Simulation Comparison]**

Upon completion of the analysis, the statistics derived from the study were used to simulate visitors in the exhibit space to determine if the method had any validity. AnyLogic software was utilized to create a visitor flow definition in the exhibit and using the probability of attraction to determine visitor path. The definition was created in such a way that a sequence of exhibits was created but a specific path was to be determined only by the software, in which the simulated visitors travel by path of least resistance to their destinations. The simulation would be determined a successful indicator for potential design application if the path drawn by simulated visitors matches the real-world pathways.

In each case the results of simulated visitors follow closely the paths of their real-world counterparts. The density mapping created by the AnyLogic software illustrates the paths taken by agents in the simulation model. In each simulation, the lighter colors mark less frequently occupied space by visitors in the exhibit zone. These areas line up well with the open space not frequented by visitors in the actual exhibit. Likewise, the areas where visitors stop most often in the actual exhibit coincide with the colored markers of high density occupation in the simulation model.

The success of the simulation model in adequately reflecting the results of real-world analysis indicate the potential of simulation modeling in the design process to predict visitor behavior in a planned exhibit space. Using the combined averages for visitor engagement with respect to their locations and the exhibit layout type, simulation may be used to test new exhibit designs for pathway optimization. Given a designer’s set goals for the project, a possible layout may be tested using simulation to determine if those goals may be successful, providing greater control and understanding of how visitors are actually experiencing the exhibit.

**CONCLUSION**

The use of visitor behavior tracking and analysis can be of great use to museum professionals and designers alike. Using established technology commonly used in other applications and adapting process to fit the context, low cost options exist to aid in the design of new museum and exhibit spaces. As shown through this study, the implementation of inexpensive cameras and intensive study of visitor pathways, a number of common behavior patterns can be extrapolated. These patterns have been proven to successfully match simulated outcomes, signaling the potential for this process to be more widely applied in the field of museum design. Architects, planners, and museum staff alike could benefit from the implementation of the process utilized in this study to better understand their patrons and predict how future exhibitions will be experienced. Using standards established through greater study of this methodology, baseline engagement rates could provide a starting point for analysis, or individual study of existing museums can more specifically predict visitor behavior. Utilizing this process, museum designers may now have better control and a quantitative understanding of how visitors engage with exhibition spaces.
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As conflict over how history is remembered arises, it is imperative that we find a way to remain as objective as possible in our recognition of the past. The period of letting historical figures and their actions go unchallenged for fear of having your patriotism questioned must end in order for society to progress. As such, in order to prevent a revisionist history from becoming widely accepted, and the injustices of the past being forgotten, we must begin to recognize these injustices publicly.

This thesis project seeks to recognize publicly the injustice of Japanese incarceration and internment through a museum design at the site of the Heart Mountain Relocation Center using ABSim in the design process. The typology of museum and memorial aims to do so through education. The application of research that enhances the museum learning environment through visitor driven planning makes this academic endeavor viable.

**RESEARCH IMPACT**

The project will be a proof of the fall semester research that museum exhibitions can be designed better with the incorporation of visitor behavior simulation. The project will provide the frame of reference to how visitor interaction research can be applied immediately in the design phase to lay out exhibitions that better education and communicate information to occupants. Through the project being built and post-occupancy evaluations, this research could further be studied for success.

**CULTURAL IMPACT**

The project is being proposed at a pivotal point in American history on multiple fronts. Politically, the United States is at a crossroads on how government ought to recognize past atrocities and assume responsibility. Currently, politicians and everyday citizens alike are engaged in debates as to how we should deal with our past, with the most contentious arguments centering around civil war monuments and how we publicly recognize, or don’t recognize, events in our history that are no longer viewed as morally or ethically acceptable. The topic of recognizing Japanese internment during World War II is equally important to examine as Americans struggle with whether or not it is okay to admit wrongdoing, and if so, how to do so respectfully to all parties.

The project is also important at this point in time because the collective memory of internment is disappearing equally, if not faster than the physical remains of the camps. Because of the distance in time to internment, many Americans know longer know of the governments exclusionary practices towards Japanese people in the early 1940s. The living memory is also disappearing as the formerly interned population ages and passes away. The need to preserve any remaining physical artifacts of the internment centers and the stories and memories of those who were there is imperative, lest the clock run out and the personal accounts lost forever.
SITE SELECTION

The site was selected because of the current attitude of recognition in the area, with a foundation and various forms of recognition of the relocation center already in place. The site was also selected because of its relative proximity to other high-profile attractions and easily accessible cities. Notably, the site is located just 70 miles from Yellowstone National Park and is within hours of Billings, MT, in addition to the many smaller communities and state and national land preserves. The site is also important because of its placement on the National Register of Historic Places and ownership of key areas of the former camp under the National Park Service and Bureaus of Land Management and Reclamation. With significant areas already under ownership of federal government agencies, including all current structures that were formerly parts of the center, the issue of land purchases and agreements is largely non-existent.

The site is also important because the purpose of its location in Wyoming is apparent: close proximity to agricultural land and an irrigation project that was completed by workers from the center. The isolation of the camp is also obvious in the location, with expansive plains and sparse population being ever present reminders that the relocation centers were designed to move all people of Japanese heritage as far away from population centers and military institutions.

HISTORICAL CONTEXT

The Heart Mountain Relocation Center Site is located between the towns of Powell, Ralston, and Cody, in Park County, Wyoming. The site is in the northwest corner of the western plains state, near the Montana border and Yellowstone National Park. Historically, the land that is now Park County, Wyoming is in lands that were settled and hunted by the Crow, Shoshone, Cheyenne, Arapaho, Lakota Sioux, Blackfeet and other Native American Tribes, though currently, no Native American Reservations exist in the county. Heart Mountain Relocation Center is located within territory charted as reservation land of the Crow Tribe under the Treaty of Fort Laramie in 1851, however, in the Treaty of 1868, all of the Crow Territory in Wyoming was opened to white settlement.

White ranchers and homesteaders first began settling the area of Park County in the 1870s, with the first organized town settlements being formed in the 1880s. The area of present-day Park County has been under the governance of various territories and counties since the 1880s, with Park County itself being officially formed in 1909, nearly 20 years after Wyoming was granted statehood in 1890. Demographically, the largest cities in the county are Cody, named for founder Col. William F. "Buffalo Bill" Cody, and Powell, founded by the U.S. Bureau of Reclamation and named for John Wesley Powell. Heart Mountain Relocation Center is located directly between the two cities on U.S. Alternate Highway 14A.

The relocation center itself was formed as one of 10 Japanese Internment Camps in 1942 after the signing of Executive Order 9066 by Franklin Roosevelt in the wake of the attack on Pearl Harbor on December 7, 1941. The camp was built in the summer of 1942 and opened to internees in August, and reached a peak population of 10,872, a number large enough to designate it the third largest town in Wyoming at that time. The Center
was located on the site because of ease of development as agricultural land, isolation from large populations, and its ability to serve as a labor center for the Shoshone Irrigation Project. The captive population of hard-working Americans, many of whom were looking to prove their patriotism, played a pivotal role in completing the irrigation project that would allow the und Bighorn Basin to be the agricultural center it is today. The center finally closed in November of 1945 after the end of World War II and the area would largely become agricultural lands again with barracks removed and used by homesteaders for various purposes.

The Heart Mountain Wyoming Foundation was founded in 1996 to preserve and remember the camp site. The foundation applied for and successfully received site status as a National Historic Landmark under the National Park Service. The foundation also completed an interpretive center and walking tour on two locations within the boundaries of the former camp. Though, few original structures still exist on the site, efforts have been made to preserve them in place, including the restoration of the hospital complex smokestack to prevent the towering fixture from collapsing, ensuring it will continue to rise from the camp grounds in permanent reminder.

**SOCIAL CONTEXT**

The social context of the Heart Mountain Relocation Center can be described in two manners: the social systems and context that exists in proximity to the site, and the social meaning that the site holds and can hold into the future. This distinction between the existing context and the broader meaning and potential context is a key principle to the validity of this thesis project. Both are important to understand and the relationship between them forms the basis of the thesis question, with the goal of the project being to provide the bridge between the two.

The current social context of Park County, Wyoming is indicative of the broader state of Wyoming itself. Politically, the county overwhelmingly votes Republican, with very little exception. Going back to when county records were first reported in the 1860 election, Park county has only voted Democrat one time. The election in which Park County voted Democrat. Lyndon Johnson in 1964, won by large margins, indicating that they are largely party voters. Wyoming as a state has voted Democrat in just seven of 32 elections, voting with the prevailing party in all but one of those seven elections. As a county and state, Wyoming politically is deeply Republican.

Park County demographics data points to the community being relatively, with exceptions in rate of health insurance and poverty. The county is home to an estimated 23,353 people, with a population density of 4.1 people per square mile. The county is relatively well educated, with 83.2% of residents 25+ holding a high school degree or higher, and 28.4% of residents 25+ holding a bachelor’s degree or higher. Statistics show that the rate of uninsured people in Park County is roughly 13.4% and the rate of poverty is 9.6%.

While nothing in particular is striking about the data for Park County, the county seems to lack initiative in remembering Heart Mountain Relocation Center, with the foundation formed of mostly family members of the internees, and various other people from outside the community. The site itself was not taken care of with little efforts made to preserve the history in the community after the camp was closed. The site has only been given new life again in recent years, with official designation as a historical landmark not coming until 2007, and the opening of the interpretive center in 2011. This lack of commemoration and preservation is indicative of both the time and the demographics, with more liberal populations more actively taking steps to remember social injustices like Japanese internment. For contrast, Manzanar Relocation Center saw efforts to remember and preserve the camp as early as 1965, with official national historical landmark designation coming in 1992. Manzanar Relocation Center is under the jurisdiction of Los Angeles County, in the much more predominantly Democrat California.

Socially, as we more often commemorate and recognize injustice in the past, Heart Mountain Relocation Center should see renewed focus. Currently, the divisive political and social landscape, particularly as it pertains to the recognition of American fault and injustice, is a battleground of opinion. Taking a broader look, it is evident worldwide that recognition of injustice is an important part of recovering from past wounds, with post-war Germany providing an excellent case study. Socially, the community must move further recognize Japanese internment and their own role in it, with the Heart Mountain site providing opportunity for community leaders to engage history. The community ought to greater recognize the injustices that occurred at Heart Mountain through more involvement in the foundation and the site.

Heart Mountain Relocation Center is a site of great injustice upon the American people. The degradation of the site has left much of the story forgotten to time, and the acknowledgment of the crimes lacking. The Heart Mountain Relocation Center has the potential to spur a revitalized effort in objectively remembering history, and begins a larger process of healing through recognition across the country. Though just a single site with a relatively unknown story, the social and ethical potential by recognizing injustice and fault is immense.

**CULTURAL CONTEXT**

The cultural context of the site and its surroundings have been highly dynamic. At points throughout its history, the cultural demographics have varied wildly, for obvious reasons. Because of this fact, it is important that these changes in demographics are discussed, but precedence must be given to the current cultural context for the purpose of guiding the design process and the thesis project’s goals.

The cultural demographics of the Park County area have changed dramatically over the last 200 years. Prior to Wyoming becoming a state, the area that is now Park County was inhabited by Native American populations from various tribes. The region was primarily home to the Crow Native Americans who named Heart Mountain, the landfill that towers over the relocation center site to the west. The original Treaty of Fort Laramie in 1861 granted the area of the Bighorn Basin where the center is located as part of the Crow Reservation. Upon the issuance of the 1868 Treaty of Fort Laramie, the Crow Reservation was reduced, and all land in present-day Wyoming was opened to settlement by White homesteaders. The reduction of treaty land forced Crow Native
Americans out of Wyoming’s Bighorn Basin and thus Park County, beginning the cultural shift.

After 1888, the area of Park County became predominantly white, however, it was very sparsely populated until the 1880s when the first towns began forming. While population in all of Wyoming was very low, the Park County area in particular was unpopulated but predominantly white. The county would remain overwhelmingly white until Executive Order 9066 was signed and enacted in 1942.

Upon the opening of the Heart Mountain Relocation Center, the population of 10,876 in 1940 nearly doubled. With the relocation center reaching a peak population of 10,827 shortly after its completion, the cultural demographics of the county would have gone from nearly completely white, to almost a complete split between white and Japanese virtually overnight. Though the change was drastic, the community was sheltered from the cultural changes because of the Japanese populations captive status. Had the removal of Japanese Americans been to freedom outside of the isolation area, this magnitude of demographic change would have been much more profound on the culture and customs of people in Wyoming. As it happened, the closing of the relocation center became an exodus of Japanese people, with few remaining in Wyoming after the end of the war, returning cultural demographics to numbers similar to the start of the war and before relocation.

Currently, Park County’s population of 29,353 is still overwhelmingly white. Of the people in park County, 90.8% are white alone. The next largest cultural demographics are Hispanic or Latinos at 5.7% and two or more races at 1.4%. As evidenced by the U.S. Census data, Park County lacks any significant measure of cultural diversity among its citizens. The combination of cultural homogeneity, social and political constants and a lack of historical recognition for the camp signal that any change to customs or ideals would be difficult at best. However, it provides an important basis for trying to enact the societal change that this thesis aims to create. By approaching a population that currently shows no exceptional measure of social recognition of the relocation center, the methods of exacting that paradigm shift can be explored without issue of piling on to a change that already is happening. It enables the thesis to exist without accusation that the ideas and processes are being executed within an echo chamber.
Heart Mountain Relocation Center is located in the far northwestern corner of Wyoming. Approximately halfway between the towns of Powell and Cody in Park County, the site is situated alongside United States Alternate Highway 14 (US 14-A includes stretches of roadway that are inaccessible during the winter months, resulting in the designation as an alternate highway). Located in the Bighorn Basin, the name of the site is derived from the land form that bears the same name. Heart Mountain stands directly west of the site, rising abruptly above the Shoshone River valley to an elevation of over 8,000 feet, a staggering 3,400 feet above the site. Heart Mountain is considered a sacred site of the Crow Native Americans, and towers above everything else in view. To the south and east of the site lie the McCullough Peaks Badlands, the rolling formation bounds the Shoshone River Valley and provides picturesque views from the site because of their immediacy to the east. The McCullough Peaks Badlands are more rocky by comparison to the Heart Mountain formation, which boasts clearly distinguishable trees across its face and towards the peak.

The site is located in a rural area surrounded predominantly by agricultural land. Some of the croplands surrounding the property are used to grow sunflowers and sugar-beets. Located in the Heart Mountain Irrigation District, the land is supplied through the Shoshone Irrigation Project, an infrastructure task completed utilizing labor supplied by the interned Japanese population. Irrigation structures are visible on and near the site in the form of both above and below-ground lateral pipelines that jog through the farmland. East of the site, running in a generally north-south direction is the Garland Canal, an irrigation spillway that parallels the Shoshone River just yards from it. The Garland Canal utilizes a system of locks and culverts to move water from various dams and reservoirs into the region and supplies the area with irrigation.

### SITE PROXIMITY & ACCESSIBILITY

As a former internment camp, the purpose of the camp system was to relocate Japanese-Americans away from population centers in places as isolated as possible. The site is extremely isolated from any large cities or major airports, however, travel to the site is still relatively easy. The site is located in close proximity to a number of major wilderness destinations, the likes of which include national parks, national forests, state wilderness and wildlife recreation areas. The site is also navigable from popular ski destinations like Bozeman and Red Lodge, MT, and can be accessed in a single day by traveling from Billings, MT or Casper, WY.

While isolation from major population centers, major airports, and immediate access from town are all possible deterrents for visitors to contend with, the isolation of the site is true to the intentions of the site’s purpose and add to the sense of connection to history felt while visiting. Accessing the site is and educating factor on the mindset of those interned in the camp and provides a deeper sense of understanding and empathy to the conditions that Japanese-Americans contended with. The intentional journey to the site for the purpose of visiting can be considered a positive when thought of as both a journey to the museum, and as one back in time. With those considerations in mind, and the recognition that the site lacks immediate access to amenities that many other national museums afford, the site does not exist completely beyond the reach of many potential visitors.

The site was selected both for the original camp features that it maintains, the likes of which will be discussed in detail in the next section, but because despite it’s designed isolation, the camp site is located near other common tourist destinations. The most notable attraction in the area is Yellowstone National Park. Encompassing roughly 2.2 million acres of land in Wyoming, Montana and Idaho, Yellowstone National Park is a world heritage site and US National Park. As part of the national park system, Yellowstone is in the top five most visited parks annually. The peak season
Heart Mountain is also located within close proximity to multiple national forests. Overseen by the Department of Agriculture, these national forests include the Shoshone National Forest to the southwest, and the Bighorn National Forest to the east, both of which are located in Wyoming. Farther away, the Gallatin National Forest, Beaverhead National Forest, Targhee National Forest, Teton National Forest and Custer National Forest all provide protected wilderness that attracts a number of people to the extended area for camping, fishing, hunting, and trail access.

Heart Mountain is located on a rural site, but various cities and towns are easily accessible from the site via state and US highways. Cities and towns that may provide feeder access to Heart Mountain include Powell and Cody, WY, each at a short distance of roughly 10 miles, Red Lodge, MT at 55 miles, Billings, MT at 97 miles, Bozeman, MT at 195 miles, and Casper, WY at 225 miles, all of which can be accessed using US 14-A which runs on the eastern edge of the site.
EXISTING SITE FEATURES

As discussed previously this site was selected for a number of reasons, including the existing site features that remain from the time of the camp, its proximity to nearby attractions, and the history and social and cultural impacts of the project. The site features are considered the greatest assets of this site for exploration of a national museum on the history of Japanese-American internment and of the Heart Mountain Relocation Center specifically (Figure 3.3.4 // See also Appendix I - Supplemental Materials). The site possesses a number of intact features that will be discussed in greater detail in this section, and extensive abilities to host a museum of the size and scope being designed in this project. The ownership of key land holdings in federal and local foundation hands also makes the process of designing this museum much more manageable.

For the purpose of the thesis project, the site can be defined as the two properties currently owned by the National Park System and the Heart Mountain Wyoming Foundation (Figure 3.3.5). The Heart Mountain Wyoming Foundation (HMWF) site is situated on the lower tier of the site and encompasses the land north of Road 19 from US 14-A to the bluff wall. The boundary of the 50 acre HMWF site extends in an irregular shape north of the existing interpretive center, parking lot, barrack installation, and replica guard tower, ending at a well defined field boundary. The HMWF site currently features a small interpretive center for the site that will be considered as a temporary solution in the process of designing the full national museum project. The size and location of the current interpretive center are adequate for a small collection, but lacks the extensive facilities needed to support the larger museum program being discussed. The current interpretive center also lacks any real interaction with the historic buildings that the site is fortunate enough to retain from the relocation center.

Because of these shortcomings, the site is considered optimal for the design of a larger, national museum, and the existing structure will be considered as a temporary museum during the design and construction of the new facility. The National Park Service property has been federally held land since before the creation of the camp system. The roughly 74 acre property was originally part of the much larger Bureau of Reclamation land used for the Shoshone Irrigation Project. In the early 1940s, before completion of the Shoshone Irrigation system, the land was transferred to the War Relocation Authority, a civilian arm of the Department of Defense, for the purpose of creating the Heart Mountain Relocation Center. The Land originally transferred to the War Relocation Center encompassed 740 acres, and provided all of the necessary land to build and run the camp, the vast majority of which was occupied by the numerous housing blocks. Following the closing of the relocation center in 1945, the land was then transferred back to the Bureau of Reclamation and to the Bureau of Land Management. In 2006, the 124 acre site, which includes both the upper property and the HMWF property were designated as a National Historic Landmark and the upper portion came under management by the National Park System of the Department of the Interior. Given the designation of both the HMWF and NPS properties as part of the Nation Historic Landmark, both properties will be considered as the combined site for the museum project.

Like most other relocation centers, following the end of World War II and the closing of the camps, most buildings and camp features were either demolished or repurposed. In the case of Heart Mountain, the majority of barracks buildings, of which over 480 originally existed on site, were given to homesteaders of the area for use on farms as storage buildings or to be converted into houses. Various examples of these can be seen on neighboring farms, giving a unique historical context to the community. Of the ten camps that were part of the relocation program, Heart Mountain Relocation Center is considered one of the best examples of the planning and use of the camp. Heart Mountain features the most intact hospital complex of any of the camps, while only two others retain good examples of intact buildings at all. One complete barrack from Heart Mountain was been moved to the Japanese American National Museum in Los Angeles in 1994, before the National Historic Landmark designation was given and the planning and completion of the current interpretive center. As of the summer of 2017, another complete barrack was returned to the site and placed on brand new foundations near the interpretive center at the lower
The lower tier also features a recreation of what the site guard towers would have looked like. The guard tower is not in an original position for the structure during the camp's operation.

On the second tier of the property, the site includes a roughly 1000 foot long walking tour path in circular plan around the former camp administration area. The road access and parking area includes various pieces of historical camp fixtures. These pieces include a chimney foundation from one of the block 23 mess hall that includes a description and dedication on the attached plaque. The foundation pier rests plainly on the ground without any additional design elements around it for context or protection. This area also includes the restored Honor Roll. The Honor Roll was originally built by the internees and stood in the same location in front of the administration building. The Honor Roll was built of a wood frame with inset asbestos tiles that were inscribed with the names of Heart Mountain men that served in the United States Military during the war. Following years of degradation ultimately resulting in the complete bleaching of names from the tiles, the monument was restored in 2003 and again features the names of the 799 men who served. Behind the Honor Roll, the original wooden flag pole of the camp has been replaced with a modern steel version, though the overall effect is the same as would have been in the original camp. The area of the Administration building that is now encircled by the walking tour path is completely filled in with sagegrass and does not appear to retain any existing foundation. The National Historic Landmark application references a 125 foot by 125 foot concrete slab on that location, however in person observation and review of satellite imagery does not corroborate that description. Just beyond the walking tour path however, in the area that would still have included administrative buildings, a nearly complete perimeter wall foundation can be seen at ground level. This foundation wall measures approximately 100 foot square and is easily seen by walking only a few yards off the designated pathway. Because of the various private owners of land that included camp features, much of the walking tour information is displayed on kiosks with viewfinders to properly frame the areas being described. The walking tour does a good job of explaining areas of the site not publicly accessible but poorly interacts with site buildings on the grounds.

All of the buildings retained in their original positions on the site exist on the upper bluff, north of Road 19. Because the walking tour path and Honor Roll are accessed using Road 19, visitors are able to see the buildings before turning away from them to do the walking tour. While the buildings are publicly and easily accessible to visitors to the site, there is no signage or immediately visible kiosks to indicate such. Heart Mountain features the most complete hospital complex of any of the ten relocation centers. The hospital complex includes three complete buildings that remain structurally stable and without any significant loss of exterior features. The first building encountered in the hospital complex when accessed from the established roadway is a hospital mess hall (Figure 3.3.6 - Left). As described in the National Historic Landmark Application document, the building was completed in 1942 and consists of a wood frame, 40 x 180 feet in dimension with further subdivision on the interior. The building is sheathed in one inch thick wood siding and finished with asphalt shingles which are not original, at the time of completion the exterior material would have been rolled asphalt of the same type that covers the roof.

Adjacent to the hospital mess hall, a hospital warehouse remains standing (Figure 3.3.6 - Right). The hospital warehouse is built in the same manner as the mess hall building and measures approximately 24 x 120 feet. The warehouse provides a good reference in scale to the housing barracks that existed on site and measure approximately the same dimension.

Various concrete slabs are visible at grade north of the mess hall and warehouse buildings (Figure 3.3.10). The first concrete slab measures roughly the same as the warehouse building (20 x 120...
feet) along side it and supported a building of the same purpose. Directly north of the first slab, another foundation slab measuring 20 x 120 feet is visible which would have supported the hospital morgue building. Both of these slabs appear to be in good shape, with some cracking visible, but still completely intact. The third concrete slab measuring approximately 36 x 87 feet and located just north of the other features appears to rest on perimeter foundation walls of an unknown depth. This slab supported the hospital laundry building which was converted to a service station after the closing of the camp, evident by the remnants of a gasoline pump island not far from the building footprint to the west. The laundry building is connected to the neighboring boiler house by a sidewalk that looks to cover a crawlspace between the two. In some areas the sidewalk has been lifted or removed to reveal the shallow space below ground.

The boiler house is the most prominent building on the site and includes the massive brick chimney that rises above the plain to a height of 75' - 6" (Figure 3.3.9). The boiler house is built of similar construction techniques as the mess hall and warehouse buildings but is constructed using 2 x 6 dimensional lumber rather than 2 x 4. The building is also more irregular in shape, with a short bump-out on the building’s south side that meets the gable roof and a sunken coal room on the north side with a low sloped roof that includes multiple hatches. The chimney is built out from the boiler house itself, connecting only through piping that exits the building facade before entering the chimney structure. The chimney itself is built of common brick and walls several wythes thick. At its base, the chimney wall is 6 wythes thick, arranged in a square measuring 8' - 8" square. The chimney steps in as it rises, with a thickness of just 2 wythes at the top. The first step occurs at a height of forty feet to measure 6' - 11" square, and again at sixty-five feet to measure 5' - 5" square. It is of special note that the chimney has undergone extensive renovation in recent years to stabilize the structure and prevent collapse of the iconic piece of camp architecture. The chimney foundation was reinforced through a Department of the Interior grant project and concrete was used to line the chimney shaft. The chimney structure is now safely stabilized to allow visitors to come directly up to the structure, though the chimney itself still leans slightly to the east.

The final remaining building on the site is outside of the hospital complex but on the same parcel of land. The building in the former staff housing is much smaller than the other three, measuring 24 x 50 feet and is just half of the original structure (Figure 3.3.7). The building is constructed like the others, but with slightly upgraded finishes, including an oak slat floor.

All of remaining buildings were determined to have asbestos finishes and materials during a study conducted in 1991. At that time a sanitizing and hazardous waste abatement was conducted and all asbestos products were removed from the site. This fact is of important not for the consideration of utilizing any of the existing structures in the new museum design. Because the hazard was properly abated and all buildings retain their structural integrity, there would be no immediate issue with utilizing the buildings interior as well as their exteriors.
SITE VIEWS

Views from the site are vast and expansive. The position of the site in a river valley provides site lines to a number of nearby landforms that provide scenic sunrises and sunsets and jut into the endless sky with breathtaking beauty (Figure 3.3.11). The vast differences in views in any direction from the site provide ample opportunities for capturing the essence of the site from within the museum.

The view to the north is defined by a low horizon with no end in site. Bordered on each site by mountainous landscape, views to the north are spill outward to the west and east as the plain seems to never end. Looking northward agriculture is on full display alongside brush-lands across multiple levels of sandy bluffs. More immediately, the site is defined by a natural spillway at the north that cuts the ridge line and rises east to west into the more rocky formation surrounding Heart Mountain. The spillway is dry at most times, though evidence of the flow is evident by the greener undergrowth at the bottom of the channel. Across the spillway at the same elevation as the site ridge, more agricultural land can be seen, with various outbuildings and farmhouses dotting the landscape.

The view to the east is defined by the rising McCullough Peak Badlands. Fanning out from beyond the horizon, the McCullough Peaks Badlands are a popular destination for hiking and wildlife observation, and provide brilliant landscape that project the colors of the Wyoming sunrises and sunsets across the valley. In the foreground, the Shoshone River winds on the edge of the valley at the edge of the badlands. The river sits well below the prevailing elevation but is visible in segments as it turns through the landscape. Running parallel to the Shoshone River, the Garland Canal is more predominant in view, and jogs diagonally to the northwest as it flows alongside the site itself. Because of the stepped nature of the site, views to the east drop out from the upper ridge, invoking the feeling of being on a platform. This feeling adds to the belief that the upper ridge is further in distance from the railway and highway than it actually is.

Looking south from the site creates the illusion of being at the vase of a funnel, with the McCullough Peaks Badlands rising west to east and the Heart Mountain formation mirroring that rising east to west on the other side of the valley. The southern view looks across a forced perspective as the valley appears to nearly close in the distance. When looking across the site itself and immediately beyond it’s boundaries, evidence of the former camp is abundant. On the site itself various camp buildings, foundations, and the current walking tour are visible. Beyond the site boundaries, ghosts of the past remain visible but barely distinguishable without some pointing out. On the level below the ridge, an overgrown marsh is visible: the former camp swimming hole. Various farmsteads and outbuildings dart the landscape.

Views to the west are dominated by the towering Heart Mountain in the distance. On clear days, Heart Mountain is impossible not to look at, but on hazier days, it takes on a more ephemeral presence. The boundary of the former camp site is marked by a change in terrain from the relatively flat farmland to the irregular sandy ridges that form the Heart Mountain landform. While the camp itself stretched all the way to this ridge, the project site ends at the gravel access road that runs alongside powerlines and the first agricultural field. The powerlines exist as a nearly forgotten feature as any views from the site tend look through them to the landscape beyond rather than at them as an obstacle. Looking west also provides views of the former barracks ground, which extended all the way to the far ridge. If properly framed, this view could be important to conveying the extent of the relocation effort and the size of the community created through the War Relocation Authority at this site.
TOPOGRAPHY

The topography of the site appears as two tiers of flat tables. In reality, the upper portion of the site is sloped gradually from the western ridge down to the bluff that cuts the two properties and slightly towards the south, causing the bluff wall to appear as a wedge shape. The sloping is extremely gradual, between 0 and 3%, but is notable as it effects the watershed for the property. Regardless, the low slope of the upper portion is lost in comparison to the steep rise of the bluff wall (Figure 3.3.12).

The most predominant feature of the site is the irregular bluff at the border of the two properties. The bluff is cut in many places by what appears to be small runoff channels. These cuts add to the irregular shape of the bluff and result in a wide range of aspects and solar exposures. Most interesting about the bluff is the height and slope of the wall. The top of the plateau is roughly sixty feet above the floor of the valley below, after a slope of nearly forty-five degrees in some areas. Despite the sharp rise and big elevation difference, the height of the bluff appears far less because of the length of the bluff wall and the expanse of views across the landscape. When viewed from the highway north of the site, the bluff appears much taller than it does when viewed from the south. This is due to the gradual sloping back towards the south at the top of the plateau. The effect this has on the sites appearance is unique, and if carefully studied could provide a unique opportunity to play with how the geometry of the building is seen from the road. From the north side of the site, the bluff can help obscure forms that are placed farther back from the bluff edge, beyond the boiler house that appears as a beacon above the plain. From the south, all of the buildings on the upper plain are in view, which may allow the new museum to appear interspersed with the historic buildings as a call to visit the site.

HYDROLOGY

Drainage of the site occurs through a predominantly west to east flow. This is accommodated by the stepping in land from the western ridge of the Heart Mountain formation, across the agricultural land at the top of the bluff, down the wall and into the lower valley towards the Shoshone River. This is also accommodated in greater volume through the large natural spillway on the north side of the site (Figure 3.3.13). The soil composition of the site is suitable for shedding water rapidly and the general slope of the site east and west results in the water flowing in rather small quantities, rather than collecting then exiting the property itself in a single channel.

Irrigation infrastructure can also be seen jogging through the site. The irrigation system used to supply the area utilizes both above and below-ground pipelines to move water from dams and reservoirs to agricultural land. Lateral H-103, a below-ground irrigation pipeline runs through the center of the site from west to east before turning north at the base of the bluff (Figure 3.3.13). Beyond the boundaries of the site, the Garland Canal can be seen with flowing water evident in its channel.
Heart Mountain is located in Wyoming’s Bighorn Basin, a structural and topographic basin bordered by the Absaroka Range in the west, the Bighorn Mountains in the east, and the Bridger and Owl Creek Mountains in the south. The floor of the basin sits at 3,500 feet of elevation and rises to heights of over 11,000 feet at its rim, fully forming the deep basin bowl. The Bighorn Basin’s size of roughly 100 miles wide by over 100 miles long prevents the full magnitude of the basin to be seen from the ground, however the basin is easily distinguishable in aerial views of the region.

Most notable about the region is the formation of Heart Mountain. Considered the largest detectable landslide on earth, the Heart Mountain detachment continues to baffle geologists. The uniqueness of Heart Mountain is easily defined when referencing the geologic eras of its formation. The limestone which comprises the mountain’s face and peak are approximately 250 million years older than the base of Heart Mountain. In typical sediment formation, the topmost layers are the youngest, stacked in striations on older sediment. In the case of Heart Mountain it is believed that the detachment occurred roughly 50 million years ago, causing in effect a landslide to occur, causing roughly 500 square miles of limestone block to essentially float down the basin from the Beartooth Mountains and into the basin proper. The result of the landslide is the formation of the Heart Mountain which stands at an elevation of 8,123 feet, and features a visible angling of layers of sediment out of horizontal at the peak. While the Heart Mountain detachment and landslide is generally accepted by scientists, the cause and timing remain unclear. Some scientists believe the slide, which occurred down a nearly flat 2 degree slope, may have occurred as quickly as a period of minutes, others believe it may have occurred in a series of movements. The cause is also unknown, with the most commonly accepted reasons including volcanic activity or earthquakes in the Yellowstone region causing the fracturing and upheaval of rock and sediment.

The soil composition of the site largely consists of sandy loam (Figure 3.3.14 / Table 3.3.15). Loam is a mixture of sand, silt and clay in single composition. For this site, the soils tend to be a fairly even mixture, though it does trend towards more of a sandy or clay loam than a silty one. This is easily explained by the dry arid climate that has defined the region for much of history. While soil characteristics and composition are largely universal across the site, the landforms that are created in the soil vary. The site’s two levels consist of nearly flat 0 - 6% slopes, however, the fan-like bluff wall is much steeper at 6 - 45%. In spite of the wide variation in slope, soil profile remains consistent across the site, as is depth to water table and restrictive features at over 80 inches. Though the soil is classified by the US Geologic Survey as not prime farmland, the area around the site is used primarily for that purpose. Soil composition should be examined further for structural capacity, as currently only small dwellings and farm buildings exist, with all existing foundations on the site itself being shallow perimeter wall or slab on grade.

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<th>Slope</th>
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<td>Very Gravelly Sandy Clay Loam</td>
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<td>8D+ in.</td>
</tr>
</tbody>
</table>

Table 3.3.15
CLIMATOLOGY

The climate of the Bighorn Basin is consistent with a high desert. The area experiences a wide range of temperatures and wind. However, the region is very dry. Summers are characterized by warm, sunny days, with temperatures ranging from sixty to ninety degrees during the summer months. The peak tourist season coincides with the moderate to warm summer weather, with sunlight lasting over 14 hours daily and over 15 hours at the solstice. The path of the sun is rather unobstructed as the nearby mountains are low enough at the horizon that they do not cast any shadows across the site. Winter months on the site are often cold and dry. Windy conditions blow whatever snow has fallen across the site and temperatures average between ten and thirty-five degrees, though they can dip below zero at times as well.

Precipitation at the site is often very little annually. In the average year, this part of Wyoming will receive less than twelve inches of total precipitation. The majority of the precipitation comes during late spring and early summer months, when storms are not uncommon. May receives the most precipitation of any month, receiving nearly two inches. The dry conditions are evident in the soil type seen, with sandy conditions being the predominant ground cover. Vegetation covers only spillway channels and irrigated land. The land sheds water quickly when precipitation does fall, channeling it into nearby reservoirs and natural creeks and rivers.

Wind at the site is nearly always present, with calm conditions happening in the minority of days. The average wind speed experienced on site is roughly 11 miles per hour, and with little upright vegetation there is little shelter. Winds blow predominantly out of the northwest and southeast, picking up loose sediment and pushing dried vegetation across the plain. The terrain conditions do little in the way of protection from the elements, especially on the upper bluff, the only spot that can be considered of any protection from wind is at the base of the bluff wall, as any winds out of the northwest roll over the edge.
The project will be approached from the perspective of designing a national museum in partnership with the local foundation. Approaching the project as a museum with support from the federal government affords a greater amount of design freedom. This approach requires a large amount of programmed space beyond exhibition space and standard visitor amenities like a shop and cafe. Some of the ancillary spaces required to support the museum include administrative spaces for museum staff, as well as on-site offices for employees of the local foundation and the National Park Service. The museum will also provide as many support services for the collection on site as possible. These services include the creation of exhibit display materials in the museum workshop, storage of permanent and temporary collections in secure facilities, archives and research spaces, and conservation of rare, vulnerable, and at-risk historical pieces in on-site lab facilities. The museum will also feature multiple flexible educational spaces to accommodate various groups and museum activities.

**EXHIBITION GALLERIES**

Exhibition galleries in the museum encompass the largest single usage of space by area of any function in the program. The museum will feature an estimated 25,000 square feet of permanent and temporary exhibition space ranging in architectural detailing and exhibit design. The exhibit spaces will be designed utilizing the research from the fall semester studio to create visitor-centric spaces while maintaining a level of flexibility for updates and the possibility of future expansion.

**EDUCATIONAL SPACE**

Education is the primary function of the museum, as such providing dedicated educational spaces in the museum is of high priority. Educational spaces in the museum will be designed for maximum flexibility to allow the museum to host and provide space for a variety of functions. Possible uses of these spaces may include student group tours, research symposiums, and the annual pilgrimage.

**MUSEUM WORKSHOP, COLLECTIONS STORAGE & CONSERVATION**

The museum workshop, collections storage, and conservation spaces in the museum will provide support services for the collection. An on-site workshop with separate dirty and clean shops and print studio will allow the museum the opportunity to build and supply exhibit furniture for use in the exhibition galleries. Collections storage will provide secure, climate-controlled facilities to maintain portions of the collection when they are rotated out of the display. On-site conservation provides all of the necessary tools to maintain rare, vulnerable, and at-risk pieces, as well as the opportunity to contract services to the surrounding community.

**ADMINISTRATION**

The nature of the multi-agency management of this museum requires adequate administrative space of museum specific employees, as well as space for members of the Heart Mountain Wyoming Foundation and the National Park Service. These areas should be considered self-contained from one another, but allow effortless collaboration between the organizations.
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<td>1</td>
<td>1,000</td>
</tr>
<tr>
<td>Exhibition Galleries</td>
<td></td>
<td>25,000</td>
</tr>
<tr>
<td>Permanent Exhibition</td>
<td>1+</td>
<td>20,000</td>
</tr>
<tr>
<td>Temporary/Traveling Exhibition</td>
<td>1+</td>
<td>5,000</td>
</tr>
<tr>
<td>Administration</td>
<td></td>
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</tr>
<tr>
<td>Museum and Site Director Office</td>
<td>1</td>
<td>150</td>
</tr>
<tr>
<td>Museum and Site Employee Office</td>
<td>1 - 8</td>
<td>800</td>
</tr>
<tr>
<td>Heart Mountain Wyoming Foundation Office</td>
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</tr>
<tr>
<td>National Park Service Office</td>
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<td>600</td>
</tr>
<tr>
<td>Workroom / Supply Office</td>
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<tr>
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<td>250</td>
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<tr>
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<td></td>
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<tr>
<td>Auditorium</td>
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</tr>
<tr>
<td>Flexible Classrooms</td>
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<tr>
<td>Research Facilities</td>
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<tr>
<td>Research Office</td>
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<tr>
<td>Library</td>
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<td>Archival Document Storage</td>
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<td>Reading Rooms</td>
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<td>Open Workroom</td>
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<td>Technology Lab</td>
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<table>
<thead>
<tr>
<th>Name</th>
<th>Room Count</th>
<th>Area (Sq. Feet)</th>
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<tbody>
<tr>
<td>Restrooms</td>
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<td>4,400</td>
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<tr>
<td>Men’s Restrooms</td>
<td>As Necessary</td>
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<tr>
<td>Women’s Restrooms</td>
<td>As Necessary</td>
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</tr>
<tr>
<td>Gender-Neutral / Family Restrooms</td>
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<td>Museum Workshop</td>
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<tr>
<td>Dirty Shop</td>
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<tr>
<td>Clean Shop</td>
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<td>400</td>
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<tr>
<td>Installation and Print-shop</td>
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<tr>
<td>Exhibition Fixtures &amp; Furniture Storage</td>
<td>1</td>
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<td>Collections Storage and Conservation</td>
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<td>Temporary/Traveling Collections Storage</td>
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<td>Rare &amp; Vulnerable Items Storage</td>
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<td>250</td>
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<tr>
<td>Conservation Office</td>
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<td>120</td>
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<tr>
<td>Conservation Workroom</td>
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<td>200</td>
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<tr>
<td>Conservation Clean-room</td>
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<td>150</td>
</tr>
<tr>
<td>Conservation Equipment &amp; Storage</td>
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<td>Storage and Receiving</td>
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<tr>
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<td>General Receiving Dock (Non-Collections)</td>
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<td>Collections Receiving Dock</td>
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<tr>
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<td>500</td>
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<td>Additional Site Features</td>
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<tr>
<td>Parking (Surface or Underground Lot)</td>
<td>Spots TBD</td>
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<td>Honor Roll Memorial Park</td>
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<tr>
<td>Walking Tour</td>
<td>N/A</td>
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</tr>
<tr>
<td>Exterior Seating &amp; Contemplation Space</td>
<td>N/A</td>
<td>180</td>
</tr>
</tbody>
</table>

| TOTAL (NSF)                  | 60,840     |
| TOTAL (GFS)                  | 91,260     |
Adjacency and interaction planning for the museum was done after consulting multiple text references on exhibition and museum architecture. The solution planned in the bubble diagram (Figure 4.2.1) and the adjacency matrix (Table 4.2.2) have been created with the recommendations of these references in mind. The adjacencies have been created in an effort to group like departments in close proximity to one another and to position restroom facilities, mechanical rooms, and workshops away from sensitive collections and conservation efforts. Positioning these functions apart from one another will help prevent unnecessary loss of artifacts from contamination and harmful liquids. All other areas were arranged with their relationship to the exhibition galleries, the largest single programming function, as the primary driver of their placement.
This project will be evaluated on a number of criteria set by the Department of Architecture and Landscape Architecture at North Dakota State University, and by the designer. The project goals include careful adherence to industry and typology standards for design, management of project scope in reference to the program requirements, various environmental and site considerations, and responsible decision making regarding occupant usage of the building. The relative complexity of the project and site location require comprehensive definition of criteria to ensure there is little ambiguity in the objectives of the project’s design. Final evaluation of the project will be included in the design portion of the thesis book in reference to the below included criteria.

SPACE ALLOCATION

The project will seek to use the site in the most responsible way possible, adhering to strict program area requirements in order to create the most realistic and practical solution for this context. The areas designated for each space in the program will provide the key barometer of success, with these numbers adjusted and explained as necessary throughout the design of the project. A unique consideration for the project will also be the incorporation of existing features and buildings on the site, with a goal of maintaining and/or adaptively reusing these fixtures to the highest possible extent.

As a means of verifying performance based on space usage in the project, a comparison will be made in the final project book between the programmed space and designed space, with explanation given for any discrepancies. The overall success of the programs accuracy, and design’s adherence to the square footage goals will be given and detailed in this section. In an effort to prevent poor calculation of special requirements in the programming phase, typological research will be used as the primary basis of supplying these figures, with additional considerations detailed. The program numbers will also be updated and explained at periodic intervals during the design phase or wherever necessary, with proper documentation to be included in the comparison document for the final project book.

The overall success of the program’s usage for space allocation will be determined by myself, the designer, with Professor Mahalingam, my primary thesis advisor. The findings of whom will be included as notes in the comparison section of the final book.

ENERGY CONSUMPTION

The location of the site dictates a keen awareness of the project’s impacts on the surrounding environment and the building’s performance in relative isolation from other buildings. The site context of the project will provide unique challenges regarding utility access and pollution prevention. Key goals regarding the project’s performance in the environment is limitation of pollutant runoff to irrigation canals and agricultural land, energy production potential, and responsible access via vehicle traffic to the site.

As a museum, the building must be to perform at a specific level to prevent any unnecessary harm to artifacts displayed, and enable the safe preservation of vulnerable historical pieces into the future. The building should meet recommended standards across all exhibition, storage, and conservation spaces. These standards include maximum lighting levels of 5 footcandles for objects sensitive to light, 20 footcandles for objects with minor sensitivity, and 30 footcandles for objects that are not sensitive to light. Environmental conditions should be designed to maintain 70° and 50% Relative Humidity (RH) in storage, conservation and exhibition spaces, and 75° and 60% RH maximum in education, auditorium and administration spaces.

BEHAVIORAL PERFORMANCE

The optimization of behavioral and usage performance of the project is one of the primary goals. In conjunction with the museum visitor research completed in the fall studio and included in the project book, the design will be analyzed extensively to predict and enhance visitor experiences in the exhibit space. Designing a museum and exhibit space for adaptability and positive visitor experience will be the target of this analysis.

Using AnyLogic Simulation Software and the data collected from the previously completed research, the project will be put through a variety of simulations at various visitor rates and exhibit plans to accurately predict behavior and determine an optimal layout for artifacts in the building and on the site. The key determination will be in finding a layout that allows a variety of experiences and prevents unnecessary skipping of museum displays by visitors during busy times at the museum. The simulation will also be used to recognize any possible choke points or blind spots to visitors as they move through the museum.

The graphics created by running simulations in the museum will be included in the project book with any relevant notes on the findings and shortlisted options may be included in the final installation such as boards, animations, or presentation.

PSYCHOLOGICAL IMPACT

The subject matter covered by the project results in a wide range of psychological responses, the nature of which is both a goal and responsibility of the design to manage. Typological research and personal experience will be heavily relied upon in determining the goals of each piece of the museum in terms of psychological impact. To determine success of creating the psychological responses, the architecture of the museum, as well as the types of exhibit pieces displayed in the museum will be studied throughout the design, with feedback from a variety of people sought to help gauge effectiveness; the people surveyed may include classmates, faculty, friends, and/or strangers, but will not be done for the purpose of any official research. The feedback will be considered and incorporated when deemed effective and will be included with the project book to explain the success or failure of the project.
ENVIRONMENTAL IMPACT

The project is located on a unique site featuring a variety of existing historic fixtures, agricultural land, irrigation infrastructure and is in close proximity to a US Highway and railway. Because of this combination of features on the site, special care will be taken to preserve as much as possible the existing environment and enhance the site through the design. The historic features are of special note, because of their link to the project’s subject matter, and will be preserved and adapted as best possible to prevent the destruction of these important artifacts. Success in preserving the site will be best measured by analysis of how well historic features are preserved, the percentage of agricultural land maintained, and the avoidance of major infrastructure modifications to the site, all of which will be discussed in the final project book.

CODE COMPLIANCE

The project will be designed to meet all relevant building codes. Because of the project’s location in the State of Wyoming, all code compliance will be determined by the 2015 International Building Code and comply with any relevant code enforcement set by the county, city, or township to which the site is under jurisdiction. The project may also be restricted through land ownership, irrigation district regulations and National Park Service and Bureau of Land Management and Reclamation requirements. Any specific code questions will be directed to NDSU faculty for clarification or other code officials as necessary.

PROJECT COST

Project cost will be a factor of limited consideration for the project. The design will be completed with a recognition of the potential cost involved but will not be utilized as a particularly restrictive factor. The nature of the project as a potential nationally recognized museum allows greater freedom of the architecture in terms of cost than a similarly sized museum of smaller subject scope.
The design process for the thesis project was documented by arching digital models at various points of progress, taking screenshots and saving images of design development and presenting the project to peers at various times throughout the studio. A selection of the project process is being included here to show how the project was designed.

Figure 5.1.1 Development of exterior form in relation to the surrounding landscape

Plan Development at time of Midterm Reviews
SECTION 5.1 Process Documentation

Development of Interior Spaces

Facade Material Study
This is the final result of the thesis project. While there are still a number of things that could be improved upon and/or changed, this is the completed project which was presented to faculty, students, and outside critiquers at the end of the Spring design studio.

Shown here is the First Floor Plan with the immediate site context shown. The first floor contains the entry area with coat check and ticket lobby, museum shop, cafe and a number of building operations areas. The various galleries are also accessed from Level 1 along with various adjoining historical structures.

Figure 5.2.1
Shown here is the First Lower Level Floor Plan. The first level below grade contains educational, library, and administration spaces. These spaces can be accessed through vertical circulation or ramp to the galleries. Renderings of the administration and education spaces are shown above.
Shown here is the Second Lower Level Floor Plan. The second level below grade is the service level, containing mechanical, storage, conservation and workshop spaces needed to sustain the museum. The vertical access corridor allows for movement of displays and artifacts into the galleries.
The wall section details above help showcase the building’s many systems and construction methods designed to create the complete museum possible. Notably, the sections demonstrate how the new construction interacts with historic structures, daylighting awareness for the first lower level, and access concerns for galleries.
The simulation plans provide design analysis and feedback to both the architect and curator of the museum. As was the intended purpose of the thesis project, the use of simulation in the design process was found to be a viable method of studying the design and perfecting it before it is built.
The exterior of the building, shown here in two renderings was designed to relate to the landscape it is surrounded by. The origami-like folded plate roof is a representation of the cascading mountain buildup behind the museum, with precast concrete and GFRC panel facades providing textural reference to the rocky land. The lower portion is capped by gentle, sweeping curved roofs clad in fiber cement panels that tonally match the grasslands in the immediate site context. Across the face of the lower building portion and supporting the entry signage, accent columns with perforated metal panel cant out from the wall to support the large overhangs. From the approaching highway, the iconic chimney and boiler house of the relocation center frame the building with Heart Mountain in the background.
The interior of the building was designed to provide a flexible space for unlimited stories to be told while still providing memorable experiences. The entry lobby is designed to help guide visitors in the direction they need to go through the architecture. The sloping ceiling helps bring in a lot of natural light while also funneling people to the coat check, ticket desk and gallery entrance. Also accessible from the lobby space is the museum shop, restrooms, and cafe space all within view of the doors. While the galleries are designed to allow flexibility and change, a few experiences designed into these spaces include the Warehouse of Stories (Figure 5.2.11) in the exiting warehouse building. This experience allows visitors to step into the personal accounts of people and families who actually lived through internment at Heart Mountain. In Gallery D, a camp barrack has been recreated to showcase daily life. Figure 5.2.12 shows the Life in Camp Display where figures representing the various lifestyles of internees tell what their days were like in internment. Inside the barrack a full size typical apartment has been rebuilt and visitor comments and social ticker room let people interact and give feedback (Figure 5.2.13). The feedback computers and social ticker allow the museum to hear more about what visitors want and expose visitors to the opinions of others in regards to internment.
This project is being evaluated on a number of criteria set by the Department of Architecture and Landscape Architecture at North Dakota State University, and by the designer. The project goals include careful adherence to industry and typology standards for design, management of project scope in reference to the program requirements, various environmental and site considerations, and responsible decision making regarding occupant usage of the building. The relative complexity of the project and site location require comprehensive definition of criteria to ensure there is little ambiguity in the objectives of the project’s design. This section includes the final evaluation of the project’s adherence to the previously set goals. For clarity the full list of goals from the previous section of the book are being included.

**SPACE ALLOCATION**

**PERFORMANCE GOAL:**

The project will seek to use the site in the most responsible way possible, adhering to strict program area requirements in order to create the most realistic and practical solution for this context. The areas designated for each space in the program will provide the key barometer of success, with these numbers adjusted and explained as necessary throughout the design of the project. A unique consideration for the project will also be the incorporation of existing features and buildings on the site, with a goal of maintaining and/or adaptively reusing these fixtures to the highest possible extent.

As a means of verifying performance based on space usage in the project, a comparison will be made in the final project book between the programmed space and designed space, with explanation given for any discrepancies. The overall success of the programs accuracy, and design’s adherence to the square footage goals will be given and detailed in this section. In an effort to prevent poor calculation of special requirements in the programming phase, typological research will be used as the primary basis of supplying these figures, with additional considerations detailed. The program numbers will also be updated and explained at periodic intervals during the design phase or wherever necessary, with proper documentation to be included in the comparison document for the final project book.

The overall success of the program’s usage for space allocation will be determined by myself, the designer, with Professor Mahalingam, my primary thesis advisor. The findings of whom will be included as notes in the comparison section of the final book.

**PROJECT SOLUTION:**

The final solution successfully falls within the predetermined programming square footage, with a total area of approximately 85,000 square feet. The final footprint of the building is also minimally invasive on the surrounding existing buildings. Where connected, the existing structures and new construction are structurally independent and areas of direct adjacency are limited. On site, two of the three existing buildings in the hospital complex have been incorporated into the final design as usable gallery space, with the remaining unattached boiler house left in existing condition. Similarly, two of the three existing foundation slabs have been attached to the new building for ease of access, with the laundry slab left isolated and in existing condition.

**ENERGY CONSUMPTION**

**PERFORMANCE GOAL:**

The location of the site dictates a keen awareness of the project’s impacts on the surrounding environment and the building’s performance in relative isolation from other buildings. The site context of the project will provide unique challenges regarding utility access and pollution prevention. Key goals regarding the project’s performance in the environment is limitation of pollutant runoff to irrigation canals and agricultural land, energy production potential, and responsible access via vehicle traffic to the site. As a museum, the building must be to perform at a specific level to prevent any unnecessary harm to artifacts displayed, and enable the safe preservation of vulnerable historical pieces into the future. The building should meet recommended standards across all exhibition, storage, and conservation spaces. These standards include maximum lighting levels of 5 footcandles for objects sensitive to light, 20 footcandles for objects with minor sensitivity, and 30 footcandles for objects that are not sensitive to light. Environmental conditions should be designed to maintain 70° and 50% Relative Humidity (RH) in storage, conservation and exhibition spaces, and 75° and 60% RH maximum in education, auditorium and administration spaces.

**PROJECT SOLUTION:**

In the final project solution, energy consumption, environmental effects, and recommended standards were either disregarded or assumed to be true. Over the course of the project, the overall thesis premise shifted from architectural recognition and memorial to testing the use of agent based simulation in the design process. With this shift, environmental goals were not followed up on and ultimately became a non-factor in the design of the project. Observance of recommended standards such as lighting levels, and relative...
humidity were assumed to be true.

RESULT:

BEHAVIORAL PERFORMANCE

PERFORMANCE GOAL:
The optimization of behavioral and usage performance of the project is one of the primary goals. In conjunction with the museum visitor research completed in the fall studio and included in the project book, the design will be analyzed extensively to predict and enhance visitor experiences in the exhibit space. Designing a museum and exhibit space for adaptability and positive visitor experience will be the target of this analysis.

Using AnyLogic Simulation Software and the data collected from the previously completed research, the project will be put through a variety of simulations at various visitor rates and exhibit plans to accurately predict behavior and determine an optimal layout for artifacts in the building and on the site. The key determination will be in finding a layout that allows a variety of experiences and prevents unnecessary skipping of museum displays by visitors during busy times at the museum. The simulation will also be used to recognize any possible choke points or blind spots to visitors as they move through the museum.

The graphics created by running simulations in the museum will be included in the project book with any relevant notes on the findings and shortlisted options may be included in the final installation such as boards, animations, or presentation.

PROJECT SOLUTION:
The approach towards behavioral performance taken during the design process was to validate agent based simulation’s viability in exhibition planning. This represents a slight divergence from the pre-design goal of finding an optimal layout. Simulation iterations were created as a means of presenting how consultants may use the software to present options to both the museum curator and architects working on the project. These simulations were extremely successful in demonstrating the viability of simulation in determining how an exhibit may be designed and eventually built. The graphics created explaining the resulting simulations are included in the previous section, 5.2 Project Solution Documentation.

RESULT:

PSYCHOLOGICAL IMPACT

PERFORMANCE GOAL:
The subject matter covered by the project results in a wide range of psychological responses, the nature of which is both a goal and responsibility of the design to manage. Typological research and personal experience will be heavily relied upon in determining the goals of each piece of the museum in terms of psychological impact. To determine success of creating the psychological responses, the architecture of the museum, as well as the types of exhibit pieces displayed in the museum will be studied throughout the design, with...
feedback from a variety of people sought to help gauge effectiveness, people surveyed may include classmates, faculty, friends, and/or strangers, but will not be done for the purpose of any official research. The feedback will be considered and incorporated when deemed effective and will be included with the project book to explain the success or failure of the project.

**PROJECT SOLUTION:**
As the overall thesis premise shifted away from memorial and recognition, this goal became less of a priority. Care was still taken in the layout and overall design to ensure good artifact placement and engaging exhibits were included. A few of the more developed sections of the galleries can be seen in renderings in the previous section 5.2 Project Solution Documentation.

**RESULT:**  
Very Poor  Poor  Slightly Poor  Neutral or Not Applicable  Slightly Successful  Successful  Very Successful

**ENVIRONMENTAL IMPACT**

**PERFORMANCE GOAL:**
The project is located on a unique site featuring a variety of existing historic fixtures, agricultural land, irrigation infrastructure and is in close proximity to a US Highway and railway. Because of this combination of features on the site, special care will be taken to preserve as much as possible the existing environment and enhance the site through the design. The historic features are of special note, because of their link to the project’s subject matter, and will be preserved and adapted as best possible to prevent the destruction of these important artifacts. Success in preserving the site will be best measured by analysis of how well historic features are preserved, the percentage of agricultural land maintained, and the avoidance of major infrastructure modifications to the site, all of which will be discussed in the final project book.

**PROJECT SOLUTION:**
Placement of the building was decided to allow interaction with historic structures, therefore ensuring additional care would be given to protect these structures for years to come. Because of the location of the building on the site, no additional land would need to be purchased beyond what is already owned by the National Park Service and the Heart Mountain Wyoming Foundation, as a result no agricultural land was disturbed and existing roadways were utilized. Overall disturbance to the site was kept minimal beyond the construction needs of the actual building site.

**RESULT:**  
Very Poor  Poor  Slightly Poor  Neutral or Not Applicable  Slightly Successful  Successful  Very Successful

**CODE COMPLIANCE**

**PERFORMANCE GOAL:**
The project will be designed to meet all relevant building codes. Because of the project’s location in the State of Wyoming, all code compliance will be determined by the 2015 International Building Code and comply with any relevant code enforcement set by the county, city, or township to which the site is under jurisdiction. The project may also be restricted through land ownership, irrigation district regulations and National Park Service and Bureau of Land Management and Reclamation requirements. Any specific code questions will be directed to NDSU faculty for clarification or other code officials as necessary.

**PROJECT SOLUTION:**
To the best of my knowledge, no building codes were disregarded or otherwise broken in the design of this building. Additionally, no variances were made or requested during design.

**RESULT:**  
Very Poor  Poor  Slightly Poor  Neutral or Not Applicable  Slightly Successful  Successful  Very Successful

**PROJECT COST**

**PERFORMANCE GOAL:**
Project cost will be a factor of limited consideration for the project. The design will be completed with a recognition of the potential cost involved but will not be utilized as a particularly restrictive factor. The nature of the project as a potential nationally recognized museum allows greater freedom of the architecture in terms of cost than a similarly sized museum of smaller subject scope.

**PROJECT SOLUTION:**
Construction methods and materials were selected, and design modifications made in an attempt to minimize costs and maximize ease of construction in for the building. While no budget numbers were ever determined, it was a factor in the design process.

**RESULT:**  
Very Poor  Poor  Slightly Poor  Neutral or Not Applicable  Slightly Successful  Successful  Very Successful
Digital Presentation

Title Slide

Agent-based modeling focuses on the individual active components of a system. This is in contrast to both the more abstract system dynamics approach and the process-focused chemotactic agent method.

In agent-based simulation, active entities, known as agents, must be identified and their behavior defined. They may be people, households, vehicles, equipment, products, or corporations, whatever is relevant to the problem. Interactions between these are established, environmental variables set, and simulations run. The global dynamics of the system then emerge from the interactions of the many individual behaviors.

Explanation of Agent Based Design, or ABSim

Explanation of how the ABSim model is created

EXHIBIT LAYOUTS

ZONE A
ZONE B

VISITOR PATHS

ZONE A
ZONE B

INTERACTION STATISTICS

ZONE A
ZONE B

Hjemkomst Center Observational Zones

Hjemkomst Center Visitor Pathways

Hjemkomst Center Artifact Interaction Statistics
The final installation of the project display included a backdrop made to represent the construction of camp barracks that were once on the site. The project is displayed on three 24” tall by 72” wide printed boards and a lower panel that wraps the model base. The 30” by 66” model is scaled at 1:10 to illustrate the massive scale of the building and highlight the relationships between the varying forms. A small monitor mounted to the display plays the simulations with a description of how ABSim was used throughout the project.
SUPPLEMENTARY MATERIALS

RIGHT (Figure A.1.1): Original WRA Layout Plan

BELOW (Figure A.1.2): Enlargement of Hospital Complex and Administrative Area
Green denotes Existing Building
Blue Denotes Existing Foundation


References


SPRING
Joan Vorderbruggen
Montessori School
Location: Fargo, ND
Pritzker Architect Bird House
Architect: Zaha Hadid
Small Dwelling
Project Name: Carter House
Location: Marfa, TX

SPRING
Ganapathy Mahalingham
AB Sim Exhibition Design
Location: Heart Mountain Relocation Center, Powell, WY

FALL
Bakr Aly Ahmed
Integrated Design Studio
Project Name: BSQ Howard
Location: San Francisco, CA
* Awarded Second Honorable Mention
Vision Award Competition
Project Name: Another Round
* Award Finalist

FALL
Ganapathy Mahalingham
Graduate Research Studio
Project Name: Visitor Driven Exhibitions
Location: Hjemkomst Center, Moorhead, MN
[Research Study]

FALL
Cindy Urness
Tea House
Project Name: Sveve Teahouse
Location: Moorhead, MN
Boat House
Location: Minneapolis, MN

FALL
Adam Beck
Timber Structure
Project Name: Fargo Community Arts Center
Location: Fargo, ND
Masonry Structure
Project Name: 292 Bowery
Location: New York City, NY

SPRING
Regin Schwaen
Concrete Structure / Design Competition
Project Name: Afterwinds
Location: Nekoma, ND
Steel Construction / Design Competition
Project Name: Lily on Lake Michigan
Location: Chicago, IL

SPRING
Dan Faulkner
Urban Design Studio
Project Name: N/A
Location: Various under different zoning styles
Marvin Windows Competition
Project Name: Fargo Archery & Nature Center
Location: Fargo, ND

FALL
Joan Vorderbruggen
Montessori School
Location: Fargo, ND
Pritzker Architect Bird House
Architect: Zaha Hadid
Small Dwelling
Project Name: Carter House
Location: Marfa, TX

SPRING
Joan Vorderbruggen
Urban Design Studio
Project Name: N/A
Location: Various under different zoning styles
Marvin Windows Competition
Project Name: Fargo Archery & Nature Center
Location: Fargo, ND

FALL
Cindy Urness
Tea House
Project Name: Sveve Teahouse
Location: Moorhead, MN
Boat House
Location: Minneapolis, MN

FALL
Adam Beck
Timber Structure
Project Name: Fargo Community Arts Center
Location: Fargo, ND
Masonry Structure
Project Name: 292 Bowery
Location: New York City, NY

SPRING
Regin Schwaen
Concrete Structure / Design Competition
Project Name: Afterwinds
Location: Nekoma, ND
Steel Construction / Design Competition
Project Name: Lily on Lake Michigan
Location: Chicago, IL

SPRING
Ganapathy Mahalingham
Thesis Design Studio
Project Name: Visitor Driven Exhibitions
Location: Hjemkomst Center, Moorhead, MN
[Research Study]
"I believe architecture is as much about humanity as it is about form or function. Buildings ought to both have a soul and provide enriching environments for their context. Studying architecture at a school like NDSU has not only cemented that viewpoint, but proven that in all things, people and purpose matter. The faculty at NDSU have provided me with an education that will not only prepare me to be a good designer, but also to be a good person."

- Brady Laurin