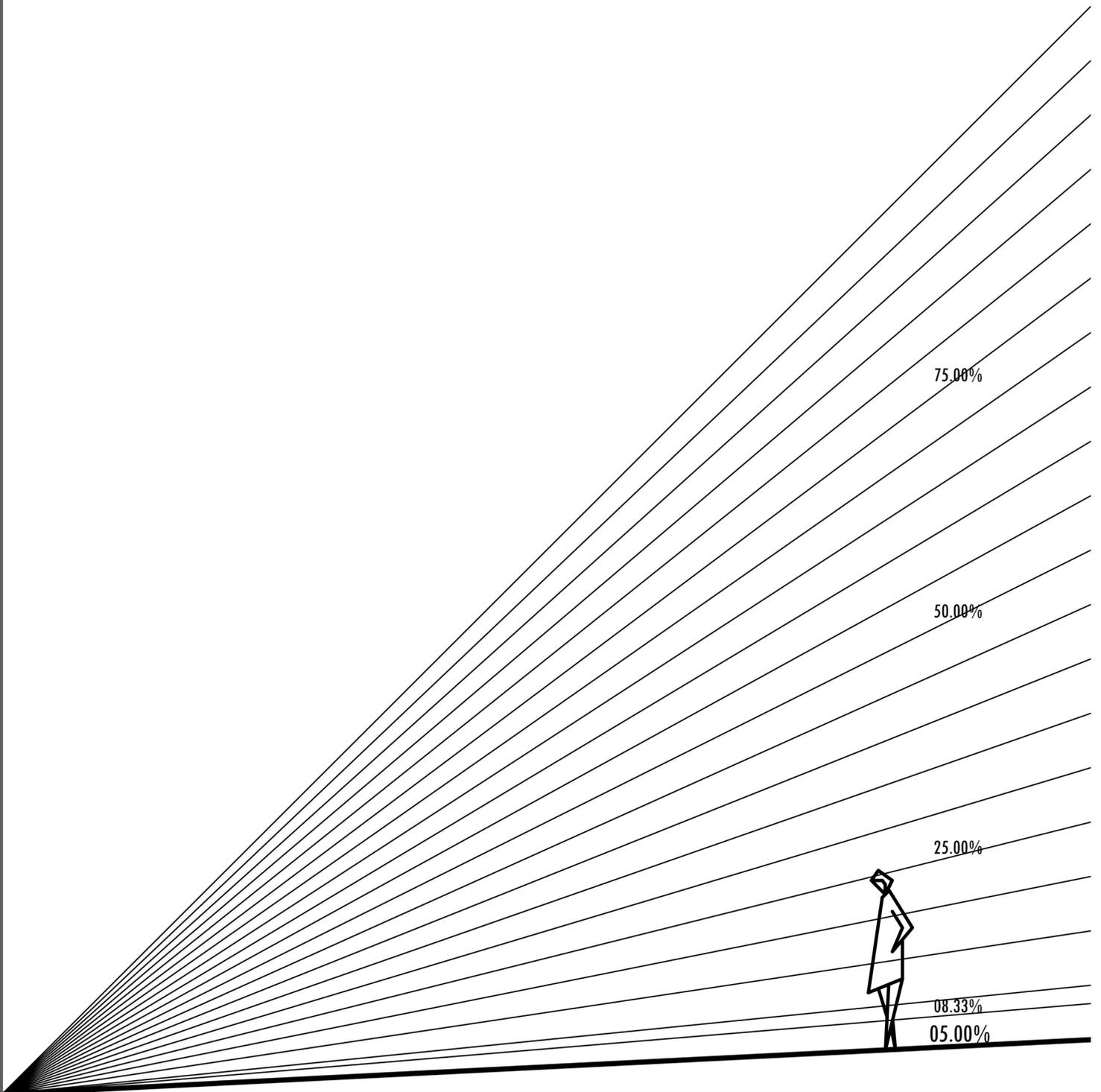


STATIC MACHINES, FRAGILE LOADS



**STATIC MACHINES, FRAGILE LOADS:
A NEW APPROACH TOWARD RETROFITTING SITES FOR
ACCESSIBILITY**

ANIRAN ASGARIFARD

Thesis submitted to the faculty of the
Virginia Polytechnic Institute and State University
In partial fulfillment of the requirements for the degree of

MASTER OF LANDSCAPE ARCHITECTURE
In Landscape Architecture
School of Architecture + Design

Laurel McSherry
Paul Kelsch
Nathan Heavers

12/03/2015
Alexandria, VA

Keywords: Lincoln Memorial, Washington D.C.; Inclined Planes, Ramp; Accessibility, Retrofit

**STATIC MACHINES, FRAGILE LOADS:
A NEW APPROACH TOWARD RETROFITTING SITES FOR
ACCESSIBILITY**

ANIRAN ASGARIFARD

ABSTRACT

Ramps are usually perceived as utilitarian objects emerging from standardized guidelines for architecture and landscape architecture. But closer examination reveals they can be quite beautiful and poetic. What we commonly call ramps, Galileo referred to as *inclined planes*, counting them as one of six classical simple machines in *Le Meccaniche (On Mechanics)*¹. Because inclined planes are actually static machines that do not require any energy to run. They do not discriminate among users. This thesis explores the work of the ramp in moving fragile loads, such as human beings.



1 Galilei, Galileo. *On Motion, and On Mechanics: Comprising De Motu (ca. 1590)*. Vol. 5. University of Wisconsin Press, 1960.

**STATIC MACHINES, FRAGILE LOADS:
A NEW APPROACH TOWARD RETROFITTING SITES FOR
ACCESSIBILITY**

ANIRAN ASGARIFARD

GENERAL AUDIENCE ABSTRACT

Passed by Congress in 1990, the Americans with Disabilities Act (ADA)¹ is a civil rights law that prohibits that discrimination against individuals with disabilities in all areas of public life, such as jobs, schools, transportation as well as public and private places open to the general public.

The ADA applies to buildings and landscapes; existing and future. This thesis explores the concept of public accessibility from both physical and experiential perspectives, and specifically, the role that ramps can play in retrofitting buildings and landscapes, both functionally and aesthetically. By exploring the untapped potential of ramps, it argues that these ‘static machines’ could not only aid individuals in ascending and descending changes in grade, but serve as devices that could enrich user experience. A design investigation focused on an iconic Washington, D.C. landmark provides the opportunity to explore the potentials of ‘the ramp’ in architectural and landscape architectural design.

¹Adopted from the <https://adata.org/learn-about-ada>

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my advisor, Laurel McSherry, for her continuous support during my thesis, for her motivation, great direction, and immense knowledge she provided.

Besides my advisor, I would like to thank my thesis committee, Paul Kelsch and Nathan Heavers for their encouragement, insightful comments, and guidance.

My sincere thanks also go to my family, parents, and friends who supported me during my study of landscape architecture. I could not have come as far as I have without their support.

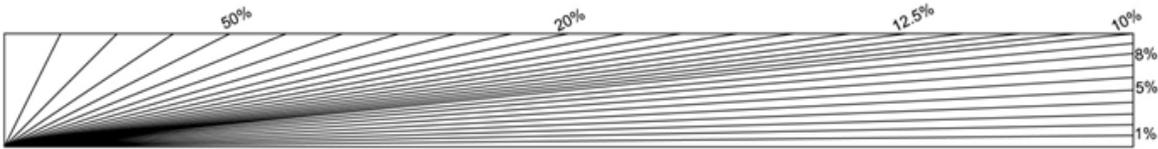
CONTENTS

List of figures	v
1. Introduction	1
2. Literature Review	2
2.1. Negotiation between Levels of Land	2
2.2. Circulation as the Main Concept of Design	2
2.3. Inclined Planes	3
2.4. Ramp/Inclined Plane Definition	4
2.5. Ramp versus Inclined Plane	4
2.6. Inclined Planes Slope	5
2.7. Landings	5
3. Case Studies	6
3.1. Guggenheim Museum	6
3.2. Denmark Pavilion, Shanghai Expo 2010	7
3.3. Dee and Charles Wyly Theatre	8
3.4. Southbank Royal Festival Hall Landscape Promenade	9
3.5. Olympic Sculpture Park	10
3.6. Lessons from the Case Studies	10
4. Applied Research	11
4.1. Retrofitted Projects	11
4.2. The Supreme Court Building Accessibility	11
4.3 National Gallery of Art East Building Accessibility	12
4.4 Design Objectives	13
4.5. Site Criteria	13
4.6. Commemorative Landscape to Mark the Nation's Values	13
4.6.1. Historical Analysis of the Site	14
4.6.2. Analysis of the Topographic Conditions	15
4.6.3. Analysis of the Traffic Circulation	17
4.7. Design Objectives	18
4.7.1. Preliminary Design Ideas	19
4.7.2. Proposed Alternatives	21
4.8. Final Design Proposal	22
4.8.1. Proposal Plan	23
4.8.2 The Monumental and Accessible Entrance	24
4.8.3. Inclined Planes for Moving and Dwelling	26
4.8.4. Design Analysis	27
5. Conclusion	28
Reference	29

LIST OF FIGURES

Figure 1 – Michelangelo’s staircase at the vestibule of the Laurentian Library	2
Figure 2 – Guggenheim Museum Ramp System	2
Figure 3 – Six Classical Simple Machines	3
Figure 4 – Solomon R Guggenheim museum in Manhattan	6
Figure 5 – Denmark Pavilion, Shanghai Expo, 2010 Ridding Ramps	7
Figure 6 – Zigzag entry ramp system to the Dee and Charles Wyly Theatre, Dallas, Texas	8
Figure 7 – The entrance to the Dee and Charles Wyly Theatre showing the ramp system	8
Figure 8 – Royal Festival Hall Southbank, London, United Kingdom	9
Figure 9 – U.S. Supreme Court Building Entrance	11
Figure 10 – U.S. Supreme Court Building Ramp	11
Figure 11 – U.S Supreme Court in plan view, comparing the main entrance and the accessible entrance ...	12
Figure 12 – National Gallery of Art East wing, Washington, DC entrance	12
Figure 13 – Analysis of the National Mall’s Entrances accessibility	14
Figure 14 – McMillan Plan of the Washington DC, 1901	15
Figure 15 – - Plan View of the West Potomac Park and the Constitution Gardens from the Lincoln Memorial to the Washington Monument	16
Figure 16 – Section A, B and C Representing the Topographical Change in the Site	16
Figure 17 – Existing topographic condition of the western side of The Lincoln Memorial	17
Figure 18 – Pedestrian Circulation	17
Figure 19 – Vehicular Circulation	17
Figure 20 – The Lincoln Memorial front stairs	18
Figure 21 – The Lincoln Memorial front stairs	18
Figure 22 – The Lincoln Memorial front stairs	19
Figure 23 – Four different proposed design alternatives	20
Figure 24 – Design alternative 1	21
Figure 25 – Design alternative 2	21
Figure 26 – Design alternative 3	21
Figure 27 – Design alternative 4	21
Figure 28 – Conceptual drawing of the ramp system	22
Figure 29 – Proposal plan	23
Figure 30 – Aerial photo of The National Mall including the proposed design	23
Figure 31 – The western side elevation	24
Figure 32 – Proposed design ramps, stairs and landings	24
Figure 33 – Section displaying the proposed design	24
Figure 34 – Section-perspective view of the west elevation of the memorial	25
Figure 35 – Proposed topographic design	25
Figure 36 – Perspective illustrating the sloped planes	26
Figure 37 – Aerial photograph looking east down The National Mall	27
Figure 38 – Aerial Photograph of The Lincoln Memorial illustrating alternative western entrance	28

1. Introduction



Everything is like the rivers: the work of the slopes.

-From Voices by Antonio Porchia²

This investigation explores the work of the ramp as one of the essential and critical performers in architecture and landscape architecture. Ramps are democratic elements in design, which can be enjoyed by every user regardless of physical condition. Considering the importance of ramps as non-discriminating machines that aid people in moving up and down, careful attention toward the design of ramps in landscape architecture is essential. In recent years, accessibility regulations have required that designers incorporate ramps into their site designs. But, in many cases, these ramps are simply just elements that are forced into projects. Usually, people prefer using elevators instead of ramps.

The main reason that ramps are unpleasant for users is that they are treated as utilitarian objects in design guidelines. Accessibility by ramps was not a concern until recent years. Even in contemporary design projects, often the most important thing for the design team is to follow the physical guidelines in providing ramps for accessibility. Other design

factors such as aesthetics and the experience for the user are of lesser importance. This problem becomes more apparent in built works that need to be retrofitted to fulfill the accessibility requirements.

This thesis explores how to retrofit existing designs with ramps that are both useful and experiential. With the growing need to retrofit the built landscape for accessibility, what might be an alternative approach to the introduction of ramps to sites? And, considering that providing accessibility by ramps is an essential components of all new projects, how can designers use ramps as powerful design elements to make their projects more beautiful, experiential, and successful?

² Porchia, Antonio. "Voices, trans." *William S. Merwin, Chicago: Big Table(1969).*

2. Literature Review

2.1 Negotiation between Levels of Land

To make land livable, humans often need to modify topography; level it, layer it, or deal with the physical aspects of land and its functional potentials. Dealing with land, cutting, filling and leveling it in different scales, has been essential throughout human history. Shaping the land in different levels raises the fundamental question of how to make connections between these levels.

Without a proper negotiation between floors, going from one elevation to another is difficult if not impossible. Stairs, ramps and elevators are elements that make the stacking of levels on top of each other possible. These built elements make the circulation between vertical spaces achievable.

2.2 Circulation as the Main Concept of Design

The use of the circulation as a principle design concept can be seen in many successful projects. As Christian Schittich mentions “Circulation areas often serve as the calling card of the building” (Christian Schittich, 2013)³. These

Schittich, Christian. “The concept of circulation.” *Designing circulation areas: Staged paths and innovative floorplan concepts* (2013): 9.



Figure 1 - Michelangelo's staircase in the vestibule of the Laurentian Library

https://commons.wikimedia.org/wiki/File:Biblioteca_laurenziana,_vestibolo,_scalinata_02.JPG

This file is licensed under the [Creative Commons Attribution-Share Alike 3.0 Unported license](#).

Author: [sailko](#)



Figure 2 - Guggenheim Museum Ramp System

https://commons.wikimedia.org/wiki/File:Guggenheim_flw_show.jpg

This file is licensed under the [Creative Commons Attribution-Share Alike 3.0 Unported license](#).

Author: [Wallygva \(talk\)](#)

circulation areas between levels are not necessarily the shortest and fastest route between the two destination points. Rather, the quality of the movement is also an important factor in designing circulation systems.

In architectural history, stairs have long been showpieces that move beyond the purely functional. Staircases can be sculptural features that shape the whole concept of a design. Michelangelo's staircase at the vestibule of the Laurentian Library in Florence, Italy is an example of a monumental approach toward reconciling changes in grade (Figure 1). On the other hand, what designers often consider when designing ramps are functionality and practicality rather than aesthetics. In many cases, using ramps as a main circulation pattern of project is both functional and aesthetic. The experience of the Guggenheim Museum in New York City is an example of how a ramp can serve as a central and organizing element of a design (Figure 2).

2.3 Inclined Planes

What people commonly call ramps, Galileo referred to as an inclined planes; and considered them as one of six classical simple machines in *Le Meccaniche*

(*On Mechanics*)⁴. These simple machines are levers, wheels and axles, pulleys, wedges, screws and inclined planes. A simple machine is a mechanical device that changes the direction or magnitude of a force to make work easier.

Historically, inclined planes had been used for moving heavy loads to higher grounds. It is said that the Egyptian pyramids were built using inclined planes. The ramp built by Romans in 72 AD to invade Masada, Israel is another example of the use of inclined planes. Moving forward in time, we find different ways that people have used inclined planes to ease movement. Loading ramps on trucks,

4 Galilei, Galileo. *On Motion, and On Mechanics: Comprising De Motu* (ca. 1590). Vol. 5. University of Wisconsin Press, 1960.

ships on planes, together with wheelchair ramps, evacuation slides, roads and railroads, pedestrian paths and sidewalks, playground slides, water slides, ski slopes and skateboard parks are all examples of inclined planes introduced to ease daily life.

Inclined planes are actually static machines that, contrary to other simple machines, do not require any energy to run. Given this, inclined planes do not discriminate among users. In other words, it does not matter whether a user is young, in a wheelchair, or pushing a stroller. Ramps welcome all users.

But what is the difference between ramps and inclined planes? Do these two terms represent the same concept, or is there a difference between the two? When should we use the term ramp

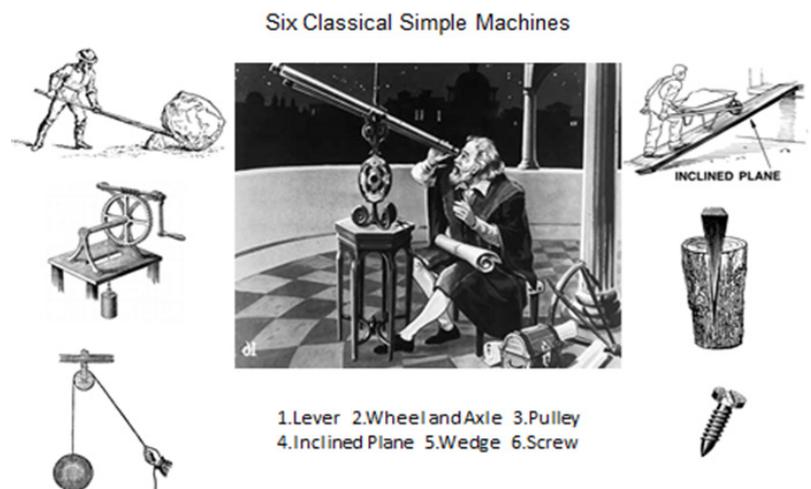


Figure 3 – Six Classical Simple Machines. This illustration shows the six simple machines that Galileo mentioned in his book *Le Meccaniche*, as being the simplest mechanical devices to change the direction of the force.

and when should use the term inclined plane? To clarify, it might helpful to look at the definition of each.

2.4 Ramps/Inclined Planes Defined

-Merriam Webster Dictionary⁵

Ramp: a sloping way or plane; a sloping floor, walk, or roadway leading from one level to another; a slope for launching boats.

Inclined plane: a plane surface that makes an oblique angle with the plane of the horizon.

-Oxford Dictionary⁶

Ramp: a slope or inclined plane for joining two different levels, as at the entrance or between floors of a building.

Inclined plane: a plane inclined at an angle to the horizontal.

Based on the definitions above and the general use of the two terms in daily life, we might say that inclined planes are a category, and ramps are actually a type of inclined

5 <http://www.merriam-webster.com/dictionary/ramp>

6 http://www.oxforddictionaries.com/us/definition/american_english/ramp?searchDictCode=all

plane. The use of the term ramp is more commonly used in architecture and landscape architecture than inclined plane. Yet, there is a subtle though important difference between the two when it comes to design.

2.5 Ramps Versus Inclined Planes

In design, a ramp is known more as a machine emerging from standardized guidelines, and following specific regulations, such as minimum width, and maximum slope and rise. But studying this machine is not the intent of my research. On the other hand, the term inclined plane is free from the standard guidelines. An inclined plane is actually a tilted surface along which people are able to move. This study seeks to explore planes that are designed as central, organizing features of projects. In other words, tilted planes that enable connections between two levels both practically and elegantly.

In landscape architecture, the surface of land is referred to as relief or topography. Topography, as David Leatherbarrow mentions in his article “Is Landscape Architecture?” (Leatherbarrow, D 2011), is a common design element across the fields of landscape architecture, architecture, and urban design. In landscape

architecture specifically, topography equates with the land and is the most permanent form-builder in any project. Each form that comes into existence in design is actually a collection of different planes that come together to create a three-dimensional object. An inclined plane can be one of these form-giving planes.

In contrast to a ramp, which is a device that is used to make movement possible, an inclined plane is really part of a site’s topography. As a permanent and foundational part of a design, these planes require careful attention for both function and beauty. In my view, compared to a ramp that is added to a building or site, an inclined plane is actually an inseparable component of topography; removing it would have a major impact on the design concept.

7 Leatherbarrow, David. “Is Landscape Architecture?”. *Arg* 15.03 (2011): 208-215. Web.

2.6 Inclined Planes and Slope

As we can see from the previous definitions, an inclined plane is a tilted device connecting different elevations of land. Any inclined plane consists of two determining factors: the rise (vertical dimension), and the run (the horizontal dimension). Slope is the term used to relate these two factors. In designing ramps for accessibility, slope is a decisive factor dictating and limiting use.

Based on American Disabilities Act (ADA) Ramp Codes⁸ the minimum possible slope for ramps is generally recommended, while the maximum should not exceed 1:12 (8.33 %). The maximum vertical change of a ramp between landings should not exceed 30 inches.⁹

In order to maintain slopes suitable for the movement of people, inclined planes are designed with longer distances and reduced heights. The greater the distance between two given elevations, the longer and slower the journey between them. On the other hand, on ramps, users often pay

less attention to the rise and fall of their movement, in contrast to when they use stairs. As a result, when people travel on ramps, they tend to be more aware of the surrounding environment then when going up or going down stairs.

2.7 Landings

The placement and dimension of landings are also key components in the design of ramps. The reason for this is because of the role they play as both a destination and a place to temporarily dwell. Landings are moments of pause within intervals of movement. When designing inclined planes, landings could be used as deliberate places to slow down movement. Slowing down the movement of a user increases their opportunities to observe and appreciate their surrounding environment.

⁸ Signed into law on July 26, 1990 by President George H.W. Bush.

⁹ Adopted from the ADA standards for accessible design, section 4.

3. Case Studies

In an effort to learn more of the characteristics of inclined planes, I studied a series of architectural and landscape architectural projects where inclined planes acted as a central and organizing feature within a design concept. These case studies illuminated some of the ways that a ramp could contribute more to a site than providing a means to negotiate a change in grade; that a ramp might also be a device to disclose and reveal context. These case studies, wherein the act of ascending or descending was exaggerated include:

1. Guggenheim Museum by Frank Lloyd Wright
2. Denmark Pavilion, Shanghai Expo 2010 by BIG in Shanghai, China
3. Dee and Charles Wyly Theatre by Rem Koolhaas
4. Southbank Royal Festival Hall Landscape Promenade by Rick Mather Architects
5. Olympic Sculpture Park by Weiss/Manfredi Architects, and Charles Anderson Landscape Architecture

The first two case studies

are architectural projects, while the remaining three are landscape architecture. However in all five of the cases, removal of the inclined planes would change and diminish the entire concept of the design.

3.1 Guggenheim Museum

New York City, New York, USA

This art museum designed by architect Frank Lloyd Wright opened in the fall of 1959. The design of the Guggenheim Museum was distinctly different from other galleries and museums—in particular, with its eye towards the presentation of the works of art. The design

entails bringing visitors to the top of a spiral ramp, which is covered by an expansive domed ceiling. From this point, visitors are invited to gradually descend a system of concrete ramps that spiral down through the center of the building. Experiencing the works of art means traveling down a continuous inclined plane and pausing at will.

Along these ramps, which were designed with a three percent slope, visitors are able to move at a leisurely pace. Within the design, the act of ascending or descending along a continuous tilted floor is the central experience of the space.



Figure 4- Solomon R Guggenheim Museum in Manhattan, showing the spiral ramp forming the outer edge of the building.

<https://commons.wikimedia.org/wiki/File:Solomon-R-Guggenheim-Museum-Levels.jpg>

Released to the Public Domain

Author: [Evan-Amos](#)

If one were to imagine this design as a series of stairs rather than a ramping floor, the underlying concept of the gradual revelation of art would be lost. One's mind would be occupied with the rise and fall of stairs, rather than the power and beauty of the works surrounding them.

3.2 Denmark Pavilion, Shanghai Expo 2010

Shanghai, China

The Denmark Pavilion at the 2010 Shanghai Expo designed by BIG with ARUP and 2+1 is interesting from an architectural and structural standpoint. The main goal of this design was to represent the cultural values of a nation. Recognizing 'bicycle culture' as a distinctive dimension in Danish life, the designers structured the building with a series of looping ramps on which visitors could ride bicycles

which were provided at the pavilion's entrance. Although stairs are also incorporated into the design, the quality of the experience on the ramps is paramount, enabling one's full awareness of their surroundings as they move along at variable speed.



Figure 5- Denmark Pavilion, Shanghai Expo, 2010 Riding Ramps
https://commons.wikimedia.org/wiki/File:Denmark_Pavilion_of_Expo_2010.jpg

This file is licensed under the [Creative Commons Attribution-Share Alike 2.0 Generic](https://creativecommons.org/licenses/by-sa/2.0/) license.

Author: [foxmachia](https://commons.wikimedia.org/wiki/user:foxmachia)

3.3 Dee and Charles Wyly Theatre

Dallas, Texas, USA

The Dee and Charles Wyly Theatre in Dallas, Texas by Rem Koolhaas was opened in 2009. The entrance of the building is below street grade. Because of the unique design of the theatre, the front of the house and back of the house are stacked; below house and above house. This unusual arrangement makes the entrance lower than the street level, and resulted in a significant elevation change between the entrance and surrounding sidewalks. In order to make the entrance accessible, the designer used inclined planes in an attractive and engaging manner, making a zigzag ramp the focal point of the entrance plaza. Although the distances the ramps travel are exaggerated compared to the stairs provided on either side, movement along them tends to be slower. Together with a series of integral planting boxes, this ramp makes the journey to the building entrance both more gradual and ceremonial.



Figure 6- Zigzag entry ramp system to the Dee and Charles Wyly Theatre, Dallas, Texas.
Original Photo by the Author



Figure 7- The entrance to the Dee and Charles Wyly Theatre showing the ramp system

https://commons.wikimedia.org/wiki/File:Wyly_slope.jpg

Released to the Public Domain

Author: Bottomless

3.4 Southbank Royal Festival Hall Landscape

Promenade:

London, United
Kingdom

This promenade was designed by Rick Mather Architects as part of the development of the landscape between London's Royal Festival Hall and the Thames River. The purpose of the project was to improve the access to a prominent cultural building and improve the setting of the river bank. A restaurant and a café, each

at different levels, were connected to a promenade along the river's edge with a series of ramps and stairs. This project exemplifies the artful combination of steps and ramps into what is known as stairramps. No preference is given in the design to the use of stairs over ramps. Both are part of a single sculptural form.



Figure 8- Royal Festival Hall Southbank, London, United Kingdom. This illustration shows the stairramp connecting the lower level to the river's edge.

3.5 Olympic Sculpture Park

Seattle, Washington, USA

An urban project that benefits from using inclined planes is the Olympic Sculpture Park in Seattle, Washington. The site for this sculpture garden, which included an industrial train track and an arterial road, contained a significant forty-foot grade change that the designers, Weiss/Manfredi Architects, with Charles Anderson Landscape Architecture, needed to negotiate.

The design that resulted addressed these issues with a sloping Z-shaped green platform connecting a pavilion on the higher elevation to the waterfront. This inclined platform makes the journey from the museum building to the waterfront edge longer. The designers used these longer paths as an opportunity to design an outdoor sculpture garden and create new experiences. Presenting the work of art along the tilted green paths demonstrates the fact that on a ramp a visitor is more aware of their surrounding environment, while descending or ascending.

3. Lessons from the Case Studies

Reflecting on the case studies and comparing them to projects with similar programs but without ramps, resulted in a series of realizations. Thoughtful uses of inclined planes in projects bring the opportunity of having ramps not only as a device for negotiating between changes in grade, but also transforms inclined planes from utilitarian to potentially aesthetic objects.

The successful projects demonstrate how designers use inclined planes to blur the boundaries between moving and dwelling.

If we consider elevators, stairs, and inclined planes as devices that make connection between different elevations of land, we can classify them based on two factors:

- speed of movement
- degree of awareness of the surrounding environment

Elevators are features with the highest speed but the least in terms of environmental awareness. Compared to elevators, stairs provide greater opportunities to observe one's environment, but the rise and fall on stairs draws a great amount of attention to the process of ascending or descending on foot. The speed of movement on stairs is also based on a

user's physical ability.

Inclined planes, in contrast, are devices wherein users travel the slowest, yet with the greatest opportunity for environmental sensation. On a tilted plane, the least amount of attention is drawn to the walking surface. A user can enjoy the surrounding environment in great detail. This feature and the nondiscriminating quality of inclined planes make them a remarkable opportunity in landscape architecture.

Saying an inclined plane is non-discriminating refers to the physical characteristics of this machine. Compared to stairs, ramps are more democratic, because they can be used by a greater range of people. Often, however, the manner in which ramps are incorporated or retrofitted into designs does result in compelling experiences for users.

4. Applied Research

4.1 Retrofitted Projects

The Americans with Disabilities Act (ADA), passed by the Congress in 1990, emphasized the need to provide persons with physical disabilities equal access to existing and future buildings and landscapes. Historically, equal accessibility was not a mandatory design consideration in architectural and landscape architectural design. Long flights of entrance stairs are iconic in classical Western architecture. The legacy of the elevated entrances of Greek temples can still be seen in contemporary design.

The aesthetic dimension of accessibility becomes apparent in the context of retrofitting existing and historic structures and landscapes. The design question that emerges is: how can projects be retrofitted with ramps that would make them both accessible and experiential?

It is useful to examine two iconic and influential buildings in the Nation's Capital: one built in 1935 in the neoclassical style; the other, a newer modern addition to the National Gallery of Art.

4.2 The Supreme Court Building Accessibility

The United States Supreme Court, the highest federal court in the land, is the demonstration of the equal justice under law. However, the ceremonial entrance to this building on Capitol Hill does not demonstrate equality in terms of accessibility. The picture below shows the monumental entrance to the building. (Figure 9)

While the main entrance is designed significantly and memorably, its accessibility ramps are provided on the side of the building with little attention to a user experience of the space.



Figure 9- U.S. Supreme Court Building Entrance
Original Photo by the Author



Figure 10- U.S. Supreme Court Building Ramp
Original Photo by the Author

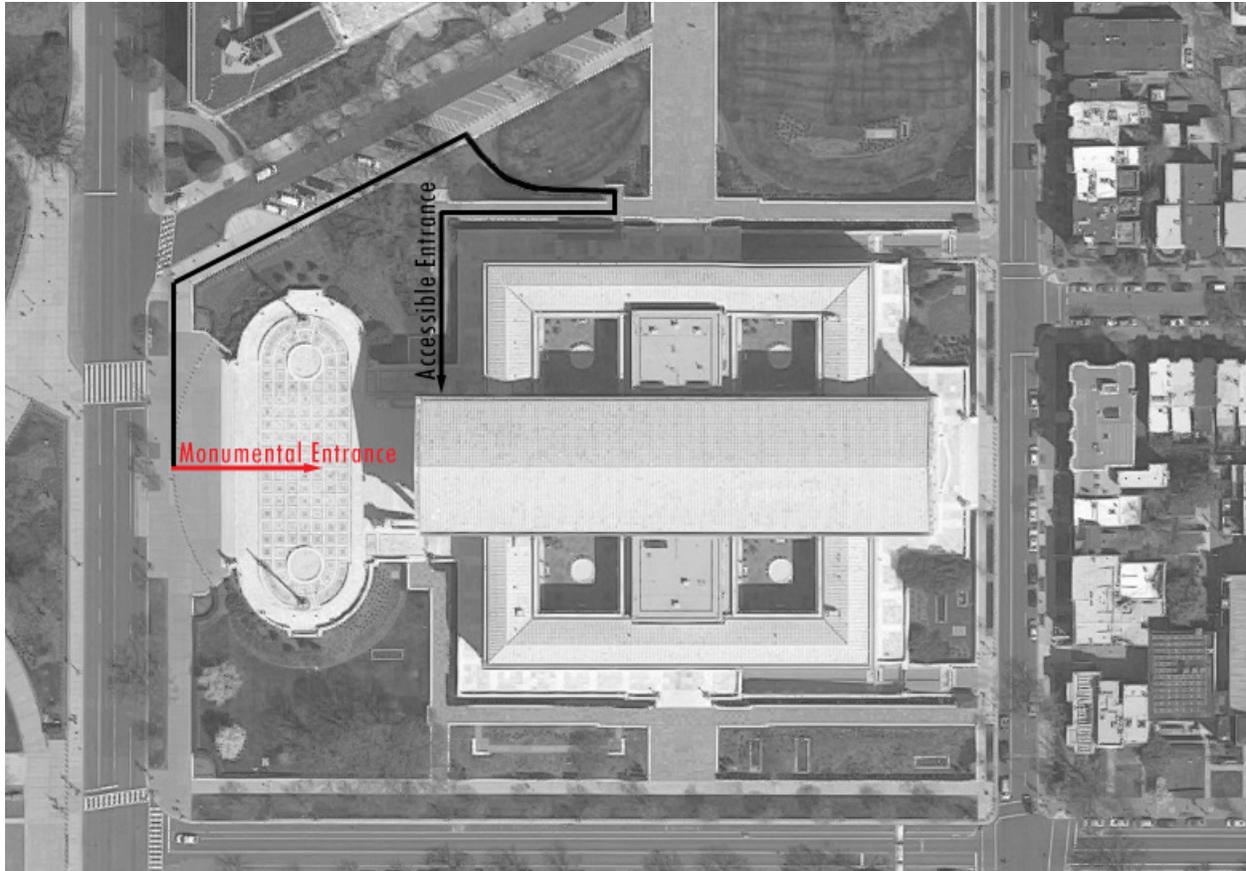


Figure 11- U.S Supreme Court in plan view, comparing the main entrance and the accessible entrance. The ramp to the building is not only on the side of the building but also it is not comparable to the main entrance in terms of spatial experience.

4.3 National Gallery of Art East Building Accessibility

This building consists of several art galleries that expands the collections located in neoclassical National Gallery of Art's West Wing. Although the building was completed in 1978, its recent retrofitted entrance shows the lack of attention towards the aesthetics of accessibility. (Figure 12)



Figure 12 – National Gallery of Art East Wing, Washington, DC entrance. This image shows the addition of a ramp to the entry staircase. Original Photo by the Author

4.4 Design Objectives

Considering the potentials of inclined planes as non-discriminating features in design, a new approach was explored to retrofit an existing design for accessibility. The goal was to provide equal physical and experiential opportunities for all users of the space.

Having studied the attributes of successful projects designed with inclined planes, a well-known site/project lacking a proper accessibility system was selected, and through the process of design, transformed into a place of both function and beauty. Specific design objectives were:

-Retrofit a project using tilted planes that are both aesthetic and follow the parameters and guidelines of accessibility.

-Create a new entrance that is equally compelling in terms of quality and spatial experience.

4.5 Site Criteria

Having analyzed the building of the U.S. Supreme Court as an iconic neoclassical building in terms of accessibility, I became further interested in choosing an iconic public building/site in Washington, DC, though one lacking proper accessibility. These conditions defined the site selection criteria:

-A monumental site which is visited by variety of people

-A significant elevation difference between its entrance and surrounding grounds

-A monumental stair system

-Lack of the proper accessibility with inclined planes

4.6 Commemorative Landscape to Mark the Nation's Values

The grand landscape between Capitol Hill and the Lincoln Memorial in Washington, DC is called the National Mall.

This continuous lawn consists of several monumental landscapes and buildings, which create a unique environment commemorating the fundamental milestones in the nation's formation. These features of the National Mall make it a compelling landscape to examine.

I began by looking at the National Mall as a reflection of the values and conflicts of the nation. The US Capitol, the Washington Monument, the White House, the Jefferson Memorial and the Lincoln Memorial are some of these reflective architectures, designed to celebrate the nation's commitment to freedom and equality. But a closer look at different sections of National Mall reveals that there are still a few sites that are not properly responding

to the fundamental need of accessibility.

To further investigate this issue, different sites within the National Mall were examined. Entrances to each of these sites were identified and studied in terms of accessibility (Figure 13). Within this figure, green lines indicate entrances which have a ramp system; orange lines indicating entrances that lack accessibility by ramp. One of the sites that is indicated with orange on the western end of the Mall is the memorial built to honor former president Abraham Lincoln, called the Lincoln Memorial.

The Lincoln Memorial is the most visited site within the National Mall¹⁰. This memorial, which anchors the Mall's western edge at the Potomac River, has been the location of several historical events, including famous speeches and public demonstrations. Martin Luther King's "I Have a Dream" speech, took place on the entrance stairs of this classically designed Greek temple.¹¹

10 Adopted from the National Park Service website : <https://www.nps.gov/linc/planyourvisit/index.htm>

11 Thomas, Christopher A. *The Lincoln Memorial & American Life*. Princeton, N.J.: Princeton University Press, 2002. Print.

4.6.1 Historical Analysis of the Site

The street layout for Washington D.C. was drawn by Pierre L'Enfant in 1791. This French-American architect and civil engineer laid out the city plan as a grid with intersecting diagonal avenues, influenced by other iconic designs, such as the Palace of Versailles. L'Enfant envisioned these intersections as potential sites for statues and memorials. The site for the House of Congress, later known as the Capitol and the location of The White House were specified as part of the L'Enfant Plan.

The McMillan Plan in 1901, adapted from L'Enfant's

earlier design, laid out the basis of the current National Mall. Although this plan was never fully realized, the idea of extending an open vista west from the Washington Monument, and reclaiming land from the Potomac River was proposed as a part of it. This western leg of the Mall serves as the location of some today's most iconic memorials, including the Lincoln Memorial, the Jefferson Memorial, the Vietnam Veteran's Memorial, and the Martin Luther King, Jr. Memorial.

The Lincoln Memorial, designed by the New York architect Henry Bacon, was located on axis with

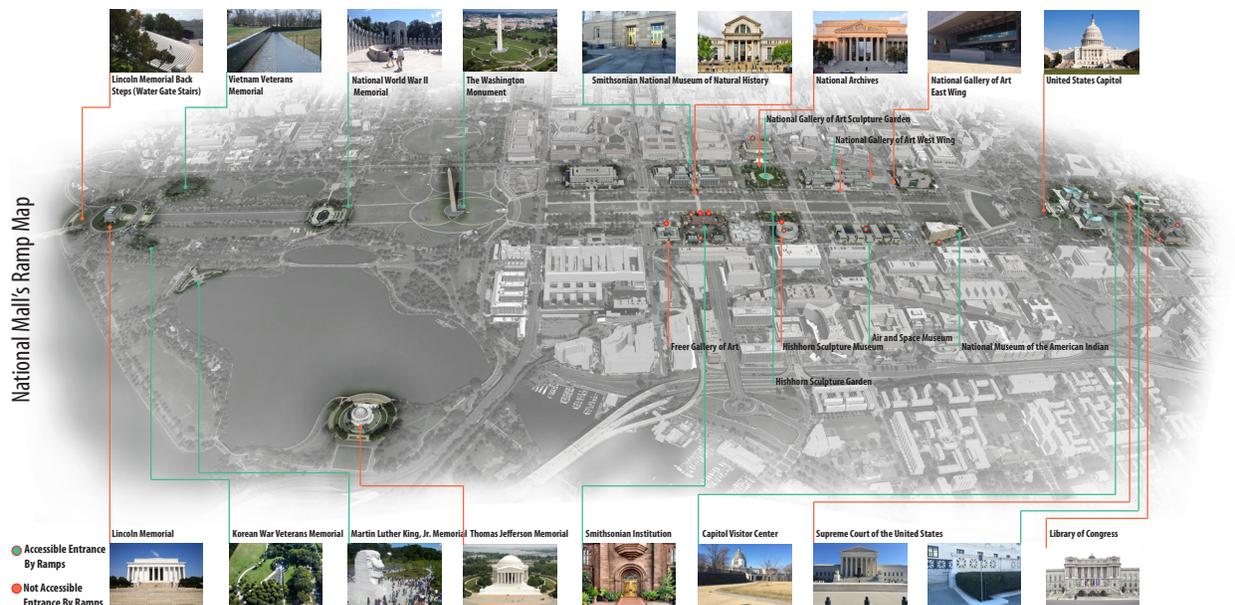


Figure 13 - Analysis of the National Mall's Entrances accessibility

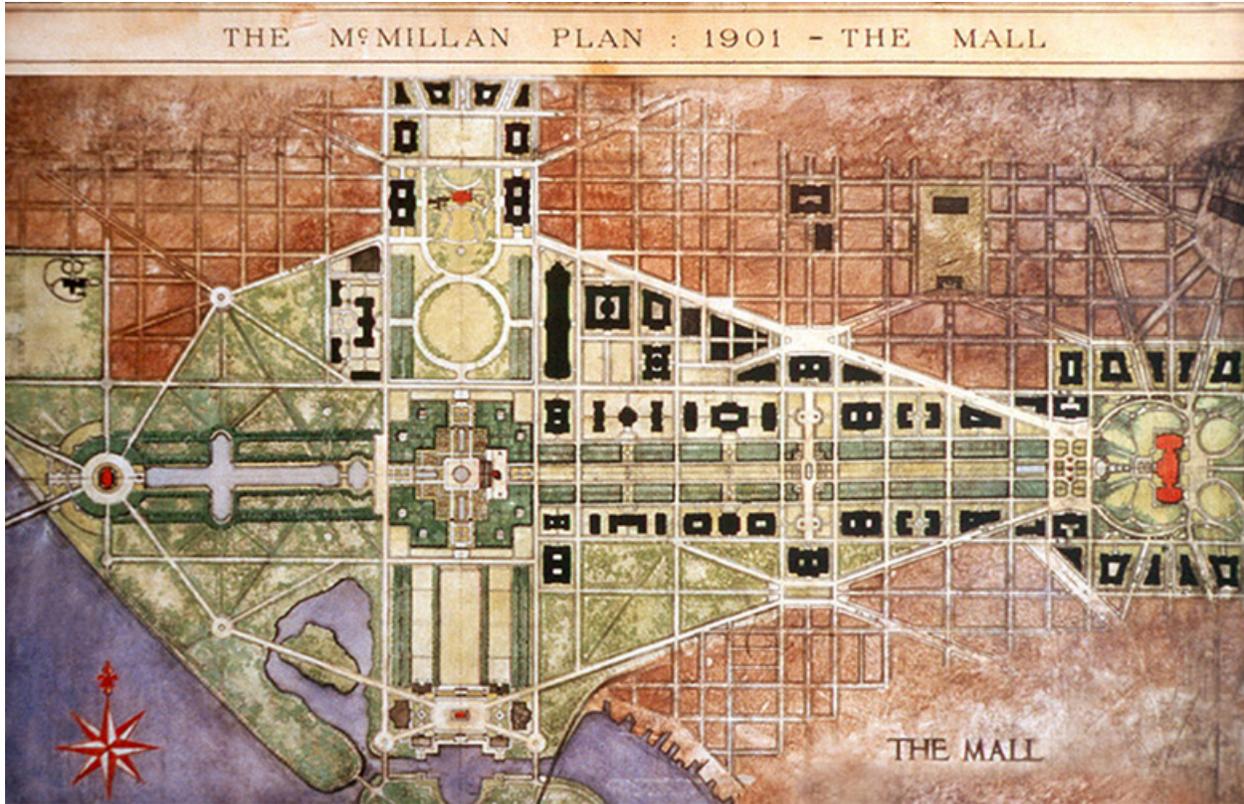


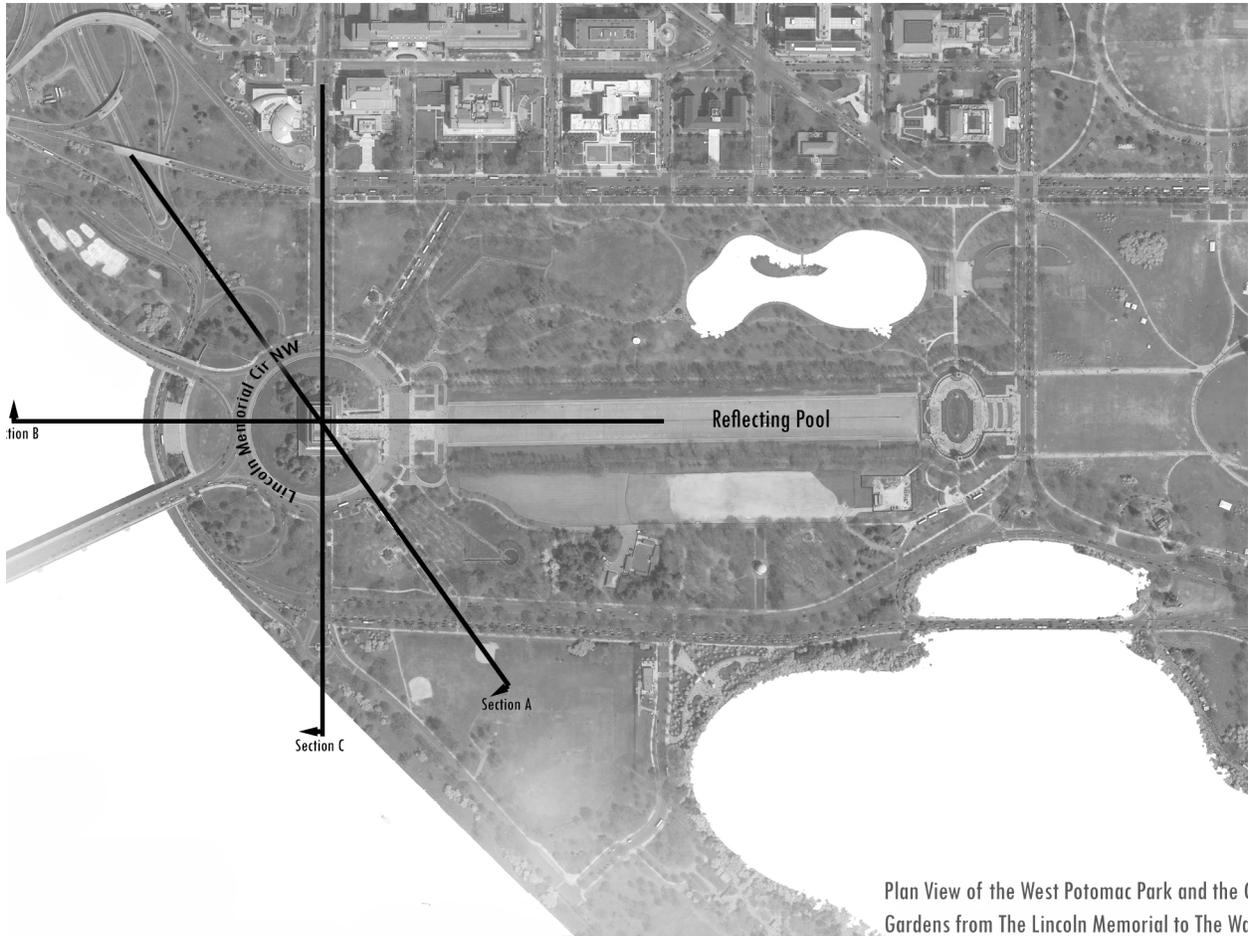
Figure 14- McMillan Plan of the Washington DC, 1901
Public Domain

the Washington Monument and the Capitol. Completed in 1922, the concept of the memorial's design borrows from the ancient Greek architecture; a white marble temple surrounded by 36 Doric columns. From a distance the memorial appears as a temple on a hillside, despite the fact that the ground upon which it sits is actually landfill and it is supported by a network of structural concrete columns hidden beneath the soil.

4.6.2 Analysis of the Topographic Conditions

The grounds of the Lincoln Memorial are lands reclaimed

from the Potomac River. Given this, and though culturally rich, the site lacks archeological significance. Figure 16 illustrates the existing differences in grade from the top of the memorial to its surrounding streets and sidewalks. Section B reveals the memorial's subterranean colonnade structure. Presently, there exists an 18 foot drop from the top of the retaining wall surrounding the memorial to the sidewalk level at the Lincoln Circle (to the west). This grade change is accessible with a set of 40 monumental steps on the eastern side of the memorial, facing the Reflecting Pool and the Washington Monument.



Plan View of the West Potomac Park and the Constitution Gardens from The Lincoln Memorial to The Washington Monument

Figure 15 - Plan View of the West Potomac Park and the Constitution Gardens from the Lincoln Memorial to the Washington Monument. Section Lines Represented on the Plan.

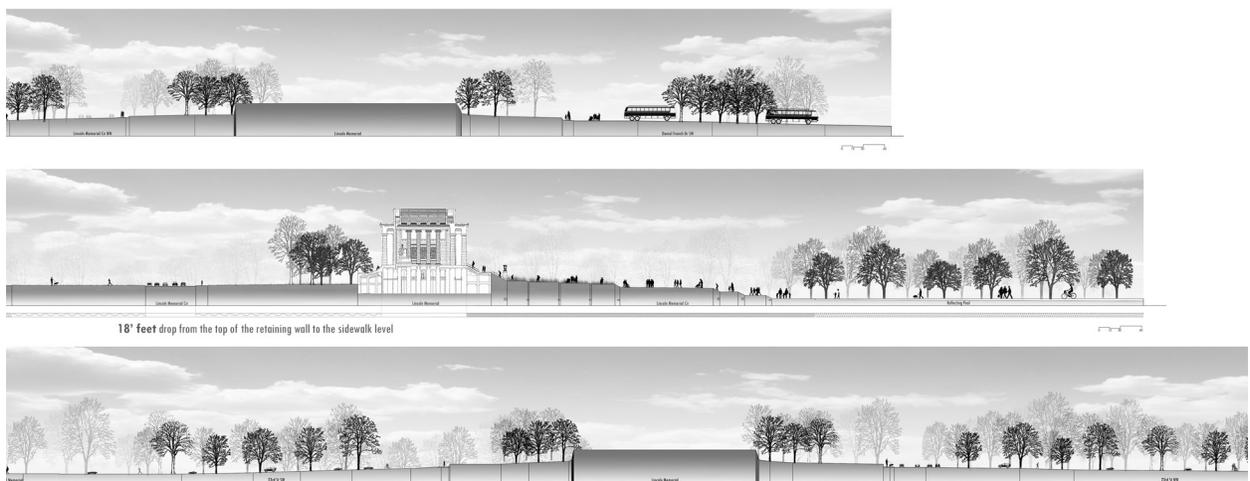


Figure 16- Section A, B and C Representing the Topographical Change in the Site.

4.6.3 Analysis of the Traffic Circulation

Vehicular and pedestrian circulation patterns surrounding the Lincoln Memorial site were studied. The site of the Lincoln Memorial experiences heavy foot traffic, given its location at the terminus of the National Mall. Figures 18 & 19 depict foot and vehicular flows in the vicinity of the Lincoln Memorial in the spirit of Louis Kahn's "Traffic Study" diagrams in his Philadelphia Planning Study.¹²

The unique situation of the site within the city grid makes for a complicated vehicular circulation pattern. In particular, the Lincoln Memorial circle is the meeting point of six different streets: Arlington Memorial Bridge, Rock Creek and Potomac Parkway NW, 23rd Street NW and SW, Henry Bacon Drive NW and Daniel French Drive SW. The Arlington Memorial Bridge carries the heaviest traffic volume coming from the Virginia side of the river to the capital.

¹² The Museum of Modern Art collection, Department of Architecture and Design. Louis I. Kahn Traffic Study, Philadelphia, Pennsylvania, Plan of proposed traffic-movement pattern, 1952. <http://www.moma.org/collection/works/488?locale=en>



Figure 17 - Existing topographic condition of the western side of The Lincoln Memorial

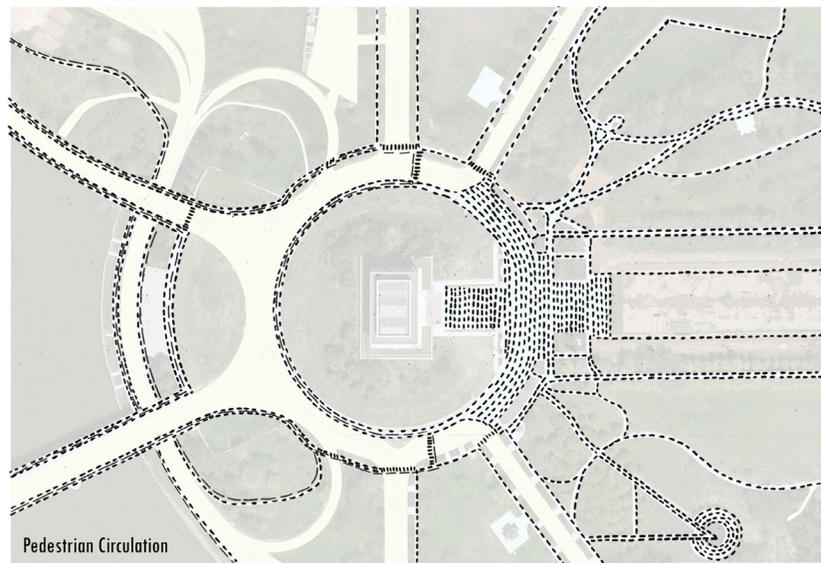


Figure 18 – Pedestrian Circulation. The drawing shows the walking paths around the site.

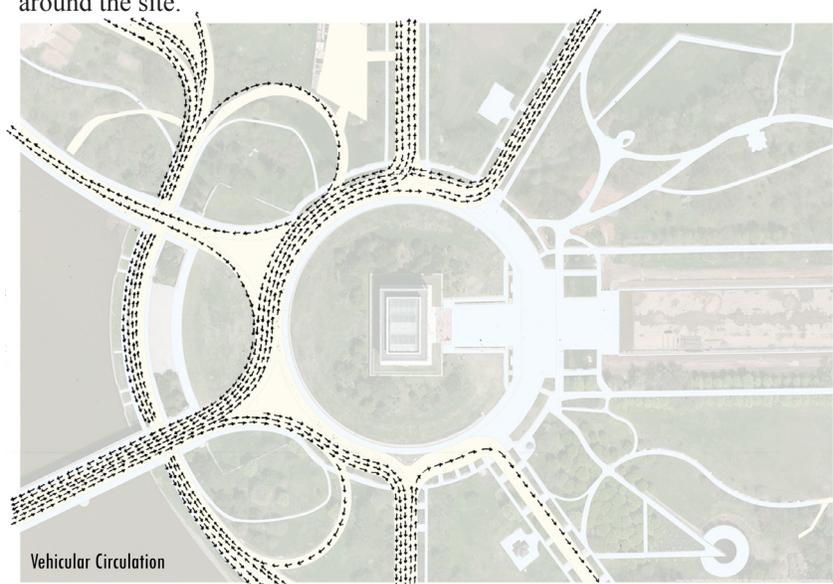


Figure 19 – Vehicular Circulation. The drawing shows the Lincoln Circle and the traffic directions surrounding the site.

4.7 Design Objectives:

More than seven million people visited the Lincoln Memorial in 2015¹³. These visitors ranged in their physical mobility. The stairs leading to the memorial's east, or mall-facing, entrance were designed with a sculptural character, and have served for important national events. However, this long ascent of stairs leading to the colonnade section of the memorial cannot be experienced by everyone. Persons unable to mount steps are required to use the elevators at the base of the monument, which negotiates a height of 18 vertical feet to deliver them to the memorial's main, interior public space.



Figure 20 – The eastern façade and entrance to the Lincoln Memorial. This photograph shows the stroller left at the base of the stairs due to the inaccessibility. Original Photo by the Author



Figure 21 – The Lincoln Memorial's east-facing entrance and stairs. This photograph shows the stroller left at the base of the stairs due to the inaccessibility

13 Number of recreational visitors to The Lincoln Memorial. <http://www.statista.com/statistics/254029/number-of-visitors-to-the-lincoln-memorial/>



Figure 22 – The Lincoln Memorial east-facing entrance and stairs. This photograph shows the stroller left at the base of the stairs due to the inaccessibility. Original Photo by the Author

After careful analysis of the memorial site and accessibility constraints, a design objective emerged:

1. explore options for accessibility using inclined planes
2. connect the upper level of the memorial (the colonnade) with the ground
3. provide an alternative entrance with a different, though comparable ceremonial experience
4. improve connections between the memorial and the Potomac River waterfront
5. respect the spirit and grandeur of the National Mall

4.7.1 Preliminary Design Ideas

The western façade of the memorial, which faces the Potomac River, has both the area and potential to accommodate an alternative entrance and experience. The drawings that follow explore strategies for negotiating between the memorial structure and street grade on the western side using inclined planes.

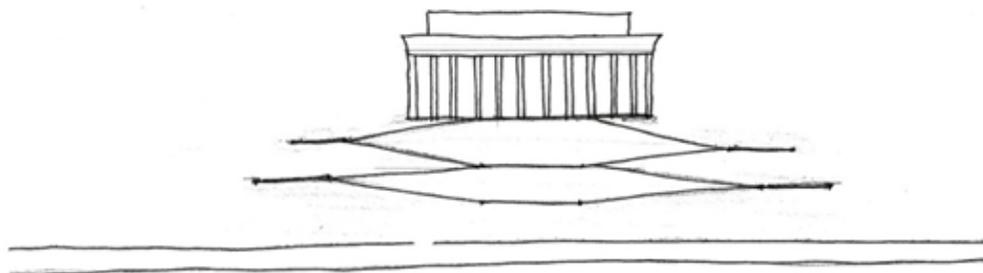
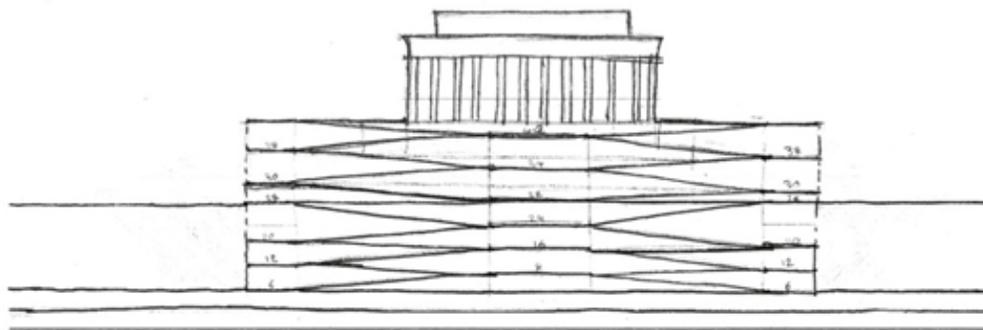
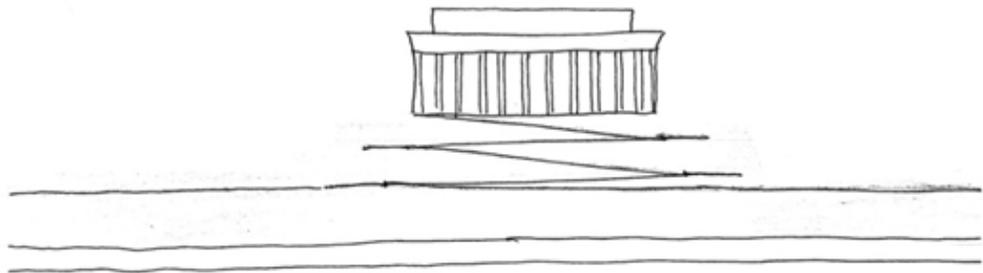
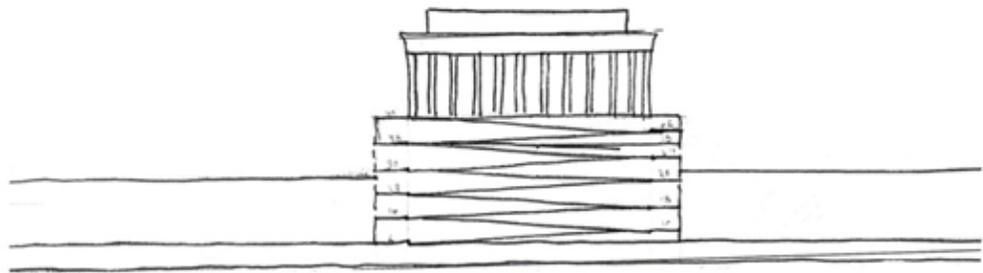


Figure 23 – Design alternative/strategies. This illustration compares four strategies for negotiating between the memorial structure and street grades using inclined planes. The first two strategies explore a single, zigzag system, while the latter two using dual and symmetric zigzag systems.

4.7.2 Proposed Alternatives

The plans to the right depict exploration of different design strategies for an alternative and accessible entrance on the western façade of the Lincoln Memorial. Among these options, the one framed in orange was further explore and developed based on experiential advantages and potential. This design borrows its form from the surrounding Lincoln Circle. Two connecting ramps provide visitors with access from the memorial’s eastern front to its western back, while two additional ramps enter the colonnade from the north and south edges of the eastern (front) entrance.

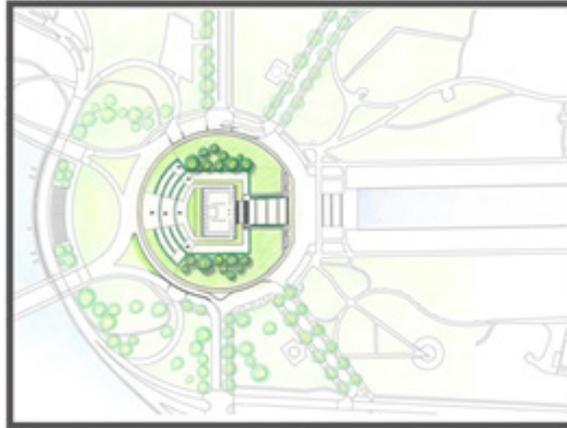


Figure 24 – Design alternative 1
Depicting the form from the memorial’s design, linear

Entering the colonnade from sides at the front

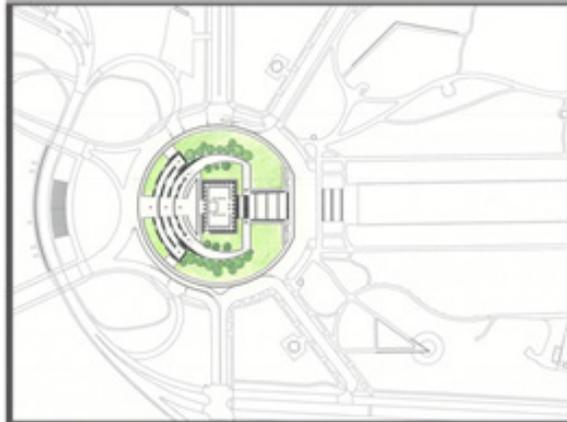


Figure 25 – Design alternative 2
Depicting the form from the Lincoln Circle, Curved

Entering the colonnade from the center at the back

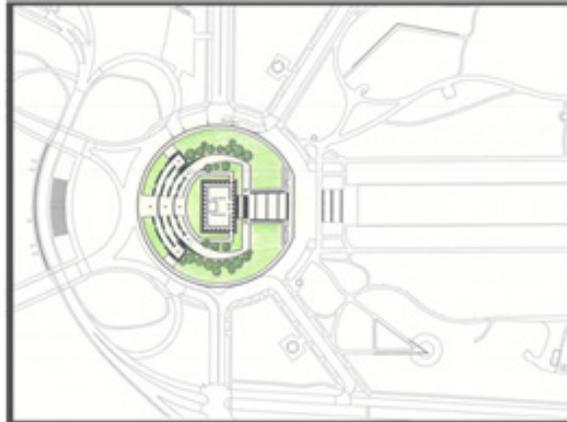


Figure 26 – Design alternative 3
Depicting the form from both the circle and the memorial, the lower ramp curved, the upper ramp straight

Entering the colonnade from the sides at the front



Figure 27 – Design alternative 4
Depicting the form from the circle, curved

Entering the colonnade from the sides at the front

4.8 Final Design Proposal:

In summary, the final design:

- introduces an alternative and accessible entrance on the memorial's western façade using a series of inclined planes;
- utilizes a mirrored, zigzag pattern of inclined planes to accommodate the 18' vertical grade change from top of the memorial's encircling retaining wall to the sidewalk;
- extends and elaborates the form of the Lincoln Circle, with tilted curving planes;
- recognizes the existing potential of the site and respects the significant architecture of the memorial;
- provides access from the eastern-facing entrance to an alternative and accessible entrance facing the Potomac River;
- introduces a gradual and experiential ascent to accommodate wheelchairs and strollers;
- recognizes the role and importance of symmetry in the existing architecture and landscape architecture of the National Mall;
- enables visitors to enter the colonnade section (the interior part) of the memorial from north and south façades;
- introduces a public lawn

at the base of the memorial where visitors sit and enjoy the river from an elevated vantage;

- provides additional stairs on the sides of the tilted planes for those able to utilize them;
- incorporates areas for sitting along the ramps for visitors to pause and dwell;
- introduces vegetation (hedgerows) along the tilted planes for texture, color, and wildlife;
- provides landings at the center and along the sides of the ramp as places for visitors to pause and interact; and
- Incorporates seating/steps on the memorial's axis, enabling opportunities for visitors to rest and/or make photographs.

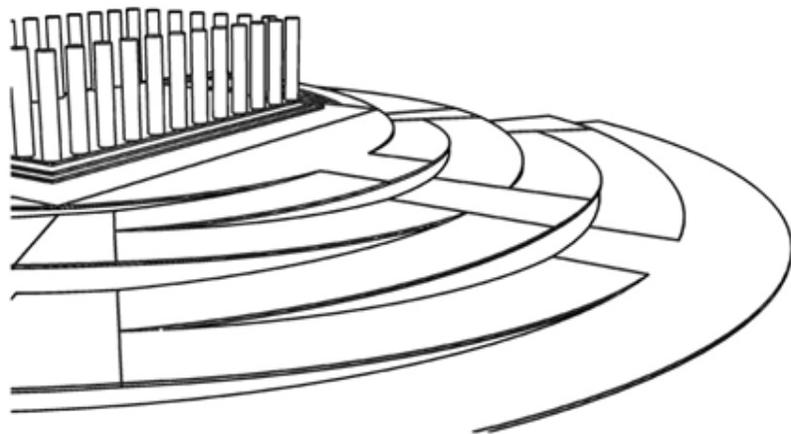


Figure 28 - Conceptual drawing of the ramp system, showing the complexity of making connections from the upper colonnade level to the ground.

4.8.1 Proposal Plan

Figure 29 illustrates the proposed plan, which includes an alternative and accessible entrance to the memorial from the existing western sidewalk. Gradually sloping planes provide visitors with different options to ascend to the interior of the memorial. Landings allow for pausing and social interaction.



Figure 29 – Proposal plan. This drawing shows The Lincoln Memorial with the proposed design for the western entrance.

Contextual plan of the proposed design (Figure 30), shows its relation to the other iconic elements of the National Mall.



Figure 30 – Aerial photo of The National Mall including the proposed design.

4.8.2 The Monumental and Accessible Entrance

The design aims to provide an alternative entrance experience to the memorial, which is both ceremonial and accessible, and which balances moving with dwelling.

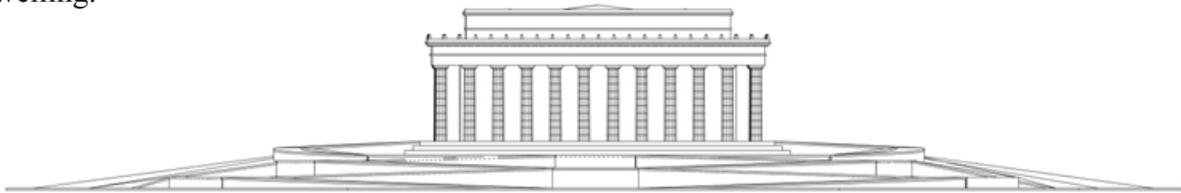


Figure 31 - The western side elevation, representing the transformation of the land from a 18' drop, to different platforms connected with gradual slopes.



Figure 32 - Section displaying the proposed re-design of the western side of the Lincoln Memorial, providing an alternative and accessible entrance.



Figure 33 - Section-perspective view of the west elevation of the memorial, illustrating the proposed alternative entrance.



Figure 34 – Proposed design ramps, stairs and landings.

Figure 35 depicts the design of the alternative memorial entrance in the form of a relief model utilizing a 2 foot contour interval.



Figure 35 – Model of proposed site relief.



Figure 36 - Perspective illustrating the sloped planes, seating areas, stairs, and the landings along the site's re-designed western facade.

4.8.3 Inclined Planes for Moving and Dwelling

As stated earlier, an inclined plane provides users with opportunities to pause at will and enjoy their surroundings. Seating have been areas incorporated into the walls of the proposed ramp, whose planes and platforms have been sized wide enough to accommodate different and simultaneous activities. The three generous platforms, located along the memorial's central east/west axis and connected by way of seating steps, would serve as places for group gathering and photograph making.

4.8.4 Design Analysis

Attributes of the Lincoln Memorial's ceremonial entrance, which include grandness and monumentality, are emblematic in the proposed alternative entrance, which transforms the site's western side from an under-utilized street-level grass area into a set of social, engaging, experiential, and accessible tilted planes. The designed lawn on the upper elevation allows visitors to sit and enjoy views to the Potomac River and Memorial Bridge. By recognizing the latent potentials of the Lincoln Memorial's western façade, the proposed design expands the boundaries of National Mall to the edge of the Potomac River, provides circulation for visitors around the entirety of the site, softens boundaries between front and back, and all while enriching and respecting the memorial's cultural and historic significance.

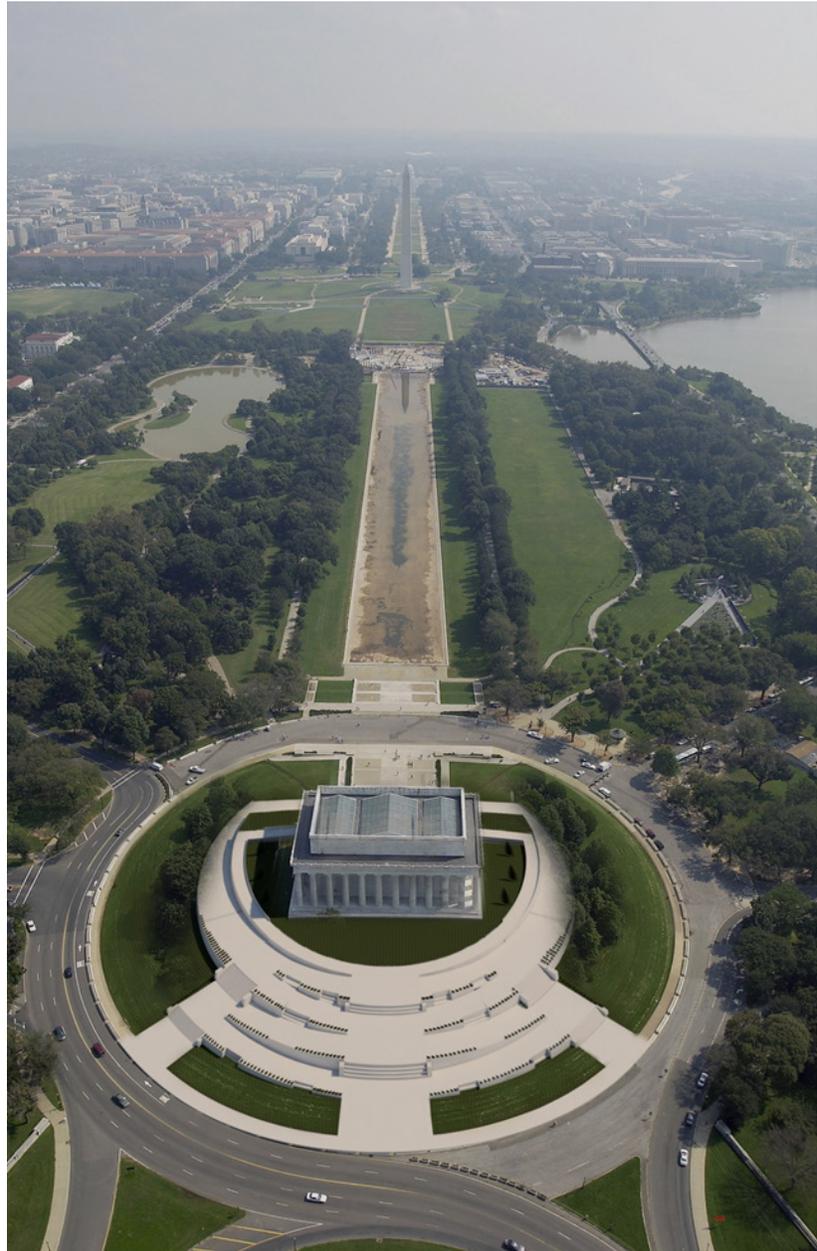


Figure 37 - Aerial photograph looking east down The National Mall from The Lincoln Memorial toward the Washington Monument, illustrating the proposed design for the western face of memorial grounds.



Figure 38 – Aerial Photograph of The Lincoln Memorial including the western newly designed entrance.

5. Conclusion

The potentials of inclined planes as non-discriminating, democratic machines in design are often neglected. The goal of this thesis was to explore their design and programmatic potential through the challenge of providing an alternative and accessible entrance to Washington DC's iconic Lincoln Memorial. In conclusion, this work suggests that using inclined planes can transform the accessibility, aesthetics, and experience of urban

landscape space. In addition to answering the wide variety of accessibility requirements, inclined planes can serve as places that are enjoyable, appealing, and welcoming. These physical, spatial, and visual characteristics can be applied to myriad projects – both retrofit and new.

References

- Architectural, U. S. "Americans with disabilities act (ADA) accessibility guidelines for buildings and facilities." *Federal Register* 56 (1991): 173.
- Alexander, Kaye. "Ramped Warehouses." *The Architects' Journal*. EMAP Construct. 2008.
- Bednar, Michael. *L'Enfant's Legacy: Public Open Spaces in Washington*. Johns Hopkins University Press, 2006.
- Condon, Patrick Michael. "Cubist space, volumetric space, and landscape architecture." *Landscape Journal* 7.1 (1988): 1-14.
- Corner, James. "Representation and landscape: drawing and making in the landscape medium." *Word & Image* 8.3 (1992): 243-275.
- Glazer, Nathan, and Cynthia R. Field. *The National Mall: Rethinking Washington's Monumental Core*. Johns Hopkins University Press, 2008.
- Howett, Catherine. "Systems, signs, sensibilities: sources for a new landscape aesthetic." *Landscape Journal* 6.1 (1987): 1-12.
- Hunt, John Dixon. *Greater perfections: the practice of garden theory*. University of Pennsylvania Press, 2000.
- Leatherbarrow, David. "Is Landscape Architecture?". *Arq* 15.03 (2011): 208-215. Web.
- Leatherbarrow, David. "Topographical stories". 1st ed. Philadelphia: University of Pennsylvania Press. 2004.
- Leatherbarrow, David. "Topographical premises." *Journal of Architectural Education* 57.3 (2004): 70-73.
- Lobeck, A. K. *Geomorphology*. New York: McGraw-Hill Book Company, Inc., 1939. Print.
- Olin, Laurie. "Form, meaning, and expression in landscape architecture." *Landscape Journal* 7.2 (1988): 149-168.
- Schittich, Christian. "The concept of circulation." *Designing circulation areas: Staged paths and innovative floorplan concepts* (2013): 9.
- Schittich, Christian et al. *Designing Circulation Areas*. Munich: Edition DETAIL, Institut für Internationale Architektur-Dokumentation GmbH & Col. KG, 2013. Print.
- Smit, Christopher R. "Aesthetic advocacy: An interview with designer and scholar sara hendren." *Journal of Visual Art Practice* 12.3 (2013): 319-327.
- Thomas, Christopher A. *The Lincoln Memorial & American Life*. Princeton, N.J.: Princeton University Press, 2002. Print.
- Vredenburg, Alison G., et al. "Evaluation of Wheelchair User's Perceived Sidewalk and ramp Slope: effort and accessibility." *Journal of Architectural and Planning Research* (2009): 145-158.