LIGHT + SHADOW
A Design Thesis Submitted to the Department of Architecture and Landscape Architecture of North Dakota State University by Cassandra L. Johnston in Partial fulfillment of the Requirements for the Degree of Master of Architecture.

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“What the eyes see and the senses feel in questions of architecture are formed according to conditions of light and shadow” - Steven Holl
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This thesis explores the question, “How can the manipulation of light and shadow through texture affect the experience of a space?” The typology for this thesis is a experiential boutique resort which is located within the outskirts of Las Vegas, NV near the Valley of Fire State Park. The unifying idea of this thesis deals with the detail and manipulation of materials that are created through the use of light and shadow which enhances the overall experience visitors have on a space. The project’s justification provokes the creation of experiences based on different aspects of light and shadow. Every space has its own light quality and wanted experience. For instance, a dark room in which one cannot see the other wall can create a sense of mystery. Where a room housed within a church lit only by a single skylight and focused view creates emotions of reverence and contemplation.

The overall perception of an architectural space depends on the details that are enhanced or dulled using light and shadow. The use of light, shadow, texture, and patterns are extremely important when creating a space. Without the use of these elements the overall sensation becomes dull and artificial.

Keywords: Light, Shadow, Texture, Patterns, Haptic Realm, Phenomenology, Manipulation
How can the manipulation of light and shadow through texture affect the experience of a space?
Statement of intent
Project Typology
Experiential Boutique Resort

Claim
Through the manipulation of light and shadow, patterns and textures are formed on materials which enhances the haptic realm and thus creates the phenomenology of the architecture.

Premises
Human experiences are provoked through architecture with the use of light and shadow. The perception of architectural spaces depends on the detail light and shadow creates.

The manipulation created by light and shadow creates a haptically rich environment when designed through the senses.

The perceptual spirit and metaphysical strength of architecture are driven by the quality of light and shadow shaped by solids, voids, opacities, transparencies, and translucencies (Holl, Pallasmaa & Perez-Gomez, 2006).

Unifying Idea
The detail and manipulation of materials are created with the use of light and shadow which enhances the overall experience visitors have on a space.

Project Justification
When creating a particular space aspects of light and shadow always have to be taken into account. Every space has it's own light quality and wanted experience. For instance, a dark room in which one cannot see the other wall can create a sense of mystery. Where a room housed within a church lit only by a single skylight and focused view creates emotions of reverence and contemplation.

The overall perception of an architectural space depends on the details that are enhanced or dulled using light and shadow. The use of light, shadow, texture, and patterns are extremely important when creating a space. Without the use of these elements the overall sensation becomes dull and artificial.
THE PROPOSAL
What the eyes see and the senses feel in questions of architecture are formed according to conditions of light and shadow (Holl, Pallasmaa & Perez-Gomez, 2006). The contrast of light and shadow has the opportunity to create a world within itself. Without the property of light the world would be completely different. There would always be shadow. However, when the two properties are combined there is nothing in the world that has the possibility to create spaces, feelings, or the opportunity of experience through the 5 senses.

My most powerful experiences associated within architecture have focused on the essence of light and shadow. When I walk into a space I immediately notice the pattern that is formed when light interacts with a screen, window, or material and creates shadows. It intrigues me when a space can change dramatically from day to night by the differing light qualities or seconds during the sunrise and sunset of each day. For these reasons and many more I have grown curious of what experiences can be created using these two elements.

This project embraces the user's interaction with the landscape throughout the building design. It creates a haptically rich experience by the manipulation of light and shadow and integrates the senses into the architecture. By designing around two different experiences the architecture has the opportunity to explore the different qualities light and shadow has on one's perspective of a space.

The site played a large role throughout the building design process. The site is located approximately 45 miles North-East from downtown Las Vegas and a little more then 5 miles to the main gate of the Valley of Fire state park following the Valley of Fire highway. Due to the enormous amount of visitors the famous state park has each year it will bring tourists, locals, and recreational seekers to the area.

The site is not only important to the design and location of the experiential boutique resort, but also a very important educational opportunity for myself. I have not had the opportunity to design within the desert confines. Therefore, the thesis will examine ways to incorporate green technologies and will create a design that is consistent with the desert ecosystem and Paleolithic theme.
The experiential boutique resort near the Valley of Fire in Nevada is designed with three primary groups of individuals: the visitor, the worker, and the professionals.

The Visitor
The resort is designed for individuals who need to escape the stresses of everyday life. These individuals will be engulfed within their natural surrounding and crave the need to explore. They need not be experienced in climbing or hiking. The resort design requires only the need to explore.

The Worker
The experiential boutique resort will be maintained and operated by local residents. These residents will be part of a special group of people dedicated to the operations and maintenance of the resort.

The worker will also be required to make each guest’s experience unique to their needs. They will make sure that each and every guest has everything they will need and wish.

The Professional
Throughout a visitor’s time at the experiential boutique resort they may come to need some guidance regarding hiking or climbing. The resort will be required to have professional guides to help visitors roam the land freely and at their own pace. The resort will include many different guided mountain climbing and hiking tours within the state park.
Throughout the Experiential Boutique Resort there are many elements that the project calls for. The project explores two different areas: the baths and the den. The peaceful exploration of the body within the baths paints a different experience then the focus of nature surrounding the den. The project called for two different experiences; differing experiences equals two different explorations of light and shadow.

The baths explore the tranquility of the body and heightening of the senses. An experience within a dark room in which one cannot see the other wall can create a sense of mystery. A room housed within a church lit only by a skylight and a focused view creates emotions of reverence and contemplation. The baths are designed in much the same way. With the massive concrete walls that echo sound to the slit of light steering your eyes toward a concentrated landscape the design fabricates an experience of admiration and awe.

Another important area to the resort are the den. The den brings the soul into its natural environment by enhancing natural lighting and focusing on the surrounding backdrop. In order to create the desired experience of the den, the design needed to delve into the natural need of human exploration.

Major Project

F005 Singita Lebombo Lodge
The City of Las Vegas
Las Vegas is located in the mountain division of the western region of the United States. The oasis-like Las Vegas Valley was first discovered by Rafael Rivera. It became a resting point for the California Gold Rushers and Spanish traders. The railroad tycoons of region deemed the water rich area to be a prime location for a stop facility and town, thus the beginning to the city of Las Vegas.

Nevada was the first state to legalize casino-style gambling and was the last western state to outlaw gaming. This began the makings of what we know the region to be known for today as the bright lit city of Las Vegas. The city of Las Vegas and the surrounding area has since grown to a population of 1,951,269 residents.

The Valley of Fire State Park
Valley of Fire State Park is Nevada’s oldest and largest state park. The Park’s name is derived from the red sandstone formations of the current landscape. The formations were created from great shifting of sand dunes during the age of the dinosaurs more than 150 million years ago. The park also holds an ancient petrified forest and 3,000 year old Indian petroglyphs.

The Site
This particular site is very important to this project. It is located approximately 45 miles northeast of downtown Las Vegas and approximately 5-10 miles away from the entrance into the Valley of Fire State Park. The site is located directly off of the Valley of Fire highway, which leads from interstate 15 to the core of the Valley of Fire state park. The closest city center in located 24 miles to the northeast of the site in Moapa Valley.

The surrounding area of the site is very mountainous and dry. It is located on the outskirts of the Valley of Fire State Park, it is the start of the red sandstone formations within the Mojave Desert.
This thesis focuses on the detail and manipulation of materials that are created with the use of light and shadow which enhances the overall experience visitors have on a space.

The project examines the haptic realm through the use of light and shadow. Lighting creates textures and patterns on materials which allows the user to experience the space through their senses. The sense of touch and site will be examined and enhanced during certain parts of the space.
Plan for proceeding

Research Direction
The research of this thesis will be conducted in all areas. The unifying idea will be further examined during the entirety of the project. The project typology, historical context, site analysis, and programmatic requirements will be further understood and investigated.

Design Methodology
The design methodology the thesis will follow is a mixed method of quantitative and qualitative approaches. It will follow a concurrent transformative strategy that will be guided by the unifying idea (which was stated earlier in the Statement of Intent chapter) and the priority will be assigned by the requirements of the idea. Further examination of the theoretical premise will determine the required process of research which will integrate the data occurring at several stages. The analyzing, interpreting and reporting of those results will be presented both graphically and contextual.

The method of gathering quantitative data will include statistical and scientific data. Statistical data will be gathered and analyzed or through an archival search. Scientific data will be obtained through instrumental or experiment which will be gathered directly or through the use of archival search.

The method of qualitative data will be gathered from the following: direct observation, local survey, direct interviews, and also through archival search.

Documenting
Documentation of the thesis will be compiled and presented using the following methods: journal, models, sketches, illustrations, text, photographs, computer software, orally, materials, etc.

Documentation of this thesis project gives the public access to the capabilities of haptic and phenomenological architecture.
THE PROGRAM DOCUMENT
The Summary

From left to right: F008 Amangiri Spa, Utah, F009 Singita Resort Dining, Africa, F010 Amangiri Outdoor Treatment, Utah
The following research explores the essence of the building through the materials it uses and multiple senses the materials provoke. According to Juhani Pallasmaa, “Every touching experience of architecture is multi-sensory; qualities of matter, space, and scale are measured equally by the eye, ear, nose, skin, tongue, skeleton and muscle. Architecture involves seven realms of sensory experience which interact and infuse each other.” Each material we use affects the experience of a space differently. The way light plays with a material it explores the contours of the surface emphasizing the shadow creating multiple different experiences and feelings depending on the day and time of the year. The use of light, shadow, texture, and patterns are extremely important when creating a space. The skin reads the texture, weight, density and temperature of a material in order to create an experience or opinion.

The haptic realm of architecture affects your sense of touch, as well as, your remaining senses. When experiencing a new material it is interpreted and ‘felt’ before the body physically touches that material. For example, everyone has come into contact with a new material of some kind during his or her life span. I can recall multiple times where I have gone up to a new material expecting it to be hard or heavy and instead find it to be extremely soft or light. The eye interprets before one experiences; which is why it is important to design around multiple senses. Deep shadows and darkness are essential, because they dim the sharpness of vision and invite unconscious peripheral vision and tactile fantasy.

An experiential boutique resort gives the opportunity to use these methods in new and unique ways. The modern sense of the word ‘resort’ is defined as a denoted building to which people generally go for relaxation or pleasure. My project pushes the boundaries of a modern ‘resort’. As society’s needs and wants change so does everything’s role in society. Society’s current needs include a greener more sustainable lifestyle. This resort plays with that need. It encourages the user to explore nature’s natural environment.
MATERIALITY OF LIGHT AND SHADOW

“Architecture is not an experience that words translate later. It is its figure as presence, which constitutes the means and end of the experience.”
(Perez-Gomez, 2006)

After a long trip, one tries to describe the experience they had in a particular place. It becomes much harder then they had anticipated. The photos never capture the beauty of the space; the use of language does not help describe the culture that was experienced. Just like a long trip, which has to be experienced through the senses in order to grow in understanding, Architecture has to be experienced in order to be fully understood or interpreted. “Only the actual building allows the eye to roam freely among inventive details; only the architecture itself offers the tactile sensations of textured stone surfaces, the experience of light changing with movement, the smell and resonant sounds of space, the bodily relations of scale and proportion. All these sensations combine within one complex experience, which becomes articulate and specific, though wordless” (Holl, 2006). Words cannot translate the experience one has when walking into that particular space. Experience is defined as the communication of ideas, personally encountering something, the totality of the cognitions by perception. One cannot describe the beauty of a sunset; one must experience it through their senses.

This thesis focuses on the user and how the architecture invites and engages at a level in which multiple senses are active through the use of light, shadow, materiality, texture and pattern. Now, one may say that these aspects of a space are not important. However, I would like you to imagine a sterile space, which is completely white, no change of material, and squared with no windows. What kind of feelings would you experience? If all architects designed in that way, with no meaning to the essence or beauty that light, shadow, textures and patterns have on a space; architecture would not have an experience, it would have no meaning, everything would be a duplicate of another. The world around us would have no meaning, no beauty.

As Juhani Pallasmaa would say, “Every touching experience of architecture is multi-sensory; qualities of matter, space, and scale are measured equally by the eye, ear, nose, skin, tongue, skeleton and muscle. Architecture involves seven realms of sensory experience which interact and infuse each other.” When we experience anything for the first time, whether that is a building, the cold winter, or a new city we use every one of our senses to form an interpretation of the experience. If this is true, why do so many architects forget to design around the senses? It should be common practice. Each material we use affects the experience of a space differently; the way light touches a material it creates shadows and textures, which enhances the
Architecture is in the field of interpretation. The architect manipulates the materials so as to give it intelligible life. Interpretation is the product of experience, understanding in action. According to George Steiner, no phenomenology, no criticism can tell us as much as the action of meaning which is the performance or structure. The structure must be experienced in order to create phenomenology or criticism. It is when we experience and compare different interpretations of the space, details, materials and lighting that we enter the life of understanding. The interpretation of light and shadow on architecture depends greatly on what the eyes see and the senses experience. The experience of a particular space is dependent on the use of light and shadow; the way a material is understood, the sound of footsteps in a dark room, the feeling of warmth through the use of color. Therefore, in order for us to understand and interpret phenomenology in architecture we must experience it and thus interpret what we experience into our own work.

THE HAPTIC REALM OF ARCHITECTURE

“The haptic realm of architecture is defined by the sense of touch. When the materiality of the details forming an architectural space become evident, the haptic realm is opened up. Sensory experience is intensified; psychological dimensions are engaged.” (Holl, 2006)

The detail and manipulation of materials with
the use of light and shadow enhances the overall experience visitors have on a place. When the haptic realm becomes evident the sense of touch is enhanced. The curiosity to touch a material and experience the texture creates an interpretation of the space.

Today the industrial and commercial forces work on creating “products” for architecture. Those products focus on mass production and the synthetic creation of materials. These products - sheets of glass, enameled metal and other synthetic materials - present their surfaces to the human eye without communicating their material essence or age. The sense of touch in those products and materials are dull or completely null using the commercial and industrial method of creation. The difficulty regarding these materials pertains to the creation of the texture in the material and how to enhance their properties to create sensations of experience.

The overall perception of an architectural space depends on the details and manipulation of materials. Therefore, the use of light, shadow, texture, and patterns are extremely important when creating a space. Without the use of these elements the overall sensation becomes dull and artificial. The skin reads the texture, weight, density and temperature of matter.

The haptic realm does not only affect the sense of touch but also your vision. The eye touches and interprets a material before the hand feels. The gaze implies an unconscious bodily mimesis; the body feels and interprets the material before it is touched. Which is why when one encounters a new material for the first time they may expect something very hard
and instead find something very soft and squishy. Maybe we should think of our sense of touch as our unconscious vision. As Pallasmaa states, “our gaze interprets distant surfaces, contours and edges, and the unconscious tactile sensation determines the agreeableness or unpleasantness of the experience. The distant and the near are experienced with the same intensity. Great architecture offers shapes and surfaces molded for the pleasurable touch of the eye. The eye is the sense of separation and distance, whereas touch is the sense of nearness, intimacy and affection. Deep shadows and darkness are essential, because they dim the sharpness of vision and invite unconscious peripheral vision and tactile fantasy. Homogenous light paralyzes the imagination in the same way that homogenization eliminates the experience of place.”

IMPORTANT OF LIGHT AND SHADOW

“What the eyes see and the senses feel in questions of architecture are formed to conditions of light and shadow.” - Steven Holl, Questions of Perception: Phenomenology of Architecture

Without light there will be no shadow, without shadow there cannot be contrast; without contrast how can there be architecture, beauty, art, or culture? Light creates variations in reflectivity of glossy, matte, colored, rough, or smooth surfaces. The spirit and strength of architecture is driven by the quality of light and shadow, which is shaped solids, voids, translucencies, transparencies, and opacities. The intensities of architecture and cities are orchestrated by natural light, with its variety of
Only the actual building allows the eye to roam freely among inventive details; only the architecture itself offers the tactile sensations of textured stone surfaces, the experience of light changing with movement, the smell and resonant sounds of space, the bodily relations of scale and proportion. All these sensations combine within one complex experience which becomes articulate and specific though wordless.

- Steven Holl
change. Imagine driving into a major metropolitan city at night, one that you had only seen in the daylight. As your approach diminishes the once small bright blob of light begins to become a large detailed mixture of light and shadow. The city you knew only in daylight is entirely different at night. This shape of light and shadow gives new dimensions to the urban experience. A work of architecture in the city may have an entirely different presence by day and by night, both equally important, as the self-contained object during the daylight becomes a larger less contained presence at night.
The Summary

From left to right: F017 City Library Teen, archrecord.com, 2013; F018 NMCA Stairs, farm7.staticflickr.com, 2009; F019, Perot Museum, archrecord.com, 2012
Each of these case studies is very unique in its own way. However, they are all very similar in the way they explore the use of light and dark and materiality throughout their spaces. When choosing these case studies, I focused on the aesthetics in the differing material choices, sustainable technologies, unique design choices, and their effects on the surrounding community.

The City Library of Seinajoki, Finland was a perfect case study for exploring the old and new in architecture. JKMM Architects had many design challenges when creating this wonderful library. The city of Seinajoki is known for housing 5 of Alva Aalto’s unique and famous buildings. While choosing an architect, the city wanted the new building expansion to respect the history that surrounds Aalto while also making a bold statement as a piece of modern architecture. JKMM Architects needed to find the right balance between the old and new. JKMM Architects also needed to expand on the idea of a social library; because technology has grown exponentially within the past 10 years, the role of a public library is currently undergoing a major transformation as a result of the rapid social change. This role change in libraries is also happening in museums. Which is why this particular case study is so important to the development of my thesis. The architects brought new and unique ideas into the design and organization of the city library.

The New Museum of Contemporary Art is very different then the previous case study in the organization and design. This study focuses on the circulation and layout of a normal contemporary art museum. However, the reason why I chose this particular case study was due to its material choices. The New Museum uses one color palette throughout the structure to emphasize the simplicity and cleanliness to the art and architecture. By only using one color palette, the use of natural light and differing textures to the materials had to be enhanced in order to excite the user.

My last case study, the Perot Museum of Nature and Science has many important aspects to the architectural design while also created by a famous architect Thom Mayne and his architectural firm, Morphosis. The museum’s mission is to inspire minds through nature and science; thus, Morphosis embraced the natural and man-made worlds by focusing on earth, space, life, natural, chemistry, physical, and engineering sciences. The Museum’s connection between natural and man-made features speaks of a hard integrity that makes architecture meaningful. By integrating architecture, nature, and technology the building stimulates our natural curiosity of our native surroundings by demonstrating new scientific principles.
THE CITY LIBRARY
SEINAJOKI, FINLAND
Designing an addition to Alvar Aalto's building is hard enough let alone next to five of his structures and in a Finnish town who's identify has been linked to the master since 1960. JKMM Architects won the Seinajoki competition in 2008 with a design that pushed its building expansion closer to Aalto's library than any other entry. They also broke up their design into three simple forms, which are connected underground to the original building as a requirement to the competition.

The city of Seinajoki wanted the new building to respect the history that surrounds Aalto’s identity within the city while making a bold statement as a piece of modern architecture; in other words, JKMM Architects needed to find the right balance between
Top Left: F021 View of the children’s library, Huisman, archrecord.com, 2012
Top Middle: F022 View of the library’s main area, Huisman, archrecord.com, 2012
Far Right: F023, Floor Plan of library, Cassandra L. Johnston, 2013
Bottom Right: F024 Section and Elevation, Cassandra L. Johnston, 2013
the old and the new.

Within the past 10 years, technology has grown exponentially. We have come to an age where we have access to the world’s information and facts simply by a couple keystrokes. The designers had a challenge creating a space for the ever-changing role the library will have on our future. The role of a public library is undergoing a major transformation as a result of the rapid social change. According to ArchDaily, “it is thus conceivable that once looking for actual information no longer plays a central role, the significance of the library as a place for interacting with information will be highlighted. Its key mission is to provide a setting for encounters, meetings, and events.” The architecture has to encourage the visitors to be active rather than passive when receiving information and services. The role of a library in this day and age has to be an adaptable public space. In order to attract visitors a library must provide experiences just like any other architecture.

**STRUCTURE AND MATERIALITY**
The building’s structure is comprised of a cast-in-place concrete structure that creates the sculpture-like design. The unobstructed panoramic views within the interior spaces were achieved by using long-span beams similar to those used in bridge...
structures. The overall visual look of the space is dominated by cast concrete surfaces. The rough feel to the concrete was produced using uneven plank moulds and leaving those faces unfinished.

**SUSTAINABILITY**

JKMM Architects chose high quality building materials to enhance the building’s life span. The building has a high-energy efficiency value due to the compact shape and good thermal insulation values of the shell and air conditioning systems. In order to minimize the need for cooling during the summer months, the structure was designed so the large curtain walls face north in order to reduce thermal loading from the sun.

**CITY LIBRARY VS. CASE STUDIES**

This case study is much different from the rest mainly because it is a City Library and not a museum of any kind. However, what I found interesting about this case study is the materiality choices the architects made and the emphasis of the old within the new. Throughout the building, JKMM Architects used many of Aalto’s previous design elements. For example, Aalto is known to clad his buildings in white tile and topping them with copper roofs. JKMM decided to reverse that idea and wrapped the new addition in copper shingles and use white as an accent piece.
The New Museum of Contemporary Art, located in the Bowery district of New York City, was completed in 2007 by the Tokyo based architectural firm SANAA, recently a Pritzker laureate, designed the New Museum. The 58,700 square feet that makes up the Museum’s mass is arranged in 6-stacked rectangular blocks offset at different heights and sizes to mimic the surrounding buildings. By the small change of size and shifting of the cube like shapes, it gives the building a dynamic and attracting form.

The New Museum’s building program consists of 13,100 square feet of four public galleries located on the first four floors, an 82-seat auditorium located in the basement, an education center on the 5th level, offices located on the 6th, and a 2,000 square foot multipurpose space on the 7th floor. By the shifting of boxes, all of the galleries have natural light illuminating the spaces combined with artificial. The offices and private locals on the top floors have amazing views and terraces that overlook the cityscape.
According to ArchDaily the New Museum of Contemporary Art shows its design concept through “simple repeated shifting of the form, the intention of the building is clearly readable from outside, and combines a convincing language with the need of natural light form top: all at once, with one operation, the project shows its force.”

**ILLUSION OF WEIGHTLESSNESS**

Now that the New Museum’s precariously stacked cardboard-boxed form is completed and enclosed there is little evidence of the system that supports the entire structure. However, every now and then one catches a glimpse of a diagonal brace through the metal mesh façade and behind the windows. The diagonal braces are part of a story-deep perimeter truss system. The trusses are considered the primary components to the gravity and lateral load resisting system. “By wrapping forces around corners the trusses permit the museum’s volumes to shift relative to one another, allow perimeter
skylights at setbacks, and provide column-free galleries spanning up to 40 feet,” according to Joann Gonchar of Architectural Record.

MATERIALITY
The materials and the façade appearance play a vital role in the building’s concept of wanting to be a light and clean object amongst the massive Manhattan skyline. The architect chose to use an anodized aluminum mesh on top of the white walls on the exterior façade. The metal mesh gives different light reflections to the building and hides office windows, doors, and balustrades of the terraces. As a result, the form has a continuous or uninterrupted façade.

Inside, the New Museum continues the lightness by using white surfaces and unique ceilings. The ceiling consists of a floating dropped screen of metal mesh which filters light from a grid of glowing florescent tubes.

NEW MUSEUM OF CONTEMPORARY ART VS. CASE STUDIES
This case study looks at the design and spacial configuration of a modern or contemporary art museum. I also chose this particular project because it looks at materials in a different way then the other two projects. The New Museum uses one color palette throughout the structure to emphasize the simplicity and cleanliness to the art and architecture. The simplicity and form to the design enhances the materials being used within. By only using one color palette, the use of natural light and different texture to the materials had to be enhanced in order to excite the user.
Bottom to Top: F035 Front Facade, Iwan Baan, 2009; F036 Offices, Iwan Baan, 2009
Completed in 2013, the Pritzker Prize laureate Thom Mayne and his firm, Morphosis, designed the Perot Museum of Nature and Science located in Dallas, Texas. The museum’s mission is to “inspire minds through nature and science;” thus, Morphosis’ embraced the natural and man-made worlds by focusing on earth, space, life, natural, chemistry, physical, and engineering sciences. The Museum’s connection between natural and man-made features speaks of a hard integrity that makes architecture meaningful.

Riddled with wrinkles and creases the precast concrete cladding engulfs the cube and plinth that provide the dominant volumetric element. By integrating architecture, nature, and technology, the building stimulates our natural curiosity for our native surroundings by demonstrating new scientific principles. The combined experience of nature and science within the city first begins on the approach to the building. The approach leads through two of Texas’ native ecologies: a terrace of native desert xeriscaping and large native canopy trees. The terrace gradually slopes upward connecting the iconic stone roof creating the main entrance into the museum. Before entering the Perot Museum one notices, the cube like main structure that seems to float among the 4.7-acre landscape surrounding the building. The heavy cloak, which engulfs the cube, consists of 656 precast panels each weighing up to 16,000 pounds with a combined total of 4 million pounds. The striated skin gives the cube life by creating strong shadow lines along its bottom and slowly diminishing as its moves up the building.

Perot Museum fills 180,000 square feet of space. Within that allocation of space inhabits multiple areas including: 5 floors of public space, an acre of rolling roofs cape, a large urban plaza, glass enclosed lobby space with adjacent rooftop deck.
features Morphosis Architects designed in a way that they used features from the smallest design choice of choosing furniture made from wood taken from sustainable forests to a more energy efficient cube shaped form over a rectilinear form. Other sustainable features include: recycling and using local materials, water heated by solar panels, drip irrigation which is 75% more efficient than sprinklers, and rainwater collection system filling two 25,000 gallon cisterns. Another feature includes recapturing the building's air conditioning condensation during the summer months to meet the demand of the building's irrigation and plumbing needs.

CIRCULATION OF SPACES
Visitors to the Perot Museum first start at the atrium space, the building's primary circulation space. From the ground level a visitor starts on a series of escalators, which eventually brings them through the atrium to the uppermost level of the museum. A visitor's first view of the city is when they arrive at the top of the museum with a bird's eye view of downtown Dallas. From this balcony, visitors slowly proceed downward in a clockwise motion through the galleries. According to Morphosis Architects, “this dynamic spatial procession creates a visceral experience that engages visitors and establishes an immediate connection to the immersive architectural and natural environment of the museum.”

GALLERY TECHNOLOGY
The Perot Museum of Nature and Science holds 11 permanent exhibit halls. These halls focus on fossils, birds, geology, space exploration, and other

SUSTAINABILITY
In spring of 2013, Perot Museum achieved Green Globes highest possible ranking for sustainable building design. It is expected that by the end of 2013 the Museum will achieve two more prestigious awards – a LEED Gold rating from the U.S. Green Building Council and a certification from the Sustainable Sites Initiative.

According to the distinguished architectural magazine, Architectural Record states “Mayne wanted the building to function as its own scientific exhibition as well as a provocative work of architecture”. Mayne created a museum that stimulates our natural curiosity for science through the architecture itself. When using these sustainable

STRUCTURE
The museum’s structure is mainly located along the building’s perimeter in a series of large V-shaped concrete columns. A concrete slab on metal deck supported by steel frames is considered the building’s primary floor system. Large girders transfer the floor systems load to the perimeter where the v-shaped column brings the load down to the structure’s foundation. Twenty-four inch diameter piles using a mechanical splice support the foundation.
topics. The technology that is spread throughout these spaces includes, sensors that allows the user to launch table tennis using their brain signals or running alongside a 55-foot moving image of a full size cheetah, tyrannosaurus-rex or contemporary athlete. The technology in the Perot Museum uses science, not of the traditional natural history museum, but the science that grows with each passing year.

**PEROT MUSEUM VS. CASE STUDIES**

This case study is different from the first two because it looks at a different type of museum then this thesis project. The way a science and history museum is designed and organized is slightly different then an art museum. However, because it is a science museum it integrates a lot of great design answers to sustainability while also being aesthetically pleasing.
What is a museum? What is its purpose? How did the role of a ‘museum’ become important in our culture?

This is a small history of the institutions that house and preserve the material evidence of the human race and natural world. Museums started by the innate human desire to collect and interpret artifacts. The idea of ‘museums’ began the idea of mass education, the accessibility of knowledge and information to the general public. In a way museums are very similar to our modern technology, the computer or the Internet.

With the ever-changing role of a museum, the architecture that houses the works of art must also change as the needs of society changes. Is it possible to design a museum in a way that changes the way society views the structure? The meaning or symbolism of a museum has greatly diminished within the last 100 years. The exponential growth of technology has diminished society's ability to slow. For example imagine that the artists of history have prepared a world exhibit for the modern society, because the public has grown used to this idea of speed and quickness they do not stop and see the exhibit, they quickly stroll through. Museums today must be designed in a way that meets societies changing needs.

The word museum has origins dated back to the ancient Greeks. In the Greek language mouseion is defined as a designated philosophical institution or a place of contemplation. Ptolemy Soter, founded the first ‘mouseion’ early in the 3rd century BC, called the great Museum at Alexandria. It was built more as a prototype university than an institution to preserve and interpret material aspects of the heritage. The word was not used again until the 15th century to describe a collection of Lorenzo de’ Medici; however, the collection was considered more inclusive rather than to indicate a building.

The modern use of the word, a building housing cultural material to which the public had access, did not come into history until the 19th and 20th centuries. However, as museums continued to evolve according to the needs of its society, the emphasis of the building became less dominant. Examples of this interpretation include open-air museums, eco-museums, and a preservation of objects in series of buildings. The commercialization of the Internet has forever changed our society. Since developing the Internet, ‘virtual museums’ have existed in electronic form. Virtual Museums may have some benefits to existing museums; however, they still remain dependent to ‘real museums’ by the preservation and assemblage of collections.

As the definition of a museum is known today the archaeological and historical records have not provided the evidence to its existence. The
first recognized public form of a museum was in the Greek and Roman empires known as votive offerings that were housed in temples, sometimes they included works of art and natural curiosities, as well as exotic items brought from other areas of the empire, these temples were normally open to the public and often a small payment was required.

Specialized collections were created in the 16th century, through the developing interest in human and natural history. According to the Information Centre of Estonian Museums, “In Italy alone more than 250 natural history collections are recorded in that century, including the fine herbarium of Luca Ghini at Padua and the more eclectic collection of Ulisse Aldrovandi at Bologna.”

THE MODERN MUSEUM
The University of Oxford was the first organization to receive a private collection and make it publicly available. The private collection contained much of the Tradescant collection and was given to the university on the condition that they build a structure to house it. The resulting building, known as the Ashmolean Museum, was opened in 1683.

By the end of the 18th century the idea of the ‘museum’ had spread to other parts of the world. The Charleston Library Society of South Carolina became the first organization in the United States to announce its intention of forming a museum in 1773. The museum’s purpose was to promote the understanding of agriculture and herbal medicine to the surrounding community.

MUSEUMS AND SOCIAL CHANGE
In the first half of the 20th century the world saw the insightful social consequences of two world wars and periods of extreme economic recession. However unlike the economy, the years that followed the two world wars was a period of remarkable achievements for museums. Museums needed to respond to an educated and rapidly changing society. As a result, the structures became a facility for education,
leisure, and social affairs. The strength of museums lay in the fact that their structures housed artifacts of ‘real things’. Where as the society has grown to making things in mass production such as, plastics, reproduced images, and deteriorating a natural and human environment.

In Europe, there was a period of postwar reconstruction. Many arts, treasures, and other artifacts had been hidden, destroyed, or stolen during the wars. In some cases the buildings, which housed these artifacts, had been destroyed as well. Reconstruction provided opportunities for ideas that had been founded earlier in the century. The new approach in larger museums consisted of comprising a team of scientists, designers to assist in exhibition work, educators to develop facilities, and even marketing managers to promote the Museum and its work. As a result to these renovations and innovated ideas, museums grew in popularity and growth.

According to the article, History of Museums, by the Information Centre of Estonian Museums, “Statistics from the United States give an indication of the increase in the number of museums and in museum visiting. Of 8,200 museums reported for 1988, 75% had been founded since 1950 and 40% since 1970. In the 1970s nearly 350 million visits per year were made to American museums; in 1988 the recorded figure was 566 million.”
With the ever-growing technology, what will that bring to the world of Architecture? A formula which anyone can ‘punch’ into the computer and the so-called ‘design’ is produced? The biggest problem architecture faces today is the ability to find meaning. Society’s idea of producing ‘things’ as quickly as possible has diminished the ‘meaning’ or beauty of architecture. As a profession, how is Architecture going to produce ‘meaningful’ structures while also meeting society’s changing needs?

The goals to this thesis is organized into three different categories: the academic, professional, and personal. These categories will help define the goals to the thesis and help the general public to understand the thesis’ objective.

THE ACADEMIC
Throughout these past five years, I have learned and interpreted the academic method of education in architecture. The biggest issue in education is the idea of ‘completeness’. Throughout these years, I have always argued with the idea of not having the opportunity to fully ‘complete’ a project. However after 4 years, it has finally hit me. In order for a student to learn and expand their knowledge, we must create a project to a level of completeness that intentionally leaves gaps in the project. Gaps lead to the exploration of questions, which provoke discussion and interpretation in the architecture or project. No phenomenology, no criticism, can tell us as much as the action of meaning which is the project or structure. The structure or project must be experienced and interpreted in order to create phenomenology and criticism.

This particular thesis will eventually become a resource for future graduate students to learn and interpret. It will always be a learning tool, not only for future students, but for myself as well.

THE PROFESSIONAL
Once a student goes out into the ‘real world’ the meaning and beauty that once was in their everyday lives will, often, be put to the side. An intern architect will be expected to create construction drawings, generate images, and learn the ways of producing architecture. However, they may not have the ability to ‘create’ architecture for some time after their schooling. How can a student produce meaningful architecture in the professional world?

As the commercialization needs of society continues to expand how will architecture continue to grow and meet society’s needs while also keeping meaning and beauty in the profession?

THE PERSONAL
In order to continuously grow as an architect or individual one must set goals. It is through the making of these goals that one can grow. This thesis project will broaden my understanding of desert architecture and the meaning of architecture. It is through the understanding of light and shadow and the 5 senses that a space can become meaningful. I have chosen to explore this topic further by manipulating light and shadow in order to create a haptically rich experience through the exploration of the 5 senses. The design will integrate the landscape into the building design. It will also explore two different experiential opportunities using aspects of light and shadow.
The Site

Site analysis is very important to this particular thesis. I have never designed a building in the desert climate. Therefore, research on the overall climate and sustainable technologies is greatly important to the overall design of the thesis.

This thesis will examine ways to incorporate green technologies and will create a design that is consistent with the desert ecosystem and Paleolithic theme. The thesis will not impact the surrounding rock formations and will be consistent with the State Scenic Byway standards of Nevada.

At first glance, the site would appear as if it is a barren waste land with little or no life. However, it is a very fragile environment.

SOLAR
With the Valley of Fire as one of the sunniest locations in the country, the site is in full sun approximately 87% of the time. The least sunny month is December with an average of 73% and the most sun occurs in June and September with approximately 92% of the months sunny.

VEGETATION
The site lies in a broad transition area between the Mojave and Great Basin Deserts. Due to this, there are a large number of shrubs, grasses, cacti, and wildflowers that occur in the immediate area. These plants are found in specific locations determined by soils, temperature, orientation to the sun, and other physical factors. Some of these plants include three werner milkvetch, Las Vegas bearpoppy, dune sunflower, silverleaf sunray, etc.

WATER
As is typical to most low-lying southern deserts, rainfall is very slight. When rainfall does occur, the majority will fall during the winter months. Summer rains do happen, however, they typically are in the form of thunder storms and may leave portions of the area wet and others dry.

Flash floods are a frequent occurrence due to the topography of the rock formations and the impermeable soil characteristics. Little to moderate rainfall may even bring flash floods into the area. The problem the site will have to face is the possibility of erosion and silt occurring during a flash flood.

With approximately 3.97 inches of precipitation yearly there is little chance for water harvesting.

WIND
The prevailing wind direction is northwesterly from February through September and changes to north from October to January. The highest wind speeds are generally recorded in May with an average high wind speed of 10.9 mph. The lowest average

0 7 5
N VIEW

NE

E
wind speeds occur in November and December at approximately 6.8 mph.

**TEMPERATURE**
The two predominant seasons of the site are hot summers and mild winters; Fall and Spring are typically too small to have any notice. The site has a subtropical desert region which is known to average 20 degrees warmer than the rest of the state. Summers of the site are extremely hot with a mean temperature of 90 degrees and daily highs of over 100 degrees. The site has a diurnal temperature change with a high of approximately 24.4 degrees during the month of July.

**HUMAN CHARACTERISTICS**
Throughout the site’s history, human activities have impacted the site and its surrounding environment. The impact of man on the valley throughout history
has left the surrounding area with unique rock carvings and petroglyphs. Historically, the site has been an area for hunting, food gathering, and religious ceremonies by the Basket Maker people and the Anasazi Pueblo farmers. However, scarcity of water would have limited their activity in the area.

The population growth around the site was never explosive. There was little settlements and farms near the Moapa valley which is located 20 miles to the northeast.

The overall site does not have many human characteristics nor does the surrounding area. However, directly south of the site lays the highway to the Valley of Fire State Park. In 2009, approximately 1,500,000 people visited the Valley of Fire State Park. The site receives many visitors or passers-by via the highway.

Due to the increasing populations of the surrounding
communities of Las Vegas and the Moapa Valley the demand to the facility will continue to grow at all levels.

SOILS
The geographic evolution of the surrounding area’s landforms date well into prehistory. During the Cambrian Period, between 500 and 600 million years ago, a large inland sea covered all of the Great Basin, leaving a thick deposit of limestone when it disappeared. Above these formations are deposits of red Kaibab limestone of the Permian period, ending over 200 million years ago.

During the Triassic period, the visible geology we know now of the area was created. The creation of the Muddy Mountains, which is located directly south of the site, occurred after the Jurassic period.

The soil surrounding the site is has many constraints. The location of facilities on the soil should avoid obvious dry washes and other drainage areas because those particular areas can be erosive during heavy thunder storms.
210 CLEAR DAYS
73 CLOUDY DAYS
82 PARTLY CLOUDY

3.97 INCHES OF PRECIPITATION ON AVERAGE
TRAFFIC
Traffic to the site is limited to vehicles. The site is located on the Valley of Fire highway and approximately 10 miles away from interstate 15. Due to this great distance between the site and other major landmarks it is only accessible via automobiles.

TOPOGRAPHIC SURVEY
The area surrounding the site is very mountainous and steep with a 10-15% slope. However, the site’s area is very flat, between 0-5% slope.

PLANT COVER
The site and surrounding area consists of mostly small bushes, cacti, and desert grasses.
Program Requirements

The program for the Experiential Boutique Resort consists of two distinctly different spaces: one private, one public. The resort’s organization is built around the visitor’s ability to interact with the landscape. This resort is designed around human’s natural curiosity to interact with each other and their environment.

BATHS  7,000 SQ. FT.
Entrance lounge
Changing Rooms
Yoga Room
Treatment Rooms
Large Bath
Outdoor Treatment Room
Aqua therapy
Rest Areas
Office
Mechanical Room
Rainwater Tank
Freshwater Tank
Water Treatment

DEN  2,500 SQ. FT. PER UNIT
Lounge
Dining

KITCHEN  1500 SQ. FT.
Dining Room
Main Kitchen
Storage

GUEST SERVICES  2,000 SQ. FT.
Lobby
Lounge
Administration

STAR GAZING  800 SQ. FT.
F052 Old Interaction Matrix, Johnston, 2013
THE PROCESS
THE CONCEPT MODEL
My concept model was created the first semester of graduate school, before the design process began. Throughout the entire process the meaning and inspiration has changed and will probably continue to change.

This model became my inspiration. It represents the natural erosion of the land. Erosion that has been made through pushing, pulling, slicing, scraping, and crushing in order to create the environment we live in today. It is an imperfect perfect representation of the land.
PROCESS MODELS + DRAWINGS
FINAL DRAWINGS
The design explores the effect that light and shadow have on a particular space in order to create a haptically rich experience. It is designed for one who is looking for an escape from the hustle and bustle of everyday life.

This experiential boutique resort is located an hour North-East of the greater Las Vegas area, near the Valley of Fire State Park. The entire area around the site is located within the Mojave desert.

The project focuses on the experience of the site and surrounding landforms. By integrating the landscape into the building and the building into the landscape the project becomes one with the environment.

There are two main areas of the project: the baths and the den. The Baths explore the tranquility of the body and heightening of the senses. The Den brings the soul into its natural environment by enhancing natural lighting and focusing on the surrounding backdrop.
The Den brings the soul into its natural environment by focusing on the surrounding backdrop. The Den’s centralized views are inspired by the natural erosion of a slot canyon which is found within the Valley of Fire State Park. Those views are fixated on the landscape so the occupant has the opportunity to interact with the constantly changing aspects within the suite. The diagram below illustrates the changing angles.

The Baths explore the tranquility of the body and heightening of the senses. To focus on the body, there must be focused views. There are a total of four areas within the baths that frame the larger surrounding environment: the main entrance, the baths, and two relaxation spaces.
DIFFERENTIATION OF LIGHT

The tranquil exploration of the body within the baths paints a different experience than the focus of nature surrounding the suites. Differing experiences equals two different explorations of light and shadow.

A dark room in which one cannot see the other wall can create a sense of mystery. A room housed within a church lit only by a skylight and a focused view creates emotions of reverence and contemplation.

The baths are designed in much the same way. With the massive concrete walls that echo sound to the slit of light steering your eyes toward a concentrated landscape the design fabricates an experience of admiration and awe.
In order to create the desired experience of the Den, the design needed to delve into the natural need of human exploration. Similar to a slot canyon, the space needed to change throughout the day. Due to the ever-changing natural lighting and differing angles needed to achieve a particular view this effect was accomplished.
Thank you very much for taking the time to read or look at my thesis project. I hope it is everything that you are looking for and more.

I would like to thank everyone who has helped me through this stressful and exciting time in my life. I would especially like to thank my parents for always being there for me and cheering me on from the side lines.

I would also like to thank my sweetheart, Jake. Thank you honey for keeping me sane, if it wasn't for you I would not be who I am today.


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Darryl Booker
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  Dwelling

ARCH 371 Design Studio III - Fall 2011
Mike Christenson
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Milton Yergens
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ARCH 471 Design Studio V - Fall 2012
Cindy Urness
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  DLR Design Competition

ARCH 471 Design Studio VI - Spring 2013
Don Faulkner
  Ghana School
  Triangle Park Renovation

ARCH 771 Design Studio VII - Fall 2013
Regin Schwaen
  RegenBoston Competition

ARCH 772 Design Studio VIII - Spring 2014
Mike Christenson
  Thesis
“Everything that we see is a shadow cast by that which we do not see” - Martin Luther King Jr.