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Building Under the Ground: An Exploration of Spirituality, Visibility and Presence in Architecture

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Building Under the Ground:
An Exploration of Spirituality, Visibility and Presence in Architecture

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In the School of Architecture and Interior Design of the College of Design, Architecture, Art and Planning

By

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Building Under the Ground:

An Exploration of Spirituality, Visibility and Presence in Architecture
Abstract

Throughout time, human beings have occupied for various purposes underground spaces, but currently architectural thinking ignores the opportunities presented by developing underground. This thesis examines the architectural implications of these missed opportunities in the re-emergence of a viable typology in the contemporary architectural community.

While there are many topics of exploration one could take to devise architectural solutions to the underground, this thesis will be restricted to the study of spirituality, visibility, and presence as they are revealed through the interior physical constraints of natural lighting and spatial configuration. These areas of concern will be ascertained and analyzed in both ancient and contemporary architectural works as well as the literary works of John Carmody, Raymond Sterling, Rosland Williams, and Nigel Pennick.

The ideals and principals of this thesis will be manifested in the design of a new underground museum for the Smithsonian Institute under the National Sculpture Garden on the Mall in Washington D.C.. The design seeks to represent the design qualities necessary to solve the challenges of the underground. Most importantly, the building will attempt to maintain a visible presence from the Mall, while preserving the functionality of the surface-scape, as well as embody the design techniques essential to evoke a spiritual connection to the underground.
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Underground Architecture

When examining architecture’s relevance in the future it is important to relate its progression with that of the city, for architecture must adapt to the constant evolution of the urban fabric. If the previous statement is agreed upon as fact, then architecture will seek to follow the current trend of urban renewal towards increased density as a solution to society’s problems and those that are perceived to be relevant in the future. As such being the case, there is a natural evolution to the development of the urban fabric, which will be restricted by the existing borders that have yet been reached. What this denotes is that cities will develop through a series of phases with
each phase terminating at a specified border, horizontal or vertical, depending on its phase of expansion.

Urban growth is typified in the United States by horizontal expansion facilitated by the ease development and availability of cheap land. This resonates in the literature of American writers who typically developed the environment of their work on the horizontal plane: where technology would invade the garden, forcing the individual to retreat, at least temporarily, from their complex civilization to a more natural environment out west or in the woods. In particular, American writers explored a “middle landscape” that existed in the both the literary and built world between urban civilization and nature. While this horizontal expansion began in the United States as an idea, it was manifested into building development and visualized in the suburban growth of cities. However, it is no longer unique to this geographical region as other cities across the world have adopted the American style of development. The result has been a universal development in which cities have expanded outward. As the population grows and the urban edge is expanded to encompass the need for building, development will seek to maintain the current conditions of the spatial quality. However, as the city expands it begins to approach a natural edge or “border” of growth that is formed by the people’s need for proximity to the city core (Figure 1.1).

Figure 1.1

1 Williams, 18-19.
This need stems from various social conditions such as: distance to work, lack of social interaction, as well as the disruption of the human condition associated with being part of an intricate network of institutions. While it is true that this border can be expanded by the development of faster means of transportation, it can never be eliminated because the peripheral edge of the expanded city cannot replicate the experiences of the core. However, it can attempt to mimic the conditions of the inner city, but these instances are never as successful.

Beyond the social implications of horizontal expansion, there exists a greater need for this land as the population and economy grow, the land available for agriculture shrinks, and the problems of transporting food and raw materials to an urban population increase.2 Thus, the ability to produce food domestically is threatened by the horizontal growth of the city and the degradation of fertile land, which ultimately leads to an increase in both land and food prices. This in turn forces people back into the city for potentially cheaper land as well as more goods that are less expensive due the vast transportation networks that terminate into a central hub located within the inner city. This generates efficient markets because of the ability of large metropolises to import and consolidate global goods, a strategy that could not otherwise be implemented in the expanding regions of limited density.

However, as the city approaches its peripheral edge, the previously stated factors will force the city's development to collapse in upon itself. The resulting architectural development will be to build taller as a means to increase density. This in turn would push transportation underground as more land is consumed for the foundation of these taller structures. This would begin to stratify the layers of development creating more space out of the same surface area. However, similar to the first scenario of expansion, the height of buildings will approach a finite edge of construction that is

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2 Carmody, 4-5.
limited by both the economic costs of construction as well as technological innovation (Figure 1.2).

While technology will continue to evolve and allow buildings to soar to new heights, the costs of material and time of construction will make it unfeasible for companies to profit from this architectural solution. For example, the Burj Khalifa, designed by Skidmore, Owings and Merrill, was recently completed in Dubai. (Image 1.1) It stands at approximately 2,717 ft. with 164 stories, and was built at a cost of $1.5 billion dollars. The building set a new standard for height pushing the realm of previously established limits, however due to its sheer size the developer is struggling to secure maximum occupancy rates and subsequently revenue. This has been further dampened by the current recession. While this could be discounted, it is reasonable certain that this economic cycle will continue in the
future and as such must be factored into all decisions of development. The result is a significant burden on the developer that stems from the financial risks of such a project, as well as a lack of utilization of the resources used in the construction. While this project does not fit within this mold of development, it is an example of the difficulties and risks associated with an extremely tall building that embodies the key concepts of this phase of development.

The mold in reference is one in which the entire city is beginning to expand vertically as is shown in Figure 1.2, however, in this situation the Emirate of Dubai does not sustain the population nor has it reached its horizontal border that would signal it to collapse back in on itself to increase its density. This is evident in Image 1.1 where one can clearly see that the tower is removed contextually from the urban fabric of Dubai and is a result of the need to demonstrate financial power as opposed to the need to create usable space. This is apparent as the foreground of the image highlights a low building height spreading out in a horizontal expanse as opposed to a city like Hong Kong (Image 1.2), which is composed of buildings at varying heights, but all are several stories, which suggests the city’s need for density and the resulting higher buildings.
There is also a high social cost to this densification phase of development, “for as the soul of the city develops, it becomes the whole world; the gigantic megalopolis suffers nothing besides itself and sets about annihilating the country picture there is no question of coexistence with nature, which is banished.”³ As buildings begin to soar into the sky, the city will relinquish more space to developers to solve the scarcity of space and “the surface-scape will begin to erode; the already dominant metropolis will be a devouring megalopolis and finally a wasted necropolis. Even now, city streets are coming to resemble deep pits: nature, except in a surviving landscape park, is scarcely to be found near the metropolis.”⁴ According to Williams, cities will continue to expand and remove any sense of nature with the confines of the built world, creating a mechanical environment for people to live. It is the social implications of this new mechanic city, devoid of nature and beauty, that provides the need if not the will of the people to acknowledge and seek out the next phase in the evolution of building and planning.

The limitations and repercussions of building taller, whether that is financial or social, will force architects to pursue the next logical phase of development, building into the subterranean layers of the city. (Figure 3) As in the other scenarios, this phase of development is defined by a boarder, the surface plane. However, unlike the other two stages, this border is defined by peoples’ perception of underground buildings, and as such can be pierced by architectural solutions to these problems. That is to say that the barrier to accessibility does not remain fixed. Preindustrial Europe could not have imagined the depths that miners would be able to reach by the nineteenth century, nor could they have gasped the oil rigs of the twentieth. What this means is that the underground as always been positioned between a visible and invisible world.⁵ These two worlds are defined by the permeability of

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³ Williams, 6.
⁴ Williams, 6.
⁵ Lesser, 2.
the surface that is a result of technology and while technology made mining possible, architectural techniques will make underground building a solution.

In this case, it is the permeability of the surface that creates the opportunity for successful development, one that has been utilized throughout history. It is this history of architecture and sociological thought that will help to portray the significance of the underground, both natural and man made, in the progression of society that will provide the rationale for underground architecture. The advantage to subterranean development is the ability to layer buildings as a way to stratify density. (Figure 1.4) This concept of stratification is represented in the difference to the treatment of the underground buildings in both Figure 1.3 and 1.4. In Figure 1.3, the underground is treated as an extrusion of the surface, with buildings occupying a consistent space from the surface into the depths of the subterranean world. However, in Figure 1.4, the underground is displayed as broken up, allowing for architectural development based on specific location and environmental conditions.
This creates unlimited possibilities with regard to the expansion of the city, for the use of underground spaces will become extremely important in the consideration of the future of any contemporary city.\textsuperscript{6} As stated, as cities continue to evolve and increase in density, architects will need to look towards utilization of underground development as opposed to vertical growth as a way to solve the scarcity of land in metropolitan areas. This will in turn create a new surface condition that focuses on openness allowing for the return of nature to the city, where it will not just be confined to parks or the peripheral edge, but rather integrated into the framework of the city.

Despite the logical progression towards underground architecture outlined above, there are several problems associated with building beneath the ground that must be addressed in order to create successful and vibrant spaces. The main challenge for the architect is to create a building that overcomes the inhibitive nature of man’s preconception of the underground as cold, dark, and damp, which has been a major obstacle in the thorough exploration of underground architecture as a viable typology to the expanding problems of urban growth. However, the experiential quality is

\textsuperscript{6} Blaser, 11.
not the only barrier, but rather is reinforced by the current sociological connections that man has associated with the underground. What is interesting to note is that the meanings of the underground were not always negative, but rather evolved into their current form during the industrial revolution.

The architectural and planning response that emerged during this period was a shift to a more utilitarian use of the underground, which has been maintained in the contemporary environment. This shift in functionality can be largely associated with the different aspects of the barriers to underground architecture, which have limited it from serving as a destination. Not only has functionality been linked to experiential quality, but it is also related to the divergence in the interaction of the different social classes with the underground. The architectural space that was created in the modern era has been predominately left to the working class for use as a way to improve certain conditions of life on the surface. The main examples of this type of architectural space have been the development of subways, tunnels, mines, and underground factories and warehouses. Subways in particular serve as a refuge for the homeless for the same reasons they are shunned by the upper and middle classes: the lack of official oversight and response to the substandard conditions. These spaces have been designed for the working class and as a result are devoid of the characteristics necessary to improve the perception and quality of underground architecture. The social elite, on the other hand, have been able to avoid a level of interaction with the underground. Their lives of privilege allow them the opportunity to take advantage of the surface-scape as opposed to entering the depths and transition through the permeable surface, reinforcing the negative stereotypes associated with the underground. Therefore, the psychological connection that people have forged with the

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7 Lesser, 19.
underground must be severed or redefined to create a more harmonious relationship.

The most logical way to re-interpret this space is to shift the function of underground architecture towards spaces that require a different experiential quality than infrastructure. That is to say, that underground spaces need to be developed with more than a utilitarian approach, they need to be spaces that are occupied, not simply moved through. Therefore, a new programmatic approach is necessary to allow for a more architecturally developed response than currently exhibited, one that facilitates social class interaction in order to allow underground architecture to be a viable solution. In addition, a successfully integrated architectural scheme will provide a basis to re-establishing a spiritual or intellectual relationship with the earth that was destroyed with the advancement of technology and scientific exploration. Finally, architecture must seek to solve the more observable characteristics of underground architecture. It must resolve issues of visibility, lighting, and spatial configuration as a way to enhance the user’s experience of the building.
Spirituality

As mentioned in the previous chapter, the spiritual nature of the underground has gone through a significant transformation at the hands of science. The paradigm shift that took place resulted in a change in the values of thought and philosophy, which in turn had a devastating impact on the experiential quality of the space created by underground architecture. It has led to the removal of the spiritual relationship that had previously existed in architecture, and has created a contextual environment that fosters negative perceptions toward subterranean buildings.

The underground's history placed it contextually in the role of a shelter, which subsequently associates it with the more positive connotations
of safety, security, and protection. The underground, often referred to as Mother Earth, was once viewed as a source of fertility and life, and yet now the space within the earth is usually envisioned as a lifeless and static environment.\textsuperscript{8} As underground buildings became more of a commodity, they were stripped of their of spiritual significance, except for those instances of architecture that serve as monuments or religious centers. While religious centers’ deeper meaning is more than just associated with the underground, the tactics employed in their development can be utilized and adapted to aid in the architectural development in other programmatic uses. The integration of such tactics can be vital to prevent the aforementioned environment in which emotion removed from architecture, which is no longer about experiential quality, but rather functionality. As mentioned in the previous chapter this can be seen in the emergence of tunneling, mining, and buildings of utilitarian function.

The collapse of the spiritual connection with the earth and the underground is not confined to the built world, but is also capture in the changing attitude of authors toward the underground. This can be highlighted in the contrast of early works such as Virgil’s \textit{Aeneas} and Dante’s \textit{Inferno}, versus the post industrial revolution works of H.G. Wells \textit{The Time Machine} and Bulwer-Lytton’s \textit{The Coming Race}. While these works are just a small sample of the literature available, in the early work the authors depict a journey which takes the main character into the underworld where they encounter a place, whether good or bad, or spiritual significance. The later works on the other hand depict an environment where man has destroyed nature with technology and the underground is conceived of as evil a place for non-human life. This collapse in the spirituality is reinforce in the relationship of literary and architectural works, which can understood as a parallel progression in which both strengthen or reference what the other is doing. This connection is reinforced by John Carmody, who stresses that

\textsuperscript{8} Carmody, 138.
“information is drawn from two sources (1) the images of the underground that seem to be rooted in history, culture, language, and possibly the subconscious, and (2) the actual experience of people in underground or other analogous enclosed environments.” However, since most peoples exposure to the underground is limited, people must draw their conclusions and perceptions from their culture and history, which is predominately recorded in written works. But Carmody’s conclusions does give rise to a situation in which as one source begins to change, the other will begin to reflect that change in their work because the two are intrinsically tied to how people process information.

Despite the parallelism, there should be more significance placed on literature, due to its ability to influence a broader audience resulting from peoples’ limited exposure to underground environments. What this creates then is a social context that is dramatically influenced by the written works of others, “a kind of common experience: a vessel in which the underground metaphor is carried and preserved.” The end result, is an environment in which words hold the power of mystery and meaning that can be nurtured, developed, and translated into architecture. However, literature does not need to be confined to description of architectural works to influence the spiritual connection that exists between these two entities. As Rosalind Williams explains:

*Stories of descent into the underworld are so ancient and universal that their fundamental structure, the opposition of surface and depth, may well be rooted in the structure of the human brain. The congruence may be explained by the Freudian hypothesis of an Oedipal experience that splits human beings into conscious and unconscious selves, or by Jungian hypothesis of a collective subconscious. In any case, the metaphor of depth is a primary category of human thought. It is the combination of*

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9 Carmody, 138.
10 Lesser, 11.
enclosure and verticality...that gives the image of an underworld....If we imagine going underground, we not only imagine an environment where organic nature is largely absent; we also retrace a journey that is one of the most enduring and powerful cultural traditions of humankind, a metaphorical journey of discovery through descent below the surface.11

While she does not differentiate between written and spoken works, the difference is irrelevant to the spiritual truth that she argues is engrained into the human subconscious. This truth or understanding of depth and verticality, that has been instilled in our culture from the past, is one that must be understood and replicated in order to create a solution to the challenges of subterranean architecture in the future. The mystery and power of the underground stems from the vertical movement that differentiates between the two worlds, surface and underworld. It is this quality that gives rise to associations of an epic journey into the unknown, one in search of truth and discovery that has manifested itself throughout centuries in various cultures.

Often this journey carried significant religious connotations, as was customary in ancient civilizations, before the interference of scientific understanding and logic. Underground spaces were for religious ceremonies. Its essence as mysterious and secret provided an environment in which to carry out initiations and rituals that required long and unbroken periods of observance hidden from the public. The most common of legends of the underworld, equate the subterranean kingdom with the realm of death from which most never return.12 As practical as the underground was for actual use, its mysterious nature made it even more common in myths and stories:

11 Williams, 7-8.
12 Pennick, 28.
There was, to begin with, Hades – that is, the imaginary underground is first of all the locus of death and rebirth, the place where dead souls go to be washed of their memories and returned to life on earth. In this sense, the underground is both place of origin and place of final rest. From this land of the shades developed the idea of the Christian hell – no longer the abode of the undifferentiated dead, but a place of eternal punishment for the damned alone. The notion of the underworld has always held something of mystery and terror for the living, but with Christianity the subterranean began to be equated with evil – a connotation which carries through to the present.13

As demonstrated by Wendy Lesser, these images of a dark underground world were transferable between various religions and cultures, which supports Rosalind Williams claims that the human experience with the underground has been instilled in the subconscious of human thought. The shared relationship or understanding of the underground provides a common thread on which one can begin to interrupt and make inferences in regards to architectural works. Not only can one understand the architecture of this period, but one can also gain clarity into the power and mystery that the underworld played in each culture’s spiritual life and development.

The subterranean realm continues to not only be defined solely as the place of death, but also carries significance as a place of healing and human transformation. These rituals believe that those who entered into the underworld would later emerge as spiritually changed. Local traditions tell how certain caves and tunnels possessed healing powers that were vital to the periods of transformation.14 Generally, these periods of transformation and healing would be centered around water, which would drip from the ceiling and collect in rock pools. However, these processes would be more

13 Lesser, 2.
14 Pennick, 49.
than just interaction with water, but would focus on the journey and seclusion from surface life. It would be this displacement from people and nature that would allow for a period of inward reflection that would be vital to a spiritual transformation.

While it is important to understand the spiritual connotations of the underground experience, it is equally important to understand how these moments and experiences were translated into architecture. The quest becomes to design spaces that encourage or focus on various spiritual interactions. One such example reinvents the realm of ancient oracles, which were almost invariably associated with subterranean. Originally, at Delphi, above a cleft in the ground, there were stories of a downward link to the infernal regions. In this case, where such a natural cavern did not exist, tunnellers made an artificial one whose plan coincided with the legendary geography of the underworld.\textsuperscript{15} Another example, in 1932, Amadeo Maiuri, a renowned Neapolitan archeologist, following Virgil’s account, excavated the fearsome cavern known as the “Antro della Sibilla” in Cumae (Image 2.1). “He found it to be 450 feet in length oriented true north-south with the cella of the Sybil at the southern end.”\textsuperscript{16}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{Image_2.1}
\caption{Image 2.1}
\end{figure}

\textsuperscript{15} Pennick, 25.  
\textsuperscript{16} Pennick, 25.
While this example does not infer anything about the quality of the space, it does suggest or reference this idea of journey with the oracle being located at the end of the long tunnel. Not only does it provide insight into how the ancients understood the underground to be associated with the search of truth, it also implies some acknowledgement of the spiritual importance of being oriented true north-south. While it is unclear to why it is oriented true north-south, one can hypothesis that it was related to the knowledge of the oracle possibly the alignment with celestial bodies.

However, beyond its geographical alignment, this example enables us to understand specific strategies employed by the ancients to give special meaning to the experience of meeting the oracle. In particular, the traditional paths to oracles involved a procession through a series of rooms that generally sloped further down into the depths of the underground. This method or tactic can be translated into modern architecture by emphasizing a sequential process for the user that involves either or both a slow transition downward or a series of spaces with evolving meaning, the current day translation of anti-chambers prior to meeting with kings. By instilling a set process that you the architect intend the user to follow and experience, you are infusing a specific meaning into the design. However, the architect must also focus on how to terminate the sequence, because both meaning and experience can be interrupted if not ruined by a lack of a well planned and designed ending. Because the question becomes how does the ending reinforce the procession that the user has been forced to take?

While there are many examples to suggest spatial organization plays a large role in the spiritual meaning of underground development, there are even more examples of where the combination of spatial layout and the integration of natural light at specific moments in time are used to instill a spiritual meaning. One specific example was left to us in the *Pall Mall Gazette* of April 20, 1892:
The great temple is dedicated to Amen-Ra, the sun-god, and on two days a year the sun is said to rise at such a point that it sends a beam of light through both halls till it falls on the shrine itself in the very Holy of Holies. Many theories are based on the orientation of the temples, and Captain Johnston wished to find on which day in the spring of the year the phenomenon took place; so he took his instruments and we all went up to the temple before dawn. It was 26 February. The great hall, with its eight Osiride pillars, was wrapped in semi darkness. Still darker were the inner hall and shrine...a hard white light filled the sky. Clearer and whiter it grew, till, with a sudden joyous rush, the sun swung up over the low ridge of hill and in an instant...one level shaft of light pierced the great hall and fell in living glory straight upon the shrine itself.\footnote{Pennick, 33.}

As is evident by this correspondent’s writings the incoming sunlight illuminates the shrine providing for a powerful experience. The builders were able to build the shrine and the space so that at special moments it exhibits a higher spiritual quality. In this particular case, the appearance of sunlight is directly correlated with the worship of the sun-god Amen Ra. This temple is just one example of a variety of monuments that used sunlight to highlight specific shrines. “At Abu Simbel (Image 2.2) it illuminated the tutelary deity of the temple. At Newgrange (Image 2.3) it shines upon the carved symbols which adorn a stone at the far end of passage.”\footnote{Pennick, 33-34} Regardless of whether the subterranean space was oriented to important astronomical events or used light funnels, the impact was to infuse a greater meaning into the space in which they occupied. It demonstrates the significance of bringing light into the darkness of the underground and the importance of this symbolism to the spiritual nature of the shrine. By employing these strategies different cultures and religions would not only be able to worship...
their god, but also impart a greater meaning and significance to the underground in their lives.
Visibility and Presence

The architectural response to underground development must discover solutions that will enable the project to maintain its visibility and establish a presence on the surface. There are two major challenges that the architect must address in order to create a successful project that overcomes the inherent nature of the underground. The first problem is the potential for the building to lack a distinct image that will attract people to the building. In 1985, C.M Deasy stated that for a building to have a good environmental image it must communicate five things: what the facility is, what benefit it offers, how one gets in, what is inside, and how one will be
received. While these points of contention are still relevant and important for a successful image, his five elements must be adapted to today's cultural environment, which is heavily dependent on visual stimuli and is easily distracted by the fast-paced nature of society.

Building underground can pose significant challenges for institutions that employ their image to stimulate business. The fact is some buildings that may be hidden below ground are not always desirable due to their programmatic intentions. Buildings such as retail stores and restaurants, must attract attention for business with visible cues and therefore, must achieve a different level of visibility. While an office building, on the other hand, utilizes its visible image as a symbol of the size, wealth, and profile of the corporations within. These buildings use their image as billboards for the companies to garner the attention of the public and to represent the values of the occupants. When one chooses to put a building underground, one is downplaying this function of the building and removing potential value from the building and company.

However, this is not to say that underground architecture cannot serve a similar function in a different way. Rather than focusing on a visible image of the building form, the architect can address the second problem of underground architecture, which is the design of a successful entry to help communicate a building image. Not only is a successful entrance necessary to accomplish the physical psychological needs associated with entry, but it can also be employed to help attract the public to the building and site by instilling alternative qualities such as being mysterious and alluring. The rationale is that people are often drawn to things that seem adventurous and to things they do not understand. This is reinforced by Brian Bain, who suggests that a particularly intriguing aspect of a successful entrance is the creation of “mystery”. This idea of “mystery” implies that the entrance is not completely obvious, but that information unfolds slowly as one moves

\[19\] Deasy.
\[20\] Carmody, 40.
through the entry sequence. The observer is lured along by curiosity and feelings of anticipations and is rewarded by pleasant surprises.\textsuperscript{21} Romedi Passini references this tactic in his discussion of labyrinths, which stimulate the user with complex wayfinding problems and ultimately rewards them with the experience of finding the solution.\textsuperscript{22}

While mystery can enrich the experience of approaching and finding the entrance, the entry design must also solve several other design issues. One of these is the entry sequence’s need for clarity, for the design must strive to create legibility due to the significant role the entrance plays in underground building design. Christopher Alexander states that:

\begin{quote}
Placing the main entrance (or main entrances) is perhaps the single most important step you take during the evolution of the building plan...The entrance must be placed in such a way that people who approach the building see the entrance or some hint of where the entrance is, as soon as they see the building itself. This makes it possible for them to orient their movement toward the entrance as soon as they start moving toward the buildings without having to change direction or change their plan of how they will approach the building.\textsuperscript{23}
\end{quote}

Alexander’s argument is further supported by Bain, who recognizes the need of the entry to serve multiple functions. The first function is to be the main signaling point of the building, which allows the user to strengthen their orientation between inside and out. The problem is that the building form is predominately below ground and therefore the entry cannot be designed in a familiar pattern. Rather than being an a distinct form or void in a larger mass, the entrance must now stand alone as an object in the site, conveying

\begin{thebibliography}{9}
\bibitem{21} Bain.
\bibitem{22} Passini,.
\bibitem{23} Alexander, 541.
\end{thebibliography}
the physicality of the building below. The entry therefore, must be designed at a larger scale to create visibility and ensure that the entry is an appropriate size for the site. This enables the architect to approach the entrance design in a manner similar to that of a building. This either entails sculpting the land into a depression to reveal the entry or build up an element that on the site that serves as the entry.

The entrance not only serves as a physical reference, but also provides a perceptual and psychological function as well conveying a sense of arrival, the mood of the building and most importantly to underground architecture, it marks a point of transition from the surface to the underground and as such must contend with the negative associations of the underground. The most prominent perceptions stem from the movement downward, from light to darkness, from openess to confinement and finally from the surface to the underworld. These transitions carry a variety of psychological issues, such as claustrophobia and fear of entrapment. In order to respond to these concerns the entry must focus on removing spatial confusion and limiting the spaces of confinement. It also important to provide adequate light around the entrance to help facilitate more positive associations.

Despite the challenges associated with instilling a sense of presence, there are techniques and design strategies that can be studied and integrated into a project to ensure a successful entry that will address both challenges. Two specific projects that have been studied to provide insights into the design strategies employed by the architects are the Chichu Art Museum, Chatem Sofer Memorial. Each of these projects utilize different design strategies that evoke a different sensual perception in the user, while maintaining a visibility and presence on their respective sites.

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24 Bain.
Chichu Art Museum

The Chichu Art Museum design by Tadao Ando was built in Naoshima, Japan, a small island of the Inland Sea of Japan, in 2004. “The name of the Art museum is composed of the Japanese signs “chi” (earth) and “chu” (middle) and thus describes the essence of the building. To build in the earth is to detach the architecture from the base area, to set as much of the building as possible below ground and thereby relieve the surface of the burden of building volume.”25 The project consists of carved volumes into the earth on top of a hill that overlooks the sea. The success of this project is not only limited to the visibility and presence of the building that originates from its relationship to the site and ground plane as well as a well-defined entry sequence that evokes associations with natural phenomenon, but is also enhance by the tactics used to integrate natural light, discussed in chapter 4.

The building is integrated into the hill with the roofs of the building form becoming the supports for surface, while the ground supports the building. Despite being underground Ando is able to maintain a level of visibility by allowing the user to glimpse the geometrical order and configuration of the museum through the extension of concrete walls above the ground plane in locations that introduce natural light. (Image 3.1) This technique creates a presence on the site that ensures that visitors are aware of the building by piercing small geometrical forms

25 Blaser, 49.
through the surface of the earth, while preventing the building from dominating the natural beauty of the site. The largest outward projection is a frosted glass pyramid that serves as a skylight for the Monet gallery. This illustrates the ability of Ando to create a harmonious relationship between nature and architecture, which adds to its presence on the site, not as building that contends with nature in an attempt to conquer, but rather one which thoughtfully engages it with gestures of respect.

The building’s presence is further enhanced by the entry sequence employed by Ando. He uses what is referred to by John Carmody as a hillside entrance to an isolated facility, which has several advantages, the main one being this type of entry does not focus on a significant downward movement, which can eliminate some of the psychological implications of a subterranean building. However, the horizontal entry is susceptible to long and possibly narrow tunnels leading into the building. Ando avoids this by thrusting the user into an open hallway exposed to the sky and natural light after a short period of darkness. In describing the entry sequence Hiroyuki Suzuki states that, “Upon arriving at the museum, the visitor passes through the entrance with the expectation of seeing art. Following the winding corridors, gradually descending into the darkness, encountering sunlight, and moving forward into the depth, the visitor loses his sense of direction.” While many would argue that it is important to provide a clear organization that enhances a user’s wayfinding, instead Ando uses confusion as a way of enhancing the user’s experience of the art and limiting the breadth of confusing experiences through the exposure to sunken courtyards.

Beyond the experiential quality of the entry sequence, the Chichu Art Museum’s entry is physically manifested in a way that represents the entry into a cave. (Figure 3.1)

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26 Carmody, 179.
27 Ando et. Al.
As one approaches the building they are confronted by a large concrete wall that juts out from the hillside to form a barrier that one must pass through to enter into the museum. The similarities in the representation stem not only from the solidity of the structure holding back the earth, but the initial experience upon entry discussed above. Ando’s approach to entry design immediately connects the user with the earth by referencing a natural phenomenon to establish a guiding principal.

**Chatam Sofer Memorial**

Another project that follows a similar principal to that of Ando in the imitation of a natural phenomenon is the Chatam Sofer Memorial designed by Martin Kvasnica in Bratislava, Slovakia. The project is the rejuvenation of the sacred tomb of Chatam Sofer in the Jewish faith that is surround by twenty-two other tombs. The site originally fell into disrepair in 1942 when the city built a new tunnel through the cemetery and increased the ground level to provide support to the Danube River. At the time, most of the graves were exhumed and moved to an alternative site, however, the twenty-three graves remained and were subsequently covered with concrete plates forcing the cemetery and the tombs further underground. After it was
covered the only way to reach the site and to visit the tomb was through a tin shelter that provided little, if any, positive experiential qualities.

The opportunity for a new project stemmed from a political and social change in the area. In order to make the new project happen they were able to move the tracks and to raise the concrete plate overtop the tombs. The effect of increasing the height was to enable the space inside to be occupied by visitors to the tomb. What gives this project a point of emphasis is how the architect approached the design of the entry. The site appears to be devoid of built objects except for a black prism that intersects a sloping mound (in reality the covered tombs) and is approached by an unambiguous line/path the moves through the old cemetery surrounded by gravel. (Image 3.2) This corresponds and successfully satisfies many of the arguments introduced by Bain, as not only does it create a sense of mystery, it is accompanied by legibility due to the simplicity of the design. As one approaches the black prism, which is reinforced concrete walls that have been covered with black paint and silicate, they are overcome with the feeling of loneliness and anxiety that is produced by the cramped space between the walls of the prism.28 While within the prism the only visible light comes from the entrance or from above as the prism opens to the sky. As the user enters the prism they also begin to descend down into the spaces beneath the ground, where they are able to see the graves of the dead. The entry sequence design by the architect creates a strong association with death through the combination of black painted walls and cramped spaces similar to that of a tomb, while choosing to leave it open to the sky allows the user to look up to the heavens as if that is place of destination, not the visitor center. Ultimately, the experience ends in death as you look over the graves of the past helping end the sequential experience of the entry.

28 Kvasnica.
The sequence and the design of the entrance to the memorial also mirror that of a canyon. (Figure 3.2) By covering the walls with silicate as a way to enhance the texture and bringing light in through the surface, the experience is similar to a journey through the natural ravines and canyons found across the world. Not only does it reference natural phenomenon, but it also shares a similarity to the conditions of ancient oracles.
The design also employs a secondary element beyond the black object in space, to give the building an image and presence on the site. In order to give the graves a presence on the surface the architect began to penetrate the concrete slab with slits where they gravestones would rest. He then pierced the ground plane with glass gravestones, which not only provide recognition of the tombs below, but also allowed light to flow into the space and highlight the tombs. (Image 3.3) This references Deasy’s requirements for a building image through the communication of the function of the building as well as how they enter. The design by Martin Kvasnica employs several unique strategies as it begins to satisfy the requirements necessary for a successful underground building as it strives to maintain its visibility and create a presence on the site.

![Image 3.3]
These projects demonstrate that there are several ways to architecturally create a successful image in an underground building and employ an entry strategy that not only instills a sense of mystery, but also is legible to the user. What is unique about these two projects is that they often employ strategies that provide experiences that are not necessarily recommended to combat the negative perceptions of the underground. However, it is important to note that each architect creates specific qualities and sequences in order to reinforce the experience of the interior, for Ando it was the art and for Kvasnica it was the focus on the tombs. Therefore, as these project suggest, it is vital that there is a consistent approach to the design of the building and that it corresponds to the image and user's experience in such a way that the potential for a negative perceptions is removed by the moments within the project.
A successful architectural response to the underground is not only defined by its entry and response to the surface condition, but also its response to the interior physical constraints that subterranean architecture imposes on the building. The two main techniques addressed in this writing to combat the key interior problems of underground architecture are spatial layout or configuration and lighting, with the dominant focus of lighting on the introduction of natural light. While these are not the only environmental needs of an underground building, they do represent specific challenges and have the greatest fundamental affect on design.
While it is clear that both architectural elements have an impact on design, addressing the spatial layout of the building is the more dominant factor in the design, as natural lighting can be adapted to fit within most projects. The reason that the layout and spatial configuration needs to be addressed in more depth is that it requires a different approach to design. The interior layout and spatial relationships are typically developed concurrently with the exterior image of the building. However, when designing an underground building the main focus of the architect is no longer the exterior image, so image and adjacency relationships no longer drive architectural form. Consequently, one can no longer rely on the techniques and strategies employed in the design of above-ground buildings, as they will result in a deficient environment for the user. It is impossible to compensate for these deficiencies with good interior design alone, but rather the architect must make a concerted effort to integrate interior design with the size, shape and arrangement of interior spaces.

**Spatial Organization**

The development of the spatial organization of the building must concentrate on solving the following design issues: lack of spatial orientation, lack of windows, which enhances a sense of confinement, and a loss of stimulation from exterior surface environment. To understand how to approach these issues it is vital to mention the overall strategy of underground architecture, which is that architects must create a layout that is inwardly oriented. This generalization will help to alleviate some of the general concerns of disorientation and compensate for a lack of connection with nature and thus a loss of stimulation. However, there are more specific tactics that can be employed to address each issue independently.

The lack of spatial orientation of the user stems from the most basic of sources, which in this case is the basic principle or advantage of underground architecture, that is to say, the overall mass and configuration of the building.
is concealed beneath the earth. It is the inability of the user to see the building form and understand the configuration that promotes disorientation, for people initially perceive and judge architecture based on form and then experience. The users rely on the exterior perspective and form of the building to give them a perception of location and enable them to understand the building from a macro vantage point before they seek out the interior experience. According to Romedi Passini, “one of the three important factors that enable people to create a mental image of places so they can orient themselves and find their way in buildings is perceiving the external organization principle given by the spatial enclosure or building volume.” 29 It is conceptually difficult for the human mind to understand space and circulation when they cannot associate it with a specific location.

This is an inherent problem with underground architecture because there are no landmarks or sight lines that the user can relate to the building. It must stand-alone and provide clarity through the interior layout of the building, relying predominately on the quality of space and specific architectural movements to communicate to the user their location in reference to the surface and an environment they are familiar with. For it is conceivable that an underground building can stretch out like the roots of a tree going out infinitely into the landscape disorienting the user. This according to Kevin Lynch, would foster a sense of anxiety and even terror, revealing to us how closely it is linked to our sense of balance and well being. The very word lost in our language means more than geographical uncertainty: it carries a tone of utter disaster.30 A modern-day example of this would be the underground tunnels in both Montreal (Image 4.1) and Houston, which are designed to be an underground network of retail, restaurants and other commercial establishments that remove the customer from the harsh climatic environment of the city. The drawback from a user’s perspective is that you are unaware of your location in reference to the

29 Passini.
30 Lynch.
surface. It is unclear to those in the tunnels whether they are under a street or a building. As a result, they can easily become disoriented and confused in regards to their location in the city.

Therefore, architects must adapt and redefine Passini’s point of contention to fit the natural conditions of the underground. The result should be a principle that proposes that a building's exterior and interior should be integrated or designed to reinforce one another. This would establish a connection between the interior and exterior elements, which would suggest to the user the building's location in relationship to the site. It could prove challenging within deep isolated buildings, to establish a visual relationship, however in shallow buildings courtyards could be employed to enhance orientation and create continuity between the surface and building. This particular design strategy was employed by Tadao Ando in the Chichu
Art Museum to infuse natural light into the corridors of the building, but also to provide the glimpses of nature and the sky. The courtyards help establish the user’s orientation in the building because they are able to relate their current location to a previous one by their position and relationship to the courtyard. Therefore, as they explore multiple levels, the configuration of the building begins to unfold itself through experience, allowing the user to create a mental image of the building. Irrespective of which technique is employed, the strategy would be integrated into a design that utilizes a clear spatial organization and moments of specific experiences within the building. This in turn would satisfy Passini’s other two factors of understanding an internal organization principle and understanding relationships among spaces.31 This will allow the user to orient themselves in relation to two points, the first being the entrance and the second being the site, in order to prevent confusion and reduce the probability of a negative experience.

What is interesting to note is that both Lynch and Passini refer back to the concept of “legibility” introduced by Bain in the previous chapter. In this case, though, Lynch is referring to the “ease with which its parts can be recognized and can be organized into a coherent pattern” as opposed to Bain who is focused on communicating a direction of movement rather than comprehension.32 Passini takes Lynch one-step farther and converts this idea of “legibility” into the term “imageability”. While Lynch looked at patterning and relationship of parts, Passini is referring to “the ease with which a place can be mentally represented.”33 Thus, he suggests that the cognitive power of the brain to map out a building is vital to maintaining orientation, which is reinforced by his three factors of a good mental image introduced earlier.

Beyond the application of the spatial layout to address conditions necessary for orientation, it can also be employed to solve states of

31 Passini.
32 Lynch.
33 Passini.
confinement and lack of stimulation. The reason these two design problems are grouped is that the architectural solutions share similar characteristics, meaning that as the architect responds to one condition they are in essence tackling the other. In a typical architectural project, both problems would be solved by the inclusion of windows. However, without windows, underground buildings are unable to provide the stimulation needed. Thus, in underground spaces the architect must utilize imagery to not only provide more stimulation, but to eliminate anxiety and dissatisfaction from the negative imagery that exists within our deep consciousness. Therefore, architects must consider the ramifications of a windowless environment at all stages of design, from the overall plan to the interior design. Within this context though, the overall layout and arrangement of spaces provide the greatest opportunity to compensate for a windowless environment. Architects must be conscious of the impact of the spatial layout in regards to the placement of specific functions. According to Muro and Sawada Hane:

_Dissatisfaction is more common in offices or control rooms than factories or department stores, where contacts with other people, the changing surroundings, and spaciousness compensate for the lack of windows. Isolated and remote work stations should be avoided in underground spaces...strict control or restriction of movement in underground spaces is extremely harmful...it has been observed that the lack of windows in underground spaces makes the psychological atmosphere susceptible to disturbances... people using such a space often feel that something is missing’ consequently they tend to imagine that what the space lacks is perhaps more significant than it really is. This phenomenon manifests itself in various expression of dissatisfaction directed at the environment conditions_.

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34 Hane,
35 Ylinen,
Within this context though, the overall layout and arrangement of spaces provide the greatest opportunity to compensate for a windowless environment.

As previously mentioned it is essential for architects to design a clear and understandable layout, yet that does not mean the layout should be simple and monotonous. Rather the contrary is true, the spatial configuration should be complex enough to provide a varied and rich experience to stimulate the user. One popular technique is to arrange spaces to overlook other spaces. This technique was used by architect Gunner Birkerts at the Law Library at the University of Michigan, where he employed open, multilevel interior spaces. The result is a stimulating and open environment where students are able to form visual connections with activities and students on multiple floors. Not only does this design feature help stimulate the user, it also is utilized to create a feeling of openness to reduce the impact of a potentially confining environment.

In conjunction with multilevel connections, an underground building requires the architect to create larger spaces. Whether that entails a physically larger space or geometrical configurations that enhance the perception of the space is for the designer to decide based on the programmatic and overall spatial requirements. This does not mean the architect can simply raise the ceiling heights or increase the dimensions. Rather the designer must make a concerted effort to understand how a space is perceived to prevent it from feeling sterile and deficient. However, regardless of which tactic is used the overall affect of easing a sense of confinement is still addressed.

**Lighting**

The second technique, integration of light, while suggested to be less dominant in driving overall design, is nonetheless vital to the experiential quality of the interior and the effectiveness of the design. That is because
“associations with darkness are frequent in underground imagery and lack of windows and natural light are among the most commonly cited drawbacks of below-grade [buildings]. If underground spaces are designed to be positive, healthy environments for people, both natural and artificial light will play a significant role.”\textsuperscript{36} The reasoning behind the vitality of designing for the inclusion of light is that it is vehicle for visual experience having an impact on the perceived spaciousness of a space as well as providing definition and character in a space through the play of light and shadow. Beyond its influence on perception, light is fundamental for the execution of tasks.

When designing underground, architects must focus on developing solutions for the several key design problems associated with lighting: lack of stimulation and connection nature due to the absence of windows, and similarly to spatial configuration, a sense of confinement. In order to appreciate the design solutions, it is necessary to first address the appeal of natural light in the built environment. First and foremost, according to Richard Wurtman, “light is the most important environmental input, after food, in controlling bodily function.”\textsuperscript{37} As suggested by Wurtman, natural light has several biological implications on the body from regulating our day and night cycles to the secretion of certain hormones. Science has shown that there are adverse side affects to a lack of exposure to natural light. Whether it is the health benefits or the enhanced quality of space, it has prompted Christopher Alexander to suggest that “buildings which displace natural light as the major source of illumination are not fit places to spend the day.”\textsuperscript{38} Therefore, this thesis is not advocating the use of underground architecture as an environment of permanence without the significant inclusion of natural light. While, on the other hand, it recognizes there are environments where natural light is not wanted or where light is needed on a more limited basis such as theaters, laboratories, and museums. Second,\textsuperscript{36}\textsuperscript{,}\textsuperscript{37}\textsuperscript{,}\textsuperscript{38}

\textsuperscript{36} Carmody, 261.  
\textsuperscript{37} Wurtman, 523-529.  
\textsuperscript{38} Alexander, 746-751.
people prefer sunlight and as a result often overestimate its perceived impact on the quality of a space.

As such, it is clear that light has a vital role to play in the successful development of underground building. The architectural response to these conditions requires the successful integration of natural and artificial light. There are several architectural responses that can be employed to overcome the design issues with lighting. However, the architect must first address natural light, which will have the greatest impact on design, as it does have the potential to fundamentally shape the building layout. For example, the use of courtyards and atriums have been used as the principle factoring organizing several projects, such as the Tadao Ando’s Chichu Art Museum (Figure 4.1) and I.M. Pei’s addition to the Louvre. On the other hand, such responses are not feasible in deeper buildings, which must in turn rely at artificial light for the same affects of natural light.
Response and Design Guidelines

Underground architecture is typified by four design approaches illustrated by the relationship of the building’s mass to the surface (Figure 5.1). While the exact number varies based on reference, both Carmdoy and Ernst Von Meijenfeldt and Dick Regenboog, agree in principle on three of the four typologies.\textsuperscript{39,40} The building forms are categorized based on varying criteria such as exposure to sunlight and views, as well as their impact on the surface.

\textsuperscript{39} Carmody, 49, 60.
\textsuperscript{40} Meijenfeldt and Regenboog, 139.
Figure 5.1

Earth-Covered Spaces

Submerged Spaces

Fully Underground Spaces

Multi-Level Spaces
As such, the designer must choose the building form or a hybrid that satisfies the conditions of the project while also interpreting which form would be appropriate for the site. For example, in the Chichu Art Museum, Ando choose to make a series of submerged spaces due to his desire to infuse the project with natural light and provide the user with glimpses of the building form below. While this could have been accomplished by employing multi level spaces, his desire to protect the natural views from on top of the site, as well as reducing the projects visual impact on nature led him to the chosen form of the project. As this project demonstrates there are a series of criteria that need to be outlined by those involved in the project that will ultimately lead to a decision to which direction and form the project will take. The following section will provide a brief description of the four typologies and in the process will outline the advantages and disadvantages of each as a way to inform those in pursuit of developing underground. It will also provide examples of projects that have been grouped into each category to provide references to the techniques embodied in the design of the building.

Earth Covered Spaces

Earth Covered projects can be divided into two categories: projects that are built into a hillside or cliff such as Petra (Image 5.1) or projects that are not strictly speaking underground, but rather build up the landscape to where it appears the ground surface is laid over the building as is the case with Mecanoo’s Library in Delft. (Image 5.2) The latter differs from the first, in that it is free from many of the technical disadvantages of underground building, while able to enjoy the spatial advantages. In addition, it is open to natural light, which is able to penetrate the space with no special techniques and finally it is able to maintain views of the exterior. However, unlike the first, it has a visible impact on the surface condition, despite its ability to recreate or alter the current surface into a new landscape. Also, it is able to
approach its exterior in a similar pattern to above-ground buildings, as it is not restricted by the ground.

The first category of projects are developed into a hillside or cliff must be developed in such a way that the entrance is legible and easy to find as a way to direct the user into the building. This is vital due to the ability of the natural elements to obscure the entrance from view unless the user is directly adjacent to it. There are little opportunities to bring light into the building, as the architect is restricted to the side of the entrance or the top of the hill. Also, the ability to bring light in through the top surface is restricted by the depth of the building. The advantage though is that the entry sequence can limit the movement downward due to the horizontal nature of the entrance.

**Submerged Spaces**

Submerged spaces are buildings that lie just below the surface, but engage with the surface to reveal the building below. The building, however, is not restricted to being shallow, but rather like the other typologies is able to extend deep into the underground. The interaction with the surface serves multiple functions for those that choose this typology, with the main one being to allow daylight to penetrate into the building. This is can be accomplished with sunken courtyards, skylights that open into an atrium, and finally a perforated surface, generally a patio or walkway. Beyond letting light into the building, the interaction with the surface provides the architect with the opportunity to communicate the information identified by Bain to the user and establish the building’s image and presence on the site.

I.M. Pei employs this form in his design of the addition to the Louvre, where he employs the use of a pyramidal skylight to not only let light into the main

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41 Meijenfeldt and Regenboog, 139
space, but to establish a strong dominant image on the surface for the building below. (Image 5.3 & 5.4)
Interacting with the surface not only provides the architect with the opportunity to express the design and provide positive benefits to the image of the building, but it also provides psychological benefits. By providing more light and views to the outside, occupants are able and willing to spend longer periods of time in these submerged spaces, as they find the architectural qualities of these spaces inviting.

The disadvantage to this approach to the design is that the building imposes more of presence on the surface, which will have an impact on the design and use of the site. Architects must be cognizant of how the surface design elements fit with in the context of the site, while maintaining the qualities necessary for successful entry design outlined in chapter 3.

**Fully Underground Spaces**

Fully underground buildings are completely underground with little to no contact with the surface world. Generally, the only interaction with the surface is the entry, but there are opportunities to connect to the building through adjacent basements leaving the surface devoid of any visual presence. These types of buildings can be either shallow or deep, but regardless their underground nature forces them to rely on mechanical devices to provide light and air into the spaces. The absence of natural light makes prolonged exposure to the building unpleasant and as a result, this type of building has been predominately used for infrastructure, which are spaces that are moved through and not occupied.\(^{42}\) One such type of development usually sited in this typology is metro stations. These spaces receive a high level of user traffic that is sustained throughout the day, however the individual user only briefly interacts with the underground spaces. While this is just one example of an infrastructural development, there are others such as storage, factories and other programmatic types that

\(^{42}\) Meijenfeldt and Regenboog, 139
are solved with fully underground buildings that do not need a high level of design to function. This is not to say that this typology should be restricted to infrastructure, rather there are opportunities to create successful projects, but they require more attention to the interior spatial quality. The Canary Wharf Station on the Jubilee Line in London is an example of a project that fuses an infrastructural development with attention to the interior spatial quality. (Image 5.5)

The advantage of a fully underground building is its limited impact on the surface which allows the surface condition to exist unimpeded by the project. In addition, in situations when the building is developed deep underground, the surface is open for development allowing the site to increase the density of development.
Multi-Level Spaces

Multi-level buildings are projects that visually connect the surface with the underground. While this is similar with submerged spaces, it differs in that the interaction occurs through a building that has programmatic functions other than purely entry that occupies the surface. The spatial sequence and other functions of the building then begin to descend into the underground. It is similar to an above-ground house with a basement; only it differs in that the lower levels are visually able to connect to the surface and the building, allowing light to filter into the lower levels. The added level of light into the building increases the time people are willing to spend in the building as people perceive the space differently and are less aware of their reality of being underground enhancing their experience. The underground building is able to interact and pierce the surface at multiple locations, creating a varying level of exposure to the user.

The advantage of this form is that it provides more opportunities for the architect to establish a visible image for the building that is able to attract the public. This makes it a preferable design approach for those buildings that require a heavy volume of people for the success of their business. The disadvantage, however, is the high level of impact that it plays on the surface. Therefore, in environments that have limited land for development or is sensitive to the development of the surface this typology would not be appropriate.
Part II
The Project
Project Description

The concepts of this thesis are manifested in the design of a museum for the Smithsonian Institute on the National Mall in Washington DC. The site is the National Sculpture Garden and is both restricted from horizontal and vertical development due to existing conditions and laws. As outlined above, this is a situational project where the only place to build is underground to be able to continually expand and increase the built density of the National Mall. The project has attempted to solve the architecture of an underground building developing its own presence on a site adjacent to an existing architectural language and style, with a visible component that will make it a destination. In addition, it studies the integration of natural light into a
spatial configuration that enables it to mimic characteristics of an above-ground building to overcome the inhibitive nature of people’s attitude towards the underground. Finally, architectural qualities translated from the past have been used to inform the development of the building in a way that establishes a spiritual meaning that is intrinsically tied to the functionality of the project and goals of the client.

The museum’s program is a science and history museum dedicated to unlocking the mysteries of the universe through the study of the Earth’s past and present paleontological and geological records of our planet. The museum’s galleries showcase the results of past and present explorations and connect them to humankind’s artistic and cultural endeavors. The client for the project, the Smithsonian Institute, has set these objectives in their 2010-21015 strategic plan as one of the four larger goals for the Institute to address moving forward. The goals of the client are enhanced by the exploration of subterranean architecture, as it reinforces the geological and paleontological aspirations of the Smithsonian Institute, as well as provide another tool to help with the education of society. The building typology, submerged spaces, was chosen due to the conditions of the site as well as the needs of the programmatic functions and the desire for a presence and visible element on the site. Also, the project has attempted to appeal to all social classes within society, in order to progress the future of subterranean architecture away from its past.

The Smithsonian Institute

The origins of the Smithsonian date back to 1826, when James Smithson, a British scientist, wrote his last will and testament naming his nephew as beneficiary. In his will he stipulated that if his nephew died without heirs the estate should go “to the United States of America to found at Washington, under the name of the Smithsonian Institution, an
establishment for the increase and diffusion of knowledge among men.”43 While the motives behind the bequest still remain a mystery, some prominent hypothesis include his disdain for the rigidities of British Society or his interest in the ideals of democracy. Following Smithson’s death in 1829 and his nephew’s in 1835, President Andrew Jackson announced the bequest to Congress. On July 1, 1836 Congressed accepted the legacy and pledged the faith of the United States to the charitable trust. It was not until eight years later on August 10, 1846 that President James Poke established the Smithsonian Institution as a trust to be administered by a Board of Regents and a Secretary of the Smithsonian.

When the Smithsonian Institute was established, Congress vested responsibility for the administration of the Smithsonian in a Board of Regents, consisting of the Chief Justice of the United States, the Vice President of the United States, three members of the United States Senate, three members of the United States House of Representatives, and nine Citizens. Even though the institute is intrinsically tied to the United States it operates as a separate entity that governs itself, however it has in the past required funding from the government in order to achieve their short and long-term objectives. While members of the government govern the Smithsonian, it must also strive to achieve the needs of those around the globe that rely on the Institute to pursue their research. In addition, it is necessary that the institution adapt to the needs of students and patrons to ensure the diffusion of knowledge.

Today, the Smithsonian Institute is striving to become an international leader, an institution that plays a pivotal role in the discourse of the day. It’s desire is to address and engage a wider audience as it attempts to stretch its influence to a greater number of global communities. The Smithsonian Institute has outlined the following:

43 Smithsonian History
**MISSION**
*The increase and diffusion of knowledge*

**VISION**
*Shaping the future by preserving our heritage, discovering new knowledge, and sharing our resources with the world*

**VALUES:**

**DISCOVERY**
*Discover and bring to light new knowledge and ideas, and better ways of doing business*

**CREATIVITY**
*Instill our work with imagination and innovation*

**EXCELLENCE**
*Deliver the highest-quality products and services in all endeavors*

**DIVERSITY**
*Capitalize on the richness inherent in differences*

**INTEGRITY**
*Carry out all our work with the greatest responsibility and accountability*

**SERVICE**
*Be of benefit to the public and our stakeholders*

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**The Museum**

Throughout time, mankind has observed and sought to understand the origins of the universe through the study of the galaxies, stars, and planets. This quest, central to the consciousness of humans, has set forth lifetimes of research. The results have yielded knowledge that has been invaluable to the enrichment of human life and has produced unquestionably vital scientific

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44 Strategic Plan, 3.
and technological advances. Its impact on the views and perceptions of philosophy and culture has been expressed in all forms of cultural behavior from the arts to scientific exploration.

Humans have progressed dramatically in their knowledge and understanding of the universe since the first human gazed into the night sky. However, despite our advances in research, man continues to arrive at more questions about the reality that we inhabit and the physical laws of the universe we reside in.

The Smithsonian’s new museum and research labs will seek to undertake research and teaching to advance the knowledge and understanding of the public with regard to the universe and the earth as it pertains to the following questions:

• *How did galaxies and clusters of galaxies, stars, and planets form and evolve from the Big Bang?*

• *How did the stars and rocky planets like our earth form and evolve?*

In order to develop an appropriate facility it was important to understand the objectives of the institution for which the project served. While the Smithsonian has outlined a goal for both the research and access portions of the museum, this project will focus more on the access component as it sought to integrate the desires of the museum to serve the public as well the as the demands of the design to address the problems of the underground. The Smithsonian’s strategic plan states the following:

45 Strategic Plan, 6.
**Goal:**

*Inspire people to probe the mysteries of the universe and planetary systems.*

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Strategies</th>
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<tbody>
<tr>
<td>Engage the public in the excitement of astronomy and geology.</td>
<td>Engage in participatory research opportunities with students at all educational levels.</td>
</tr>
<tr>
<td>Encourage a new generation of astronomers and earth scientists by sharing the excitement of Smithsonian research through formal and informal STEM education initiatives.</td>
<td>Exhibit cutting edge astronomical and geological research, and further disseminate results through informal and formal education and new media outreach initiatives.</td>
</tr>
<tr>
<td>Transfer Smithsonian knowledge and technology to advance science-based solutions to real-world problems.</td>
<td>Create a seamless digital view of the universe by providing access to astronomical, geological, geophysical, and atmosphere-hydrosphere datasets with guides to promote scientific experiences for K-12 learners and the public at large.</td>
</tr>
<tr>
<td></td>
<td>Tell the stories of how people in many places and times have interpreted, visualized, and imagined the universe, the Earth, and their places in them, as reflected in science, art, and cultural practices.</td>
</tr>
<tr>
<td></td>
<td>Develop a technology transfer initiative to identify and disseminate innovative new technologies and applications developed by Smithsonian researchers.46</td>
</tr>
</tbody>
</table>

46 Strategic Plan, 8.
The Program

The Smithsonian Institute did not outline a program or list specific spaces that would be needed to address their needs in a new museum. The following is a program that has been adapted from the study of similar facilities as well as an interpretation of the Smithsonian’s goals and objectives.

Galleries.....................................................................................................................5,000 Sq. Ft.
  Large natural history exhibits

Public Services..........................................................................................................	
  500 Sq. Ft.
  Information Desk

Temporary Exhibit..................................................................................................1,500 Sq. Ft.
  Small historical exhibits
  Medium sized artifacts
  Interactive galleries

Collections Management and Storage ..........................................................10,000 Sq. Ft.
  Janitorial closet
  Collections storage
  Research storage
  Office storage

General Staff Services..........................................................................................1,200 Sq. Ft.
  Break Room

Curatorial Office ....................................................................................................
  150 Sq. Ft.

Administration Office ............................................................................................ 100 Sq. Ft.

Conference Rooms.................................................................................................. 400 Sq. Ft.

Museum Shop.............................................................................................................1,500 Sq. Ft.
Coat Room................................................................. 100 Sq. Ft.

Restrooms................................................................. 600 Sq. Ft.

Security Room.......................................................... 350 Sq. Ft.

IMAX Theater............................................................ 2,500 Sq. Ft.

Planetarium.............................................................. 4,500 Sq. Ft.

Research Laboratories.............................................. 2,000 Sq. Ft.

Mechanical............................................................... 20,000 Sq. Ft.
  HVAC
  Electric
  Audio/ Video

Seminar Room.......................................................... 750 Sq. Ft.

Auditorium............................................................... 1,200 Sq. Ft.

Kitchen................................................................. 750 Sq. Ft.

Cafe........................................................................... 1,000 Sq. Ft.
Site Analysis

The National Mall is a national park demarcated by an open expanse of land to the east of the Potomac River in downtown Washington D.C. It stretches from the Lincoln Memorial to the United States Capitol. It was originally designed in 1791 by Pierre Charles L’Enfant, who envisioned a garden lined “grand avenue” to the west of the Capitol Building. However, his master plan for the site never came to fruition. Over the next 130 years federal agencies developed several schemes for L’Enfant’s envisioned park. However, it was not until 1901, when the Senate Park Improvement Commission of the District of Columbia enlisted the service of some of the greatest American architects, that they developed a new plan, the McMillan
Plan. A unified vision for the Mall emerged with this new plan that would guide the development of the mall for the next century. (Image 7.1)

This radical redesign replaced greenhouses, gardens, trees, and buildings with an open space. It differed from L’Enfant’s by reducing his 400 ft. wide “grand avenue” to 300 feet. The new grass expanse would be lined on both sides by rows of American elms and bordered by streets and buildings.

While the McMillan plan was not developed to the exact design specifications of the original architects, it did establish a discourse in regards to the architectural style and standards for the national capital. These discussions led to the creation of the United States Commission of Fine Arts in 1910, which was established with the mandate to review and provide advice on the design and aesthetics of federal projects in Washington D.C.. This governmental body still controls the aesthetics and development of federal projects, and as such would need to approve all the design decisions for this project.
The Mall: Building Context

The Smithsonian Institution Building, nicknamed The Castle, was designed by architect James Renwick Jr. in the Gothic Revival style. It was completed in 1855.

The Arts and Industries Building is the second oldest Smithsonian Museum. It was designed by architects Adolf Cluss and Paul Schulze and was completed 1881.

The National Museum of Natural History was designed by Hornblower and Marshall in the Neoclassical style. While opened in 1910, it was not fully completed until 1911.

The Freer Gallery of Art was designed by architect Charles Platt in the Italian Renaissance style. It was completed in 1923.

The U.S. Department of Agriculture Administration Building, the first large Beaux-Arts style building, was designed by architects Rankin, Kellogg and Crane. While the L-shaped wings were completed by 1908, the central block was not completed until 1934.
The National Gallery of Art’s West Building was designed by John Russell Pope in the Neoclassical style. It was completed in 1941.

The National Museum of American History was designed by McKim Mead & White. It was completed in 1964.

The Hirshhorn Museum designed by architect Gordon Bunshaft. The design was in direct contrast of every building on the mall due to its collection of modern art. It was completed in 1974.

The National Air and Space Museum was design by architect Gyo Obata of Hellmuth, Obata and Kassabaum. It was designed to not to stand out against the Capitol building. It was completed in 1976.

The National Gallery of Art East Wing was designed by Architect I.M. Pei. It is connected to the west building by a spacious underground passage. It was completed in 1978.
The National museum of the American Indian was designed by GBQC and Douglas Cardinal Ltd. It was completed in 2004.

National Sculpture Garden

The National Sculpture Garden is currently owned by the National Gallery of Art after it was transferred to them in 1991 in order to develop the current design of the site. The current design was created by Laurie Olin for the site and was completed in 1999. It sits adjacent to the National Museum of Natural History, the National Gallery, and the National Archives. It is located across the Mall from the Hirshhorn Museum along the direct north-south axis that stretches from the old courthouse south across the Mall. According to the architect Laurie Olin:

*The National Sculpture Garden is a welcome oasis in the vast scale and bustling environment of the adjacent National Mall. It is a lush retreat created by planting, pathways, and furnishings designed to highlight some of the finest examples of twentieth century sculpture in the Nation's Capital. Olin's concept for the garden was to create a series of outdoor rooms to provide an appropriate setting and route for viewing the collection. The garden was to be a comfortable enclave for people to rest, relax, dine, and watch each other in the presence of great art...Curvilinear paths guide visitors through the rooms and choreograph a comfortable pace for observation. An elegant fountain*
replaces the old, non-functioning one, and is transformed into an ice skating rink in the winter.\footnote{Olin.}

As Laurie Olin highlights there is a vast scale to the Mall and the adjacent buildings that provide a disproportionate reference for the size of development needed for the site. As highlighted in the figure ground (Figure 7.1) the size of the site is small in relative to the scale of the open space of the Mall. This supports the need of his design and future site adaptations to reserve the “welcome oasis” as Olin termed it, in specific reference to the smaller scale and more intimate setting of the site.
The following sections are a brief outline of the conditions of the site.

**Topography**

The site slopes from the southwest corner to the north over approximately 450 feet at 3% grade. The lowest point on the site is the northwest corner. The elevation change is approximately 13 ft. The area around the fountain is relatively flat beyond the need to move water for drainage.

**Transportation**

The center of the park is reserved for quiet pedestrian circulation, while the perimeter is bounded by busy arterial roadways. Public transportation is limited to several Metro stations indicated on the diagram. (Figure 7.2) The green line runs directly adjacent to the site and as the depth and exact location of the line is undisclosed it is important to be conscious of this element in the design of the new museum. Vehicular parking is also limited, so most visitors to the western end of the National Mall arrive by private bus service.
Design

The design of the project began with an examination of how the architect must rethink the placement of programmatic spaces as it relates to an underground building. Traditionally, during the planning stages of the building the designer will position programmatic spaces according to their need for exterior access and then move inward according to adjacencies. However, in the design of underground buildings the exterior access begins at the top and then instead of moving inwards, as the architect is not restricted from bringing light in at any point on the horizontal plane, you must design down. As such, I began to outline what I deemed as activity categories on a vertical axis. (Figure 8.1) The vertical axis in this diagram
looks at levels of natural light, time of occupation and levels of interaction in a decreasing magnitude. This means that the upper levels of this diagram and the museum need more natural light as it is expected to have a higher time of occupation and subsequently more social interaction. This was vital for understanding how the program in chapter 6 would be translated into the design.

A few key points can be drawn from this diagram without referring back to the program. First, transition deals with the entry sequence: how people move into the building and what spaces they would be directly exposed to. The next level, termed interaction, focuses on programmatic elements that fostered interaction between people such as the café and gift shop. The programmatic zone identified as meandering represents the exhibit spaces and describes the process of how people move through spaces that focus on displays. The final programmatic levels, stationary and discovery, are areas of the program that do not require natural light due to the short time span for which they are occupied.

Figure 8.1
Once the principles for which the program of the museum would be designed, it was imperative to next establish how the exhibit spaces would be designed to integrate into the needs of an underground building. (Figure 8.3) From this task three strategies were outlined:

**Clarity**-

The concept behind clarity is that the relationship between the exhibition space and the main organizational area. The premise maintains a strong visible connection that is never interrupted. The user is always able to view the center space from the exhibit to provide an ease of understanding.

**Reengagement**-

Reengagement is the act of removing the user experientially from the center organizational space. By briefly disrupting the visual connection you disrupt their understanding of flow and force them to fully engage the exhibit.

**Disengagement**-

Disengagement occurs when the user is removed experientially from the main space for a sustained period of time and then re-emerges at another level of the building. It provides an exhibit approach that focuses on sequential experience.

**Design Strategies**-

![Exhibit Studies](image)

- **Clarity**: The idea surrounding clarity is the relationship between the exhibition space and the main organizational area. The premise maintains a strong visible connection that is never interrupted. The user is always able to view the center space from the exhibit to provide an ease of understanding.

- **Reengagement**: Reengagement is the act of removing the user experientially from the center organization. By briefly disrupting the visual connection you disrupt the user's understanding of flow and force them to fully engage in the exhibit.

- **Disengagement**: Disengagement occurs when the user is removed experientially from the main space for a sustained period of time and then re-emerges at another level of the building. It provides a building form that is consistent with a sequential experience.

*Figure 8.2*
The design integrates both reengagement and disengagement as its dominant strategy. These two design approaches were chosen as a way to enhance the spiritual connection of the museum as they both highlight the sequential nature of this exhibit design. The inclusion of a sequential experience, referenced in chapter 2, was a vital component that hints at a deeper meaning. In this case, the exhibit content tells the story of the universe, from its beginnings to now. It looks at the various galaxies and then hones in on ours along a journey that ends in the self-examination of the earth. It enables humanity to put its existence in the context of something bigger, something more. By integrating these two approaches with the descent of the main circulation path the design was able to coordinate the content of the exhibit with the descent. In this particular case as one nears the lower levels the exhibit focuses more the study of the earth, which allows the user to become more aware of their impact on their earth. This was designed to enhance the opportunity for the spiritual connection that has lapsed in the past.

Visibility and Presence

The museum design follows the principles of the submerged spaces. It fully engages the surface condition through the implementation of a signal wall, skylights, and a sunken courtyard used as an entry into the museum. The signal wall was designed to respond to the formal needs of the museum on the site, as a way to announce to visitors its presence. (Image 8.1) It was designed to reinforce the language of the fountain and plays on the design of the Hirshhorn museum. (Image 8.2) The varying heights of the wall correspond to the needs of the site to retain the intimate character of spaces. By varying the height the wall, it creates spaces that are at the human scale, while the taller portions are able to represent the building scale with minimal impact on the surface.
The entry sequence of the museum follows the interior of the wall as both stairs and a ramp lead the user into a sunken courtyard. (Image 8.3) The sunken plane allows the user to spend more time below grade exposed to the open sky before they enter. This strategy helps to ease the transition from above to below ground as the user’s initial perception of below grade mimics the conditions of the surface. The pathway continues to proceed around a solid wall that encircles the fountain until it finally enters below the pathway into the fountain area. At this point, the solidity of the wall is pealed away to reveal a class wall that allows the user to see directly into the museum along the east-west axis, contrasting that of the other buildings on the Mall. Once they enter, the spatial strategies of the interior pull them through the exhibit sequence allowing information to unfold before them until it is time to ascend to the surface, releasing them once again onto the surface and back within the intimate spaces of the site.
Bibliography


