

AN EARTHLY COSMOLOGY

Wm. Dennis Bree IV

Thesis Work 2010-2011



An Earthly Cosmology

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

Master in Architecture in Architecture

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Abstract

The following thesis project explores the design of a nature center and planetarium within Rock Creek Park, in Washington, DC. The project evolved from a desire to re-imagine a relationship with nature in a way that allows conversation, reflective thinking, and allows one's sense of wonder to enter a place which is between science and myth. The design of the nature center and planetarium was developed by investigating the dualities which exist within and around the site, such as earth and air, day and night, and winter and summer. The goal was to create a building which is fully embedded in the site around it, to create a unique environment for exploration and conversation, and a place to contemplate one's relationship with nature.

Acknowledgements

Thank you to my committee for helping me see architecture in ways that cannot be seen.

Marcia, thank you for your encouragement and belief in me to pursue ideas even when they sounded really strange. I would often draw for hours after our conversations with your support to keep investigating my thoughts.

Susan, thank you for pushing me to keep looking into what architecture really is and can be, but to always continue to edit those thoughts.

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The three of you have had an immense effect on my thinking and I will be investigating ideas and thoughts you've provoked for years to come.

Thank you to the great friends I have made at the WAAC, who inspired and challenged me to look deeper and continue to investigate architecture in new ways. A special thank you to Byron, Shaheen, Jost, and Sam for your contributions, thoughts, and support.

Thank you to my family. All of you have continuously supported me and have never told me what I should do, but prepared me to thoughtfully decide on my own. My parents have shaped my life as an architect, though they may not realize it, through my dad's practicality and creative problem solving, and my mom's patience and love for detail.

Thank you, Kate. You were often the first person to hear my ideas and helped me articulate them into a coherent whole. I am excited for our wedding, and I am excited for our life together. We have made it through an intense, often changing schedule with both of us in school and working. I think our lives might feel like a vacation after these few years. I love you very much.

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Rock Creek Park, Washington, DC

FINDING A BEGINNING

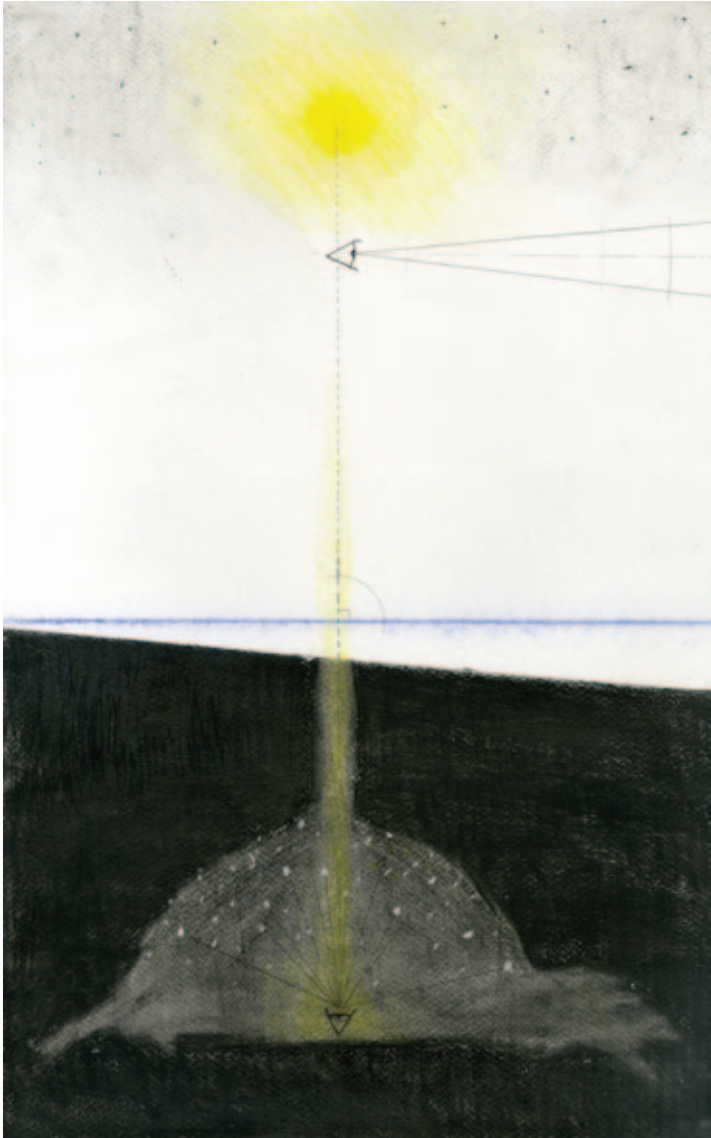
“The Imagining powers of our mind develop around two very different axes.

Some get their impetus from novelty;
they take pleasure in the picturesque, the varied, and the unexpected.
The imagination that they spark always describes springtime.
In nature these powers, far from us but already alive, bring forth flowers.

Others plumb the depths of being.
They seek to find there both the primitive and the eternal.
They prevail over season and history.
In nature, within us and without, they produce seeds –
seeds whose form is embedded in a substance, whose form is internal.”

Water and Dreams, Gaston Bachelard

Concept drawing of technology and nature





Trail in Rock Creek Park

The thesis began with a walk in the woods.

A site within Rock Creek Park was one of my earliest thoughts on a possible thesis project because of its beautiful topography and seemingly endless quiet. Rock Creek Park is a bit of a contradiction. It is an urban park and yet there is very little connection to the urban context. There are no grand entrances similar to Prospect Park in Brooklyn, or large gathering meadows one finds in Central Park. Rock Creek Park has seemed unapproachable to many because of the quiet, often hidden entrances to its trails and pathways and its lack of clear organization. It is not a planned park to recreate a romanticized version of nature, but a landscape held in reserve to reveal its true origins and the power of nature to reclaim land it once lost to farmland, orchards, and estates. It was set aside in the late nineteenth century as a respite from the harsh summer heat and living conditions in early Washington, DC. Urban parks, as argued by Frederick Law Olmsted, would vastly improve the living conditions in cities and would be designed “to counter the enervating and unhealthy urban environment. Nature as a civilizing force with romantic associations with morality, peace, health, and the vitality of the individual and family was deeply rooted in American intellectual tradition. By the mid-nineteenth century social reformers, religious leaders, landscape architects, and civic leaders became concerned by the potential threat posed to these values by uncontrolled, explosive growth in American cities. They strenuously advocated creation of parks and open living spaces to help alleviate the squalor and misery of crowded and disease-ridden neighborhoods.¹”

1 Bushong, 61.



Thesis site in Rock Creek Park

This moral imperative Olmsted championed is not a complete picture of how urban parks fit into the lives of those who use them. This doesn't fully answer how a walk in the woods feels, the feeling of a connection to an ancient home, a subtle sense of comfort that cannot quite be placed. Through readings and research of Rock Creek Park, one wonders how the park fits into Nature itself, so surrounded by the City. The park is a place where a deep connection can be made, and a place to re-discover how humans fit into the idea of Nature. The thoughts provoked after walking through Rock Creek park are best described by David Abram. He says, "walking in a forest, we peer into its green and shadowed depths, listening to the silence of leaves, tasting the cool and fragrant air. Yet such is the transitivity of perception, the reversibility of the flesh, that we may suddenly feel that the trees are looking at us – we feel ourselves exposed, watched, observed from all sides. If we dwell in this forest for many months, or years, then our experience may shift yet again – we may come to feel that we are a part of this forest, consanguineous with it, and that our experience of the forest is nothing other than the forest experiencing itself."²

My continued hikes into Rock Creek Park revealed new places and details passed unnoticed before. The site I eventually discovered for the thesis project was a confluence of the creek, a suitable hill and human activity. It was immediately clear that this site balanced all of my thoughts about the project and a place to highlight all of the factors at play in Rock Creek Park.

2 Abram, *Spell of the Sensuous*, 68.

An existing nature center and planetarium is located near Military Road where it crosses Rock Creek Park. The site is flat and wooded but adjacent to a rolling meadow, and has a large parking lot. From the outside, there is very little that would suggest anything more than a building sitting at the edge of a parking lot. The building does not attempt to engage its site, or celebrate its place. There are few windows and it faces no particular direction.

The exhibit spaces feature separate plants and animals inside small acrylic boxes on pedestals with information signs near them. Guests are invited to record any animals they have seen while visiting the park, and sadly lines 1 through 7 of the log span approximately 16 months. The planetarium space is small, but enveloping, and offers a glimpse of the stars in a straightforward way.

After visiting the center, it was clear that this was the thesis project. The building location, however, did not feel like Rock Creek Park. It did not offer an overview of what the park is or what visitors could look forward to. A nature center in Rock Creek Park should be located in a place that integrates with the park and allows visitors a place to learn more about the nature around them.



Portion of existing building closest to parking lot next to main entrance



Basement level exhibit room of existing nature center



Hallway on main floor of existing nature center

The Site



Site photo facing south showing the prominent hill in profile.

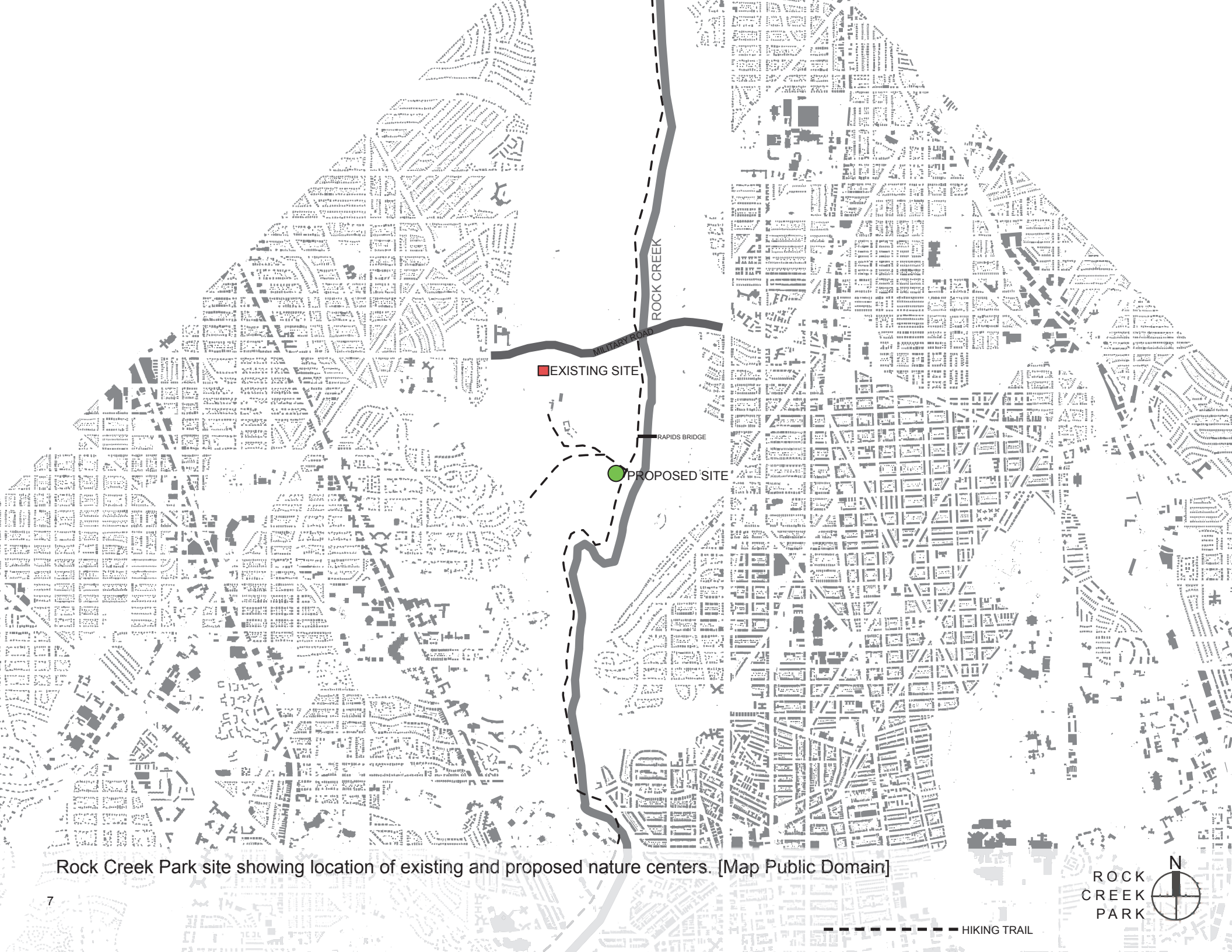


Site photo from top of the hill looking east toward the creek.

This particular place revealed itself through a walk on the hiking trails nearby. Exploring and looking for a site that would work, suddenly the sounds of water, leaves in the wind, and the human voice mixed as the trails, the creek, and the wooded hills met at this location. This site was chosen because it represents all the pieces of Rock Creek Park as a whole. The site is immediately adjacent to the creek, allowing the sounds of the water to penetrate the lower portions of the site. Next to the creek is the intersection of three hiking trails that bring hikers and equestrian riders together at the site. Across the creek, bicyclists pass the site on Beach Drive and have access via the Rapids Bridge. West of the trails is a prominent hill that overlooks the creek and shows the quick change in topography in this creek valley. The hill offers a view of the immediate area while hidden among the large trees and saplings. Further west on the site, Ridge Road passes by, offering vehicular access for school groups that would be arriving at the center. This particular site offers an overview of Rock Creek Park as a microcosm of the environment as a whole.



Site photo looking south near the creek and hiking trail.



EXISTING SITE

PROPOSED SITE

ROCK CREEK

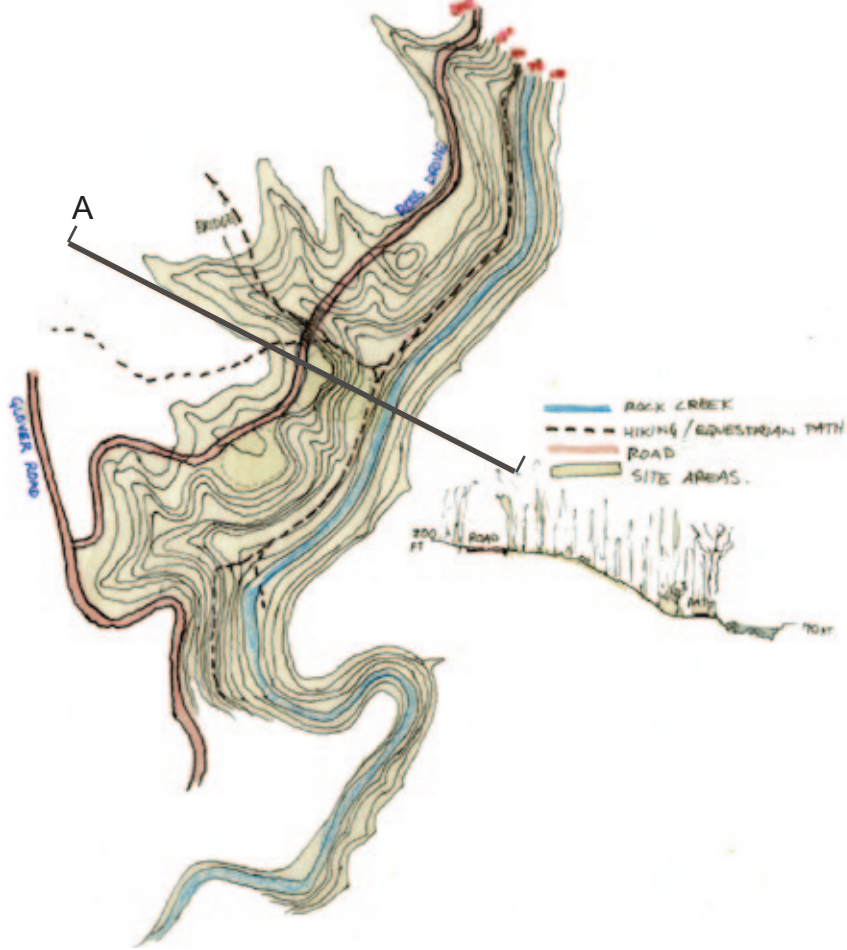
MILITARY ROAD

RAPIDS BRIDGE

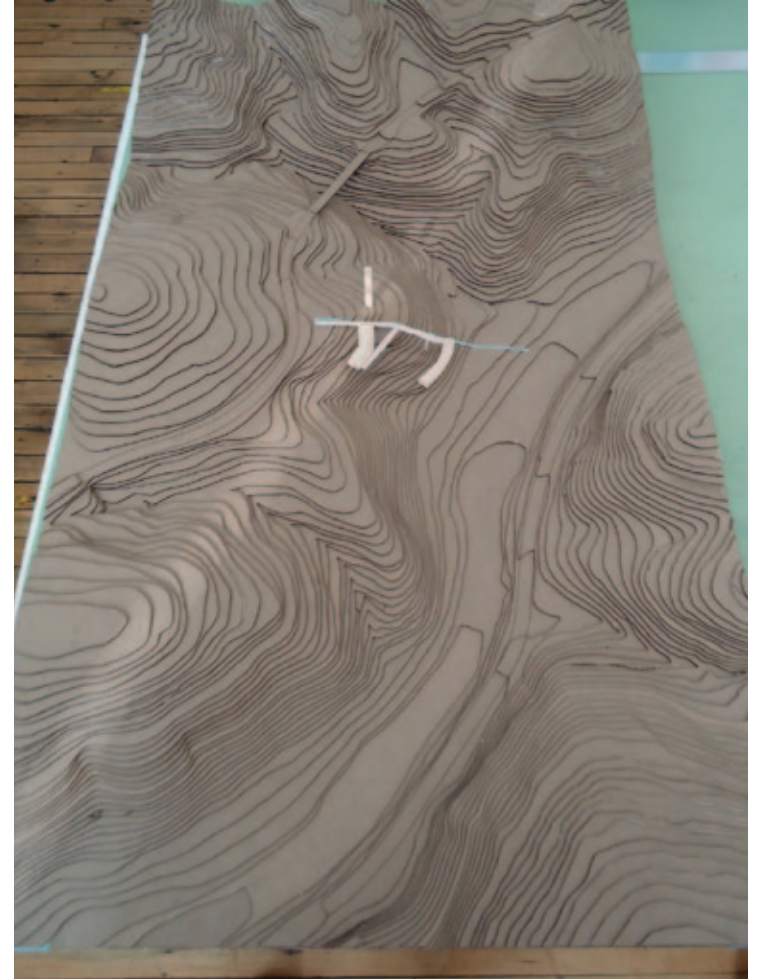
Rock Creek Park site showing location of existing and proposed nature centers. [Map Public Domain]



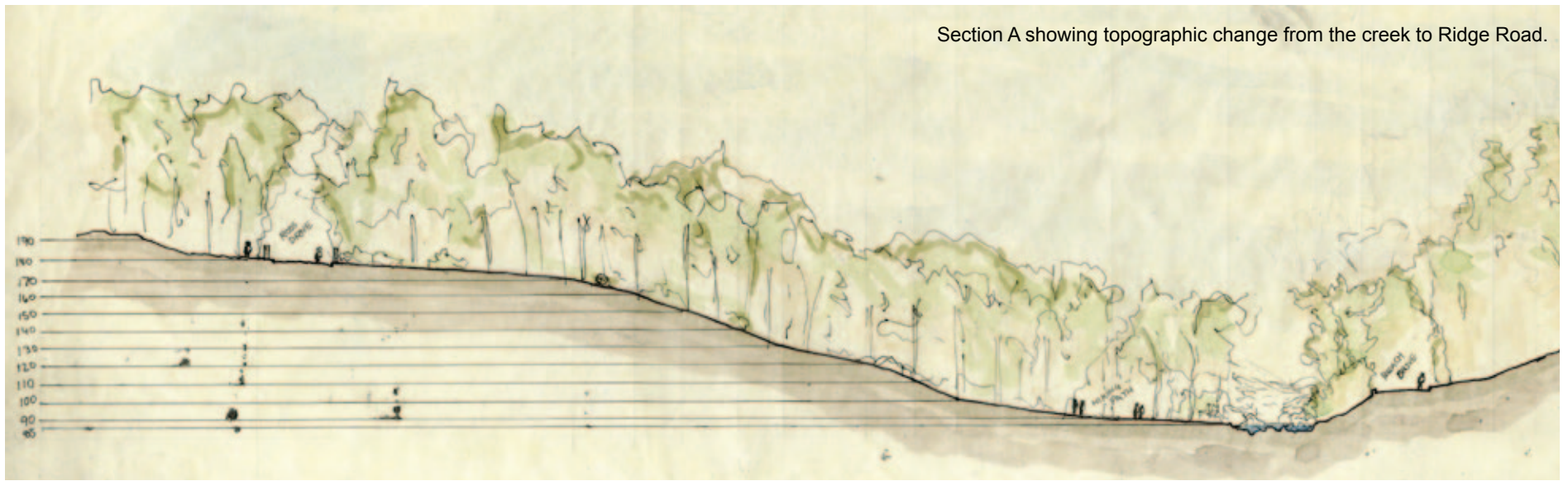
HIKING TRAIL



Site drawing with Section A showing paths, roads, and the creek.



Site model showing topographical change



Section A showing topographic change from the creek to Ridge Road.

A CONVERSATION

“The song of the river is, likewise, cool and clear. The noise of the waters quite naturally takes on the metaphors of coolness and clarity.

Laughing waters, ironic streams, waterfalls with their noisy gait, all are found in the most varied literary landscapes. These laughs, these babblings are, it seems, the childhood language of Nature.

In the stream the child Nature speaks.”

Water and Dreams, Gaston Bachelard



Photo taken from the site with a hiking tour group and horseback riders crossing paths



Current Nature Center, 2010. Exhibits and displays are separated and enclosed in boxes with no reference to the actual park on the other side of the exterior wall.

The thesis continued to develop by looking at the site not only as a physical place, but as a lens to view a link between humans and nature as a complex relationship of dependence, mystery, and imagination. This relationship can be likened to attempting to hold a conversation with nature; a necessary dialogue allowing a better understanding of both humans and nature. One may not understand the language of nature, but listening intently can still unlock thoughts and views about what it might be saying. Sitting at the site at various points and times of day unlocked an understanding of the site as a complex web of interlocking pieces. The site speaks different languages near the creek and on top of the hill. At the creek, it speaks loudly, rambling on as the water rushes over the rocks and twigs. On the hill, it speaks softly, quietly reflecting on the day as the leaves rustle in the wind and an occasional bird call echoes through the din. These auditory changes in the site directly led to the development of the overall site organization as a system of pairings. An entrance at both the creek and the top of the hill serves these two types of sounds. These sounds can be seen as two types of clients using the building and site in different ways. One client, a slow, quiet and reflective journey moving down the hill. The other client, a loud, quick moving overview rushing through the site only at the surface.



Figures 1 & 2. Nature Van, Circa 1952. From the photographer: “Nature van” is a unique, mobile, audiovisual unit. Used in the 1950-60s for interpretive presentations at various locations in the Park and for evening movies under the stars.

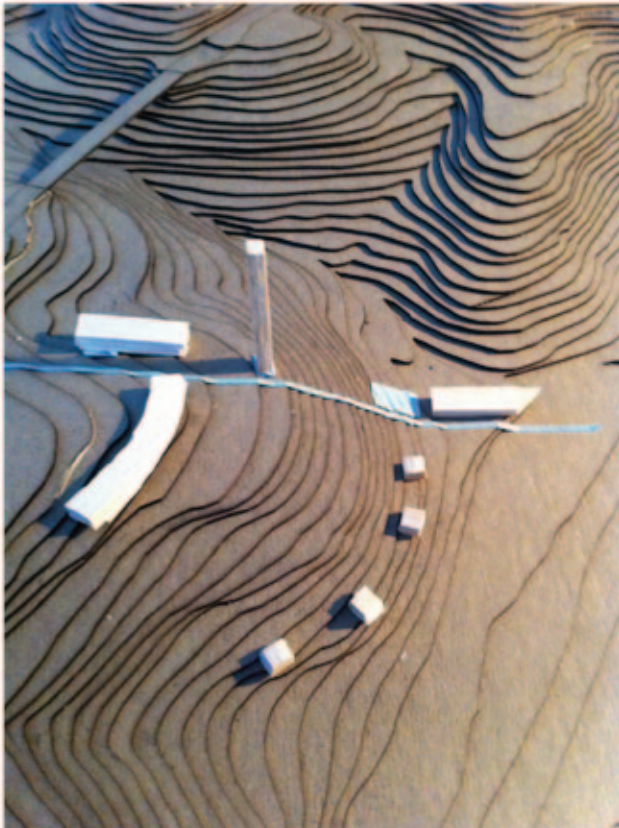
Continued research revealed that before the current nature center existed with its sterilized look at how nature works, there was a Nature Van that showed movies outside, and without exhibits, relied on storytelling and demonstrations to educate the public on Rock Creek Park and National Parks around the country. The Nature Van provided direction for the new nature center to educate visitors through spoken stories that use the active imaginations of the listeners to “see” nature. It is the only possible way to travel through and without time, and shift scales from the very local place in Rock Creek Park and connect the park to the universe as a whole. Renewing oral culture, as David Abram describes it, “is thus not at all a matter of “turning back the clock” but rather of stepping, now and then, out of clock time entirely. It is not a matter of “going back” to an earlier way of life, but aligning ourselves with the full depth of the present [...] to make conscious contact with the darker humus in which our humanity is still rooted. The soil at that depth is made of dances, and songs, and the hushed cadence of spoken stories. By remembering ourselves at that depth, by tapping the nutrients in that timeless soil, we draw fresh water on up into stems and leaves of the open present.”¹ Using drawings to visualize what the site and project could be, beyond what could be seen, a cosmos appeared that isn’t separate from the earth, but deeply rooted within it. Through these drawings, a unique cosmology began to develop.

1 Abram, *Becoming Animal*, 292.

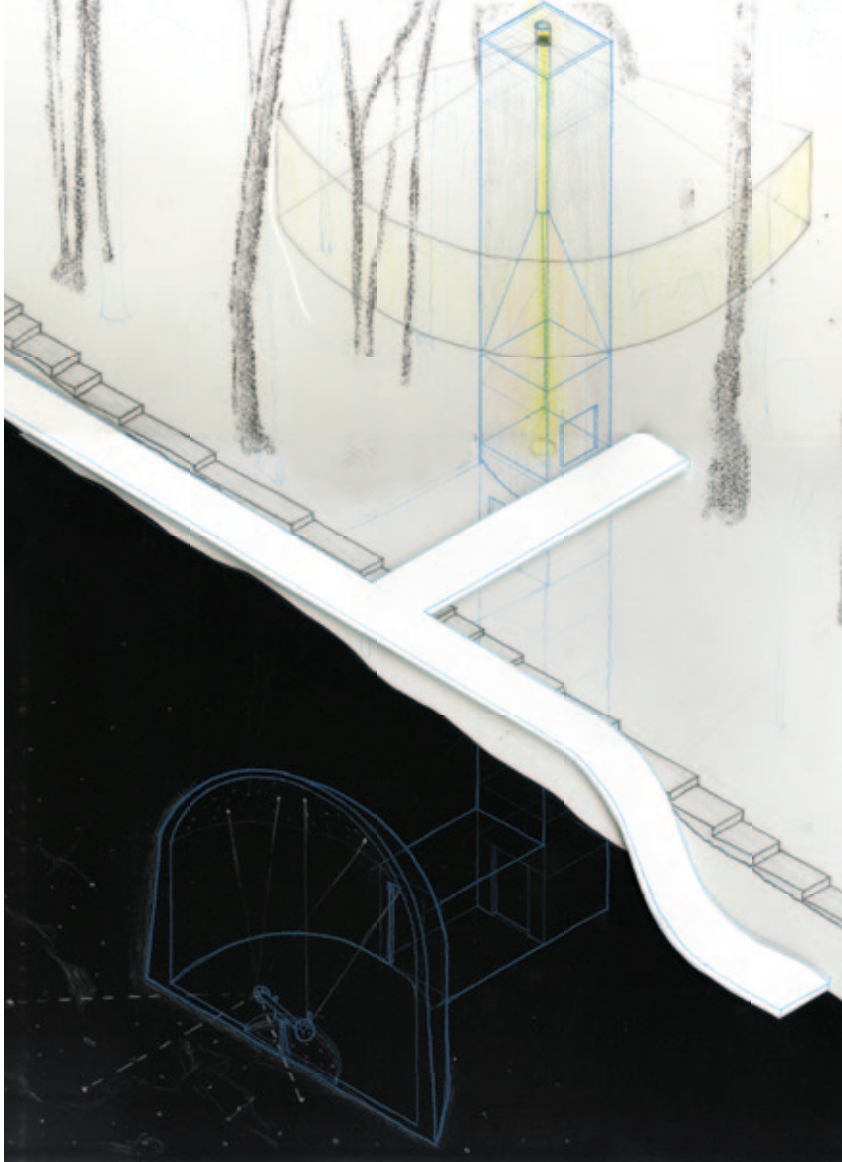


Stair near Pierce's Mill outside Rock Creek Park.

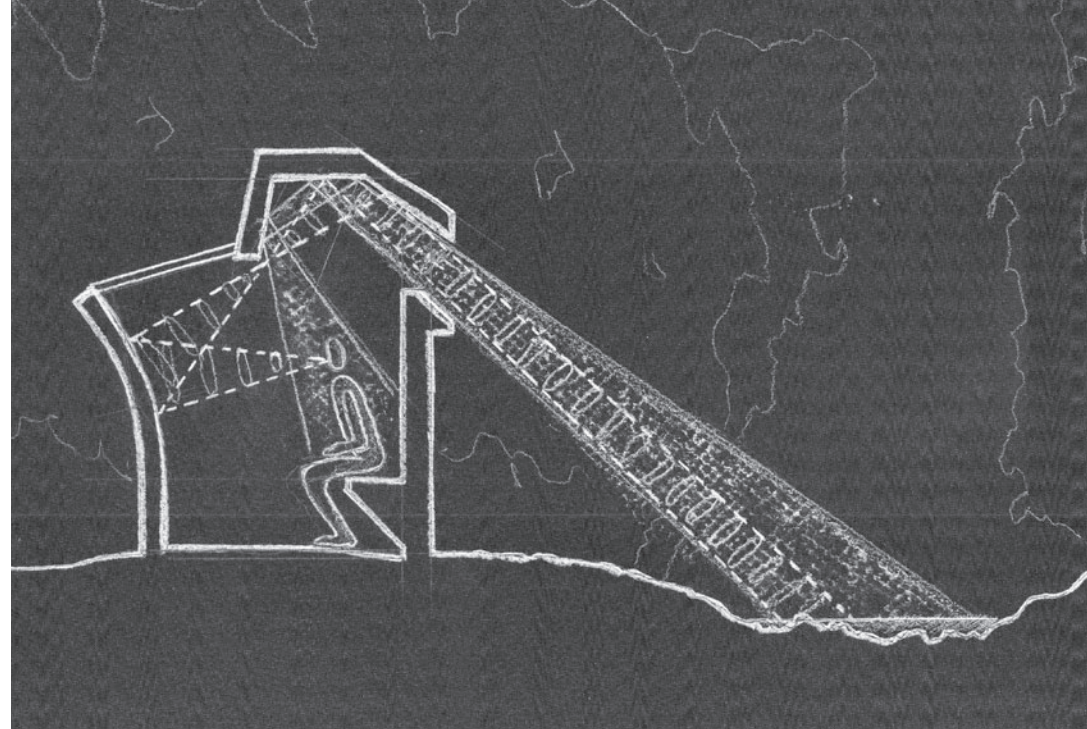
This stair signifies a human relationship with nature without seeing a human figure. The stair in plan is perfectly straight, while in section, it navigates the hill with changing sizes of stone. Its perfection in one dimension is allowed only through compromise in another.



Early site organization designs illustrating need for two distinct zones on top of the hill and near the creek.

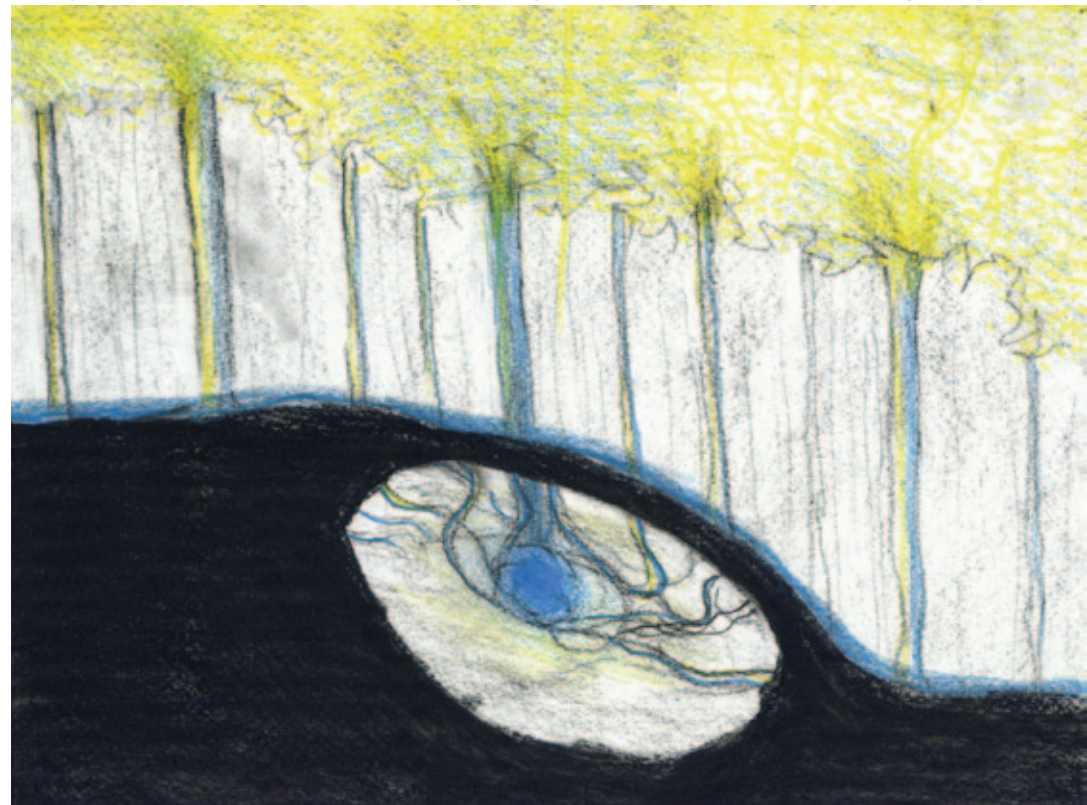


Pairing of sky and cosmos separated by the surface of the earth.



A room for conversation with the creek.

Two types of water at the site. One moving quickly over the surface, the other moving slowly upward.





Site photo looking north toward Ridge Road bridge

THINKING THROUGH DRAWING

Identifying the pieces

“The computer creates a distance between the maker and the object, whereas drawing by hand as well as model-making put the designer into a haptic contact with the object or space.

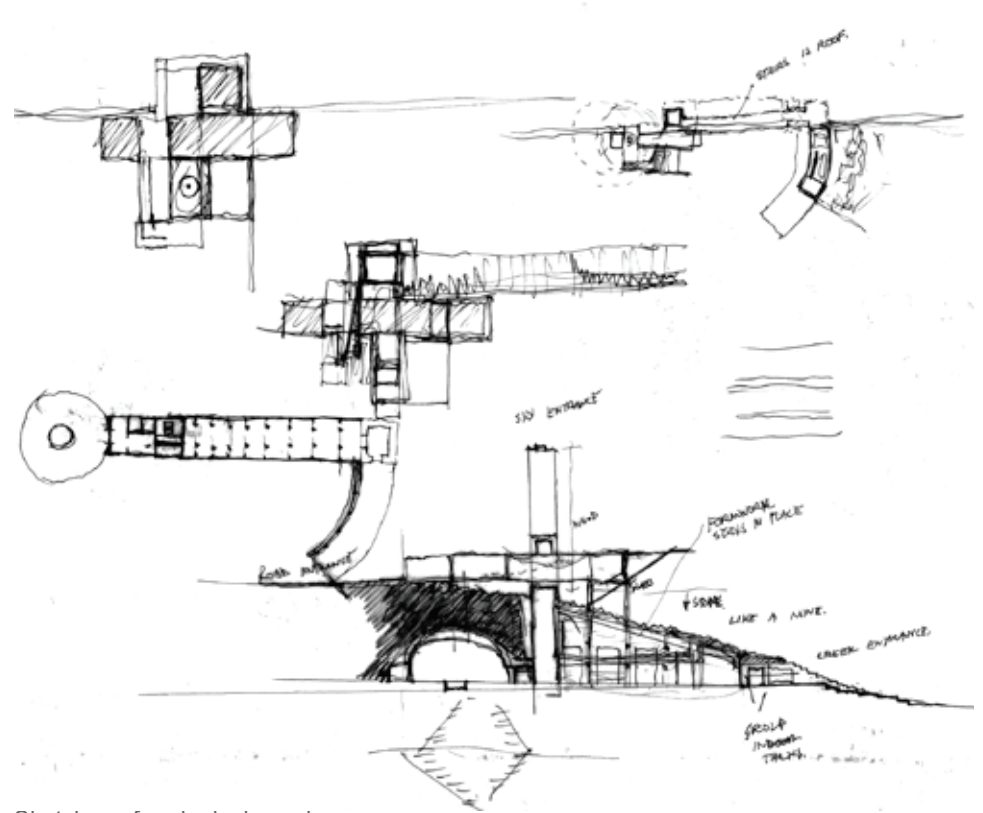
In our imagination, the object is simultaneously held in the hand and inside the head, and the imagined and projected physical image is modelled by our bodies.

We are inside and outside of the object at the same time.”

The Eyes of the Skin, Juhani Pallasmaa



Structural bay model analyzing effect of the sunset



Sketches of early design schemes

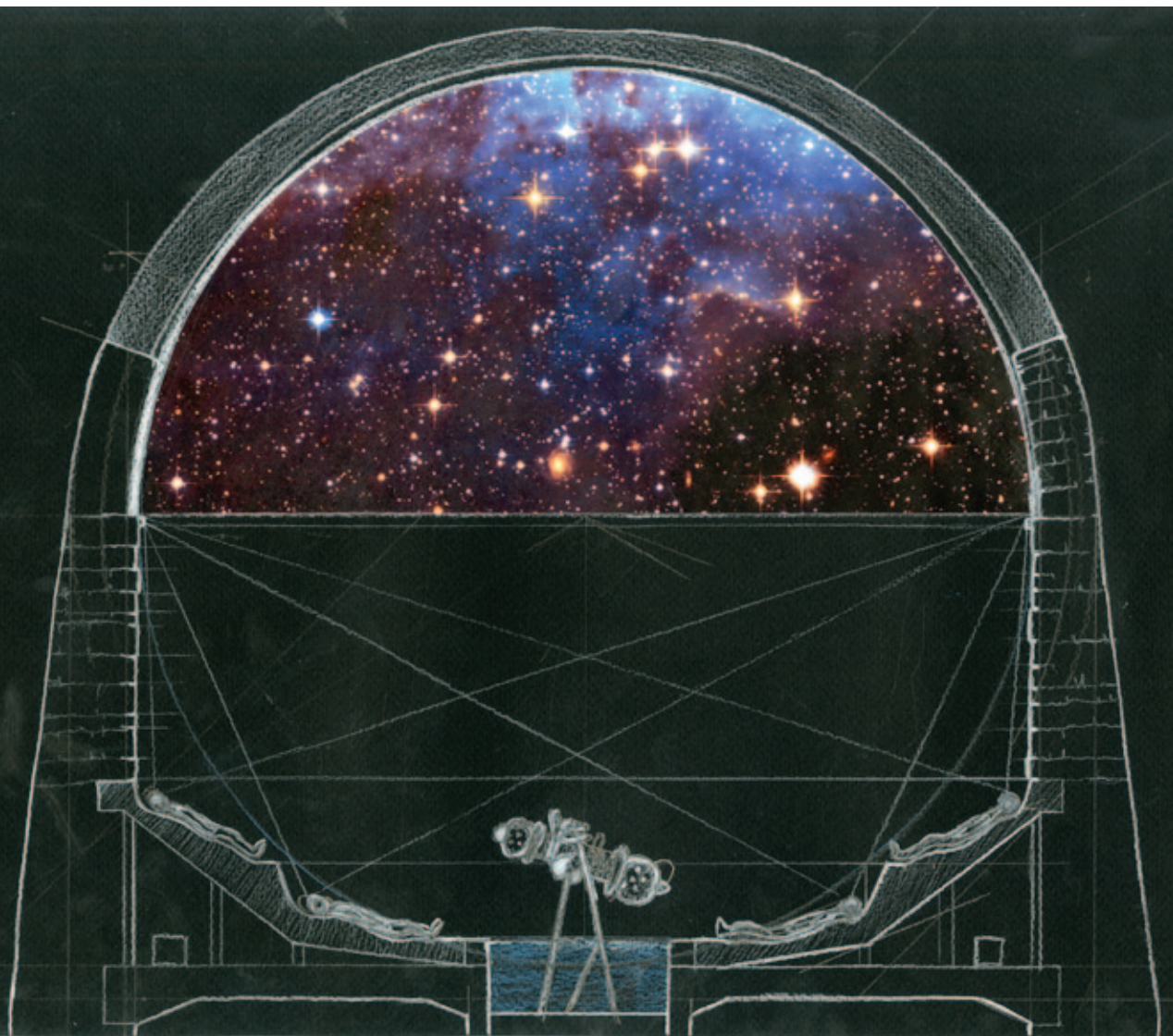
Through hand drawing and modeling, the project continued to develop. With these methods, one could remain close to the tectonics of the project by allowing the hand to move in ways which reflect the various materials. When drawing earth, charcoal was used to represent its density and difficulty in removal from the drawing. When drawing things in the air, single thin lines were used to represent their relative weightlessness. To carve the underground portion of the building, the drawing was completely covered in charcoal and an eraser was used as an excavator to slowly remove the earth to create a tunnel. To explore the important pieces in this project and to focus the design decisions, numerous drawings were created that were direct reactions to quotes that had interesting and important abstract ideas within them. These drawings came to represent a list of the design decisions that were developed into a final project. These quotations and the subsequent drawings created as reactions to them are presented in this chapter.



“...For my hut was set in the middle of a large patchwork of rice paddies, separated from each other by narrow two-foot-high dikes, and these paddies were all filled with water. The surface of these pools, by day, reflected perfectly the blue sky, a reflection broken only by thin, bright green tips of new rice. But by night the stars themselves glimmered from the surface of the paddies, and the river of light whirled through the darkness underfoot a well as above; there seemed no ground in front of my feet, only the abyss of star-studded space falling away forever.”

(Pg 4. *The Spell of the Sensuous*, David Abram)

This drawing illustrates an important concept for the design of the planetarium. It led to the incorporation of a pool of water in the planetarium to reflect the projected sky above. The drawing also led to decisions to put the planetarium completely underground to simulate the idea of floating in endless space.



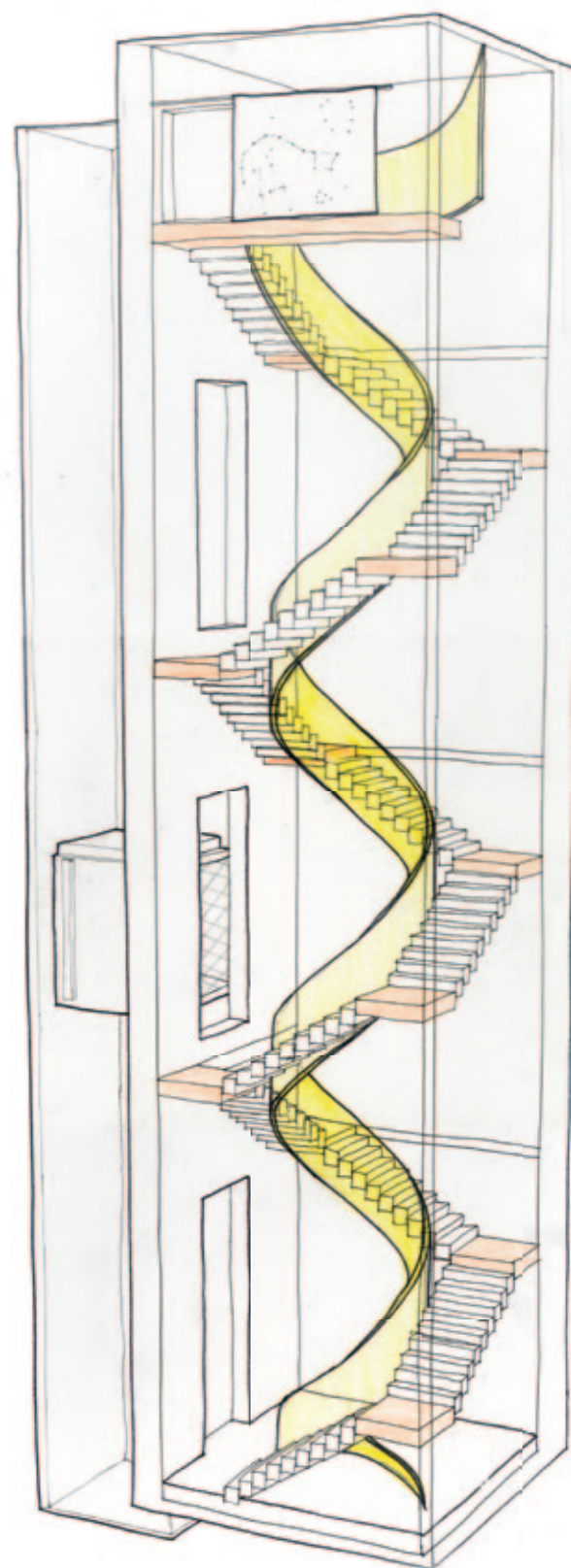
“Or if we were a different mammal – a fox, for instance, our nose tuned to smells that drift in ribbons along the ground – we’d hardly notice that alluring openness overhead, and night would be a boon for us. But since we balance on just two legs, our heads are held already in the sky, and so we can’t avoid the stunning puzzle posed by the stars. Beyond a certain degree of astonished gawking, our necks begin to hurt, and our legs begin to buckle; our bodies long to lie down horizontal on the earth. We lend ourselves to gravity, becoming adjuncts of the ground itself. Only by thus renouncing the vertical stance – dropping away our upright individuality and leaning back upon the earth, letting our gaze become the gaze of Earth itself – do we make some sense of the endless depths in which Earth dwells.”

(Pg. 23 *Becoming Animal*, David Abram)

This quote prompted reconsideration of the previous sketch into an architectural drawing showing a section of the planetarium. The seats of the planetarium are made of stone to directly connect the visitors with the earth and are reclined to enhance the feeling of being enveloped within the earth while also seeing what it sees.

“Phenomenologically considered, it is as though the luminous orb of the sun journeys into the ground each evening, moving all night through the density underfoot, to emerge, at dawn, at the opposite side of the visible world. For some indigenous cultures, it is precisely during this journey through the ground that the sun impregnates the earth with its fiery life, giving rise to the myriad living things – human and nonhuman – that blossom forth on earth's surface.”
(Pg. 221 *Spell of the Sensuous*, David Abram.)

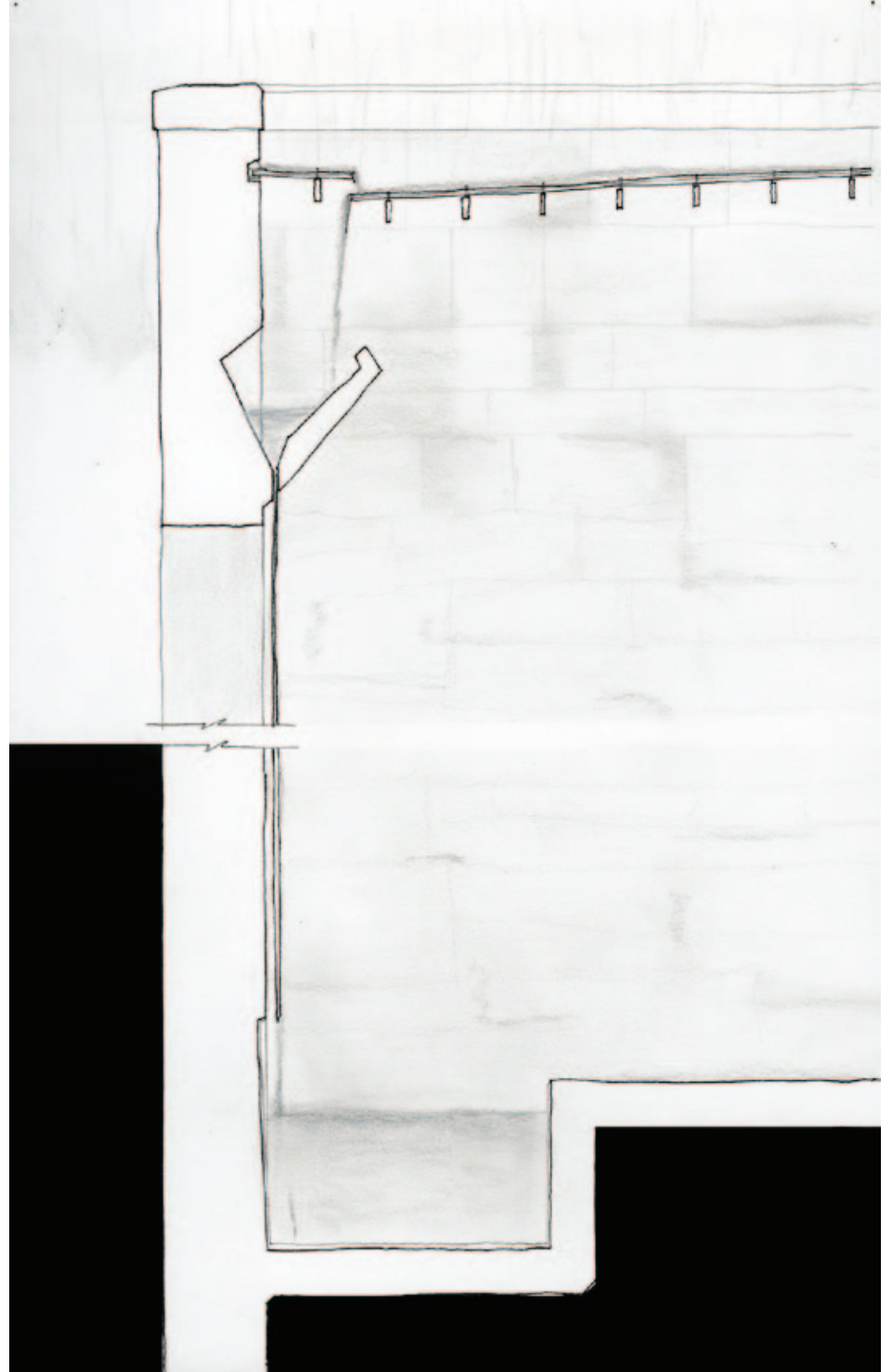
The journey underground to the planetarium is a place to tell the story of the sun instead of in the sky. This is an opportunity to see the sun in a new way which could inspire a visitor to re-understand the movement of the sun across the sky during the day. At sunset, this shaft carved into the earth could host the sun as it journeys through (or around) the earth and visitors could circle the edges as they descend, walking with the sun inside the earth.

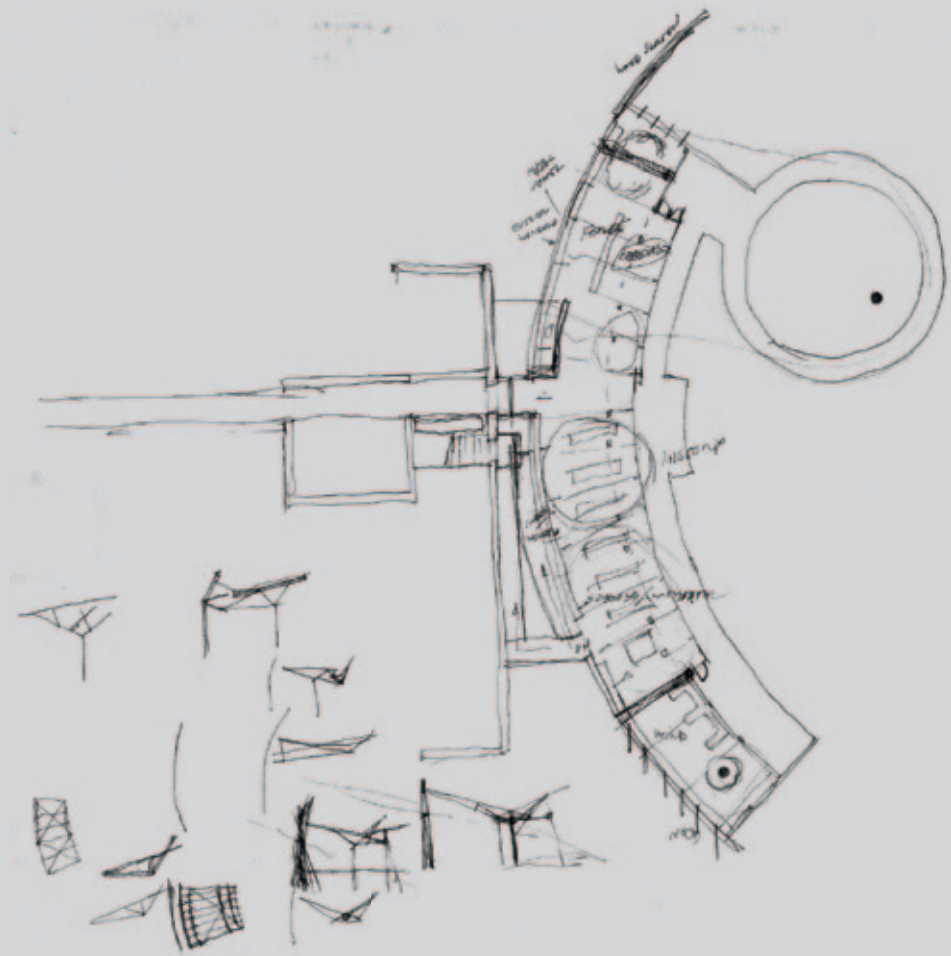


“...The nocturnal sound is a reminder of human solitude and mortality, and it makes one conscious of the entire slumbering city. Anyone who has become entranced by the sound of dripping water in the darkness of a ruin can attest to the extraordinary capacity of the ear to carve a volume into the void of darkness. The space traced by the ear in the darkness becomes a cavity sculpted directly in the interior of the mind.”

(Pg. 50, *The Eyes of the Skin*, Juhani Pallasmaa)

This drawing shows a detailed section of the sun shaft. During the day, this is a shadowy space and visitors would need time to adjust their eyes to the dwindling light. To help understand the volume of the space without seeing it, a rain and water collector appeal to their other senses. By letting the water drip from the roof all the way to the bottom of the space, one feels the volume of the space by listening to the water pooling below.





Sketch of exhibit floor plan

A SENSE OF WONDER

Developing the design

“In every case one must achieve a simultaneous solution of opposites”

-Alvar Aalto

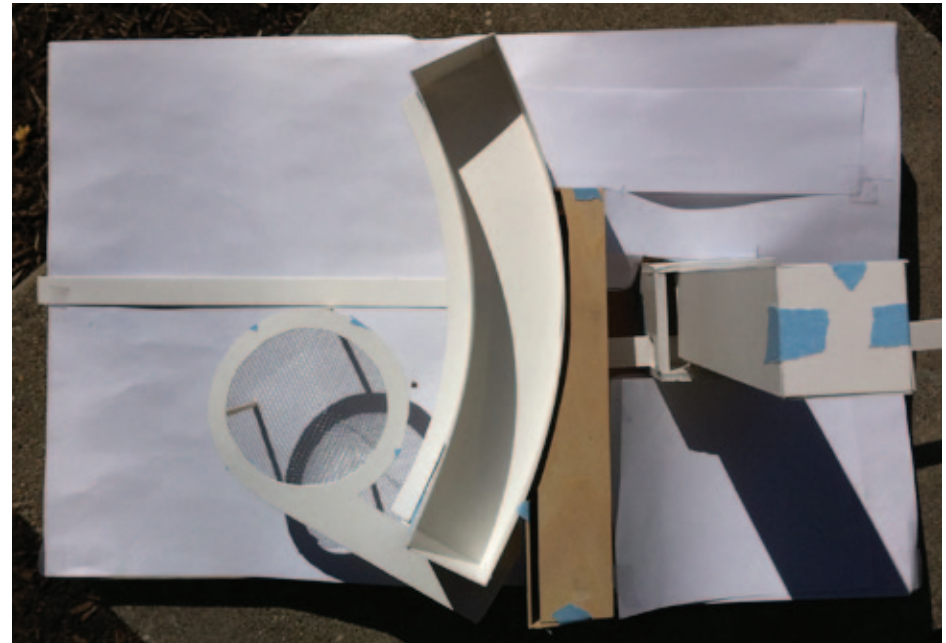
Just as important as the final drawings, these working drawings and models shaped thoughts and brought new ideas to light. Through this iterative drawing process, new meanings emerged about what the project is and how it is embedded in the site around it. Only by continuing to see the drawings differently, sometimes simply by turning them upside down, one finds that the drawings can begin to speak on their own and suggest their own next steps.

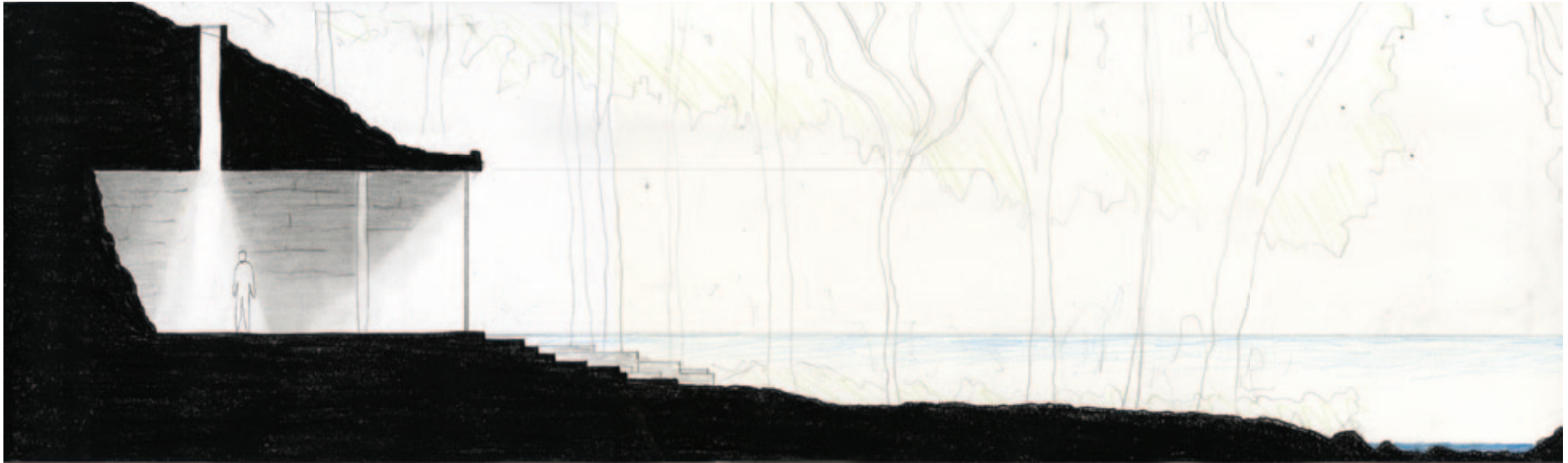
This continued sense of wonder fueled the final months of the design and allowed investigations into not only the final presentation format, but into how the drawings themselves as a physical object could help tell the story of the project.

Hiking trail near site in summer



Sketch model of early scheme

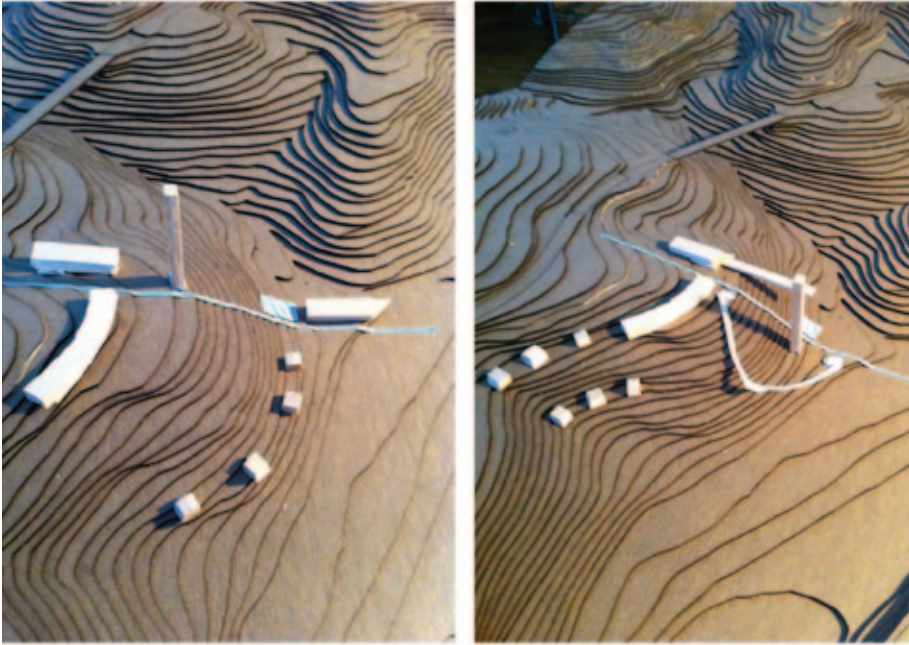




Creek pavilion floor flood line drawing

Site photo taken in winter. The site acoustics change as the site is exposed without leaves and the sounds of the creek can be heard from a further distance.



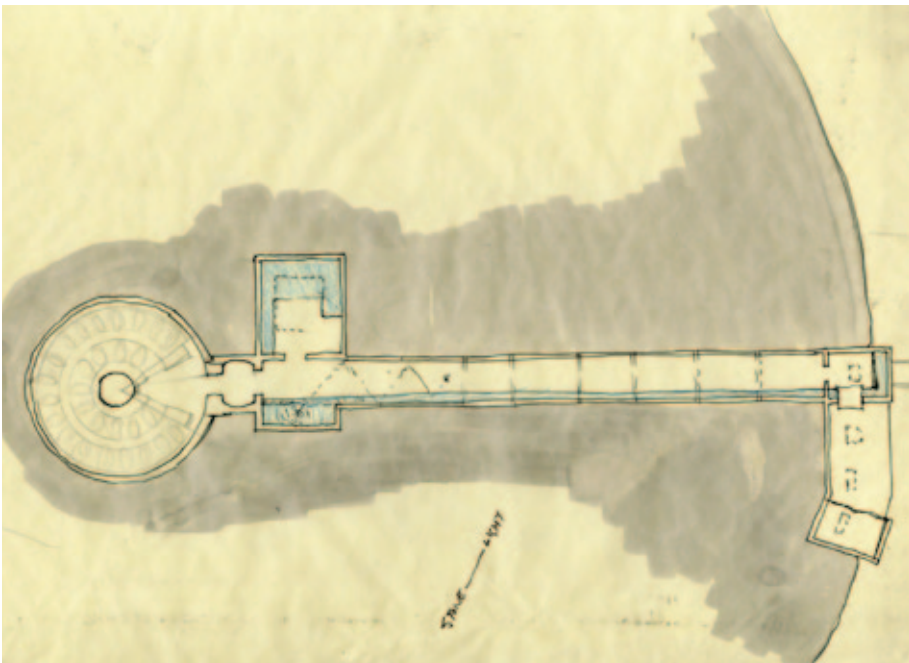


Site models exploring early thoughts on site design.

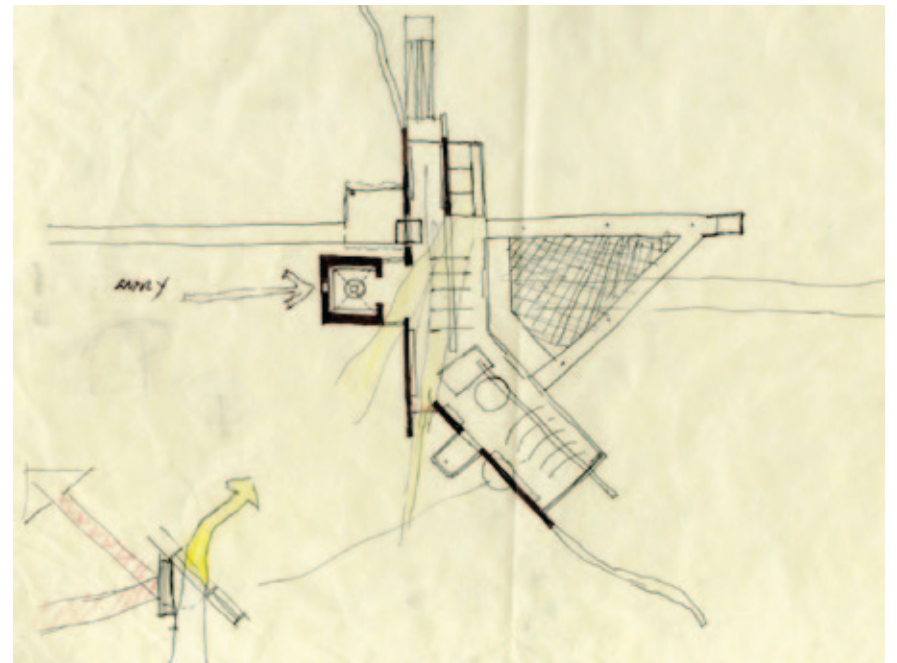


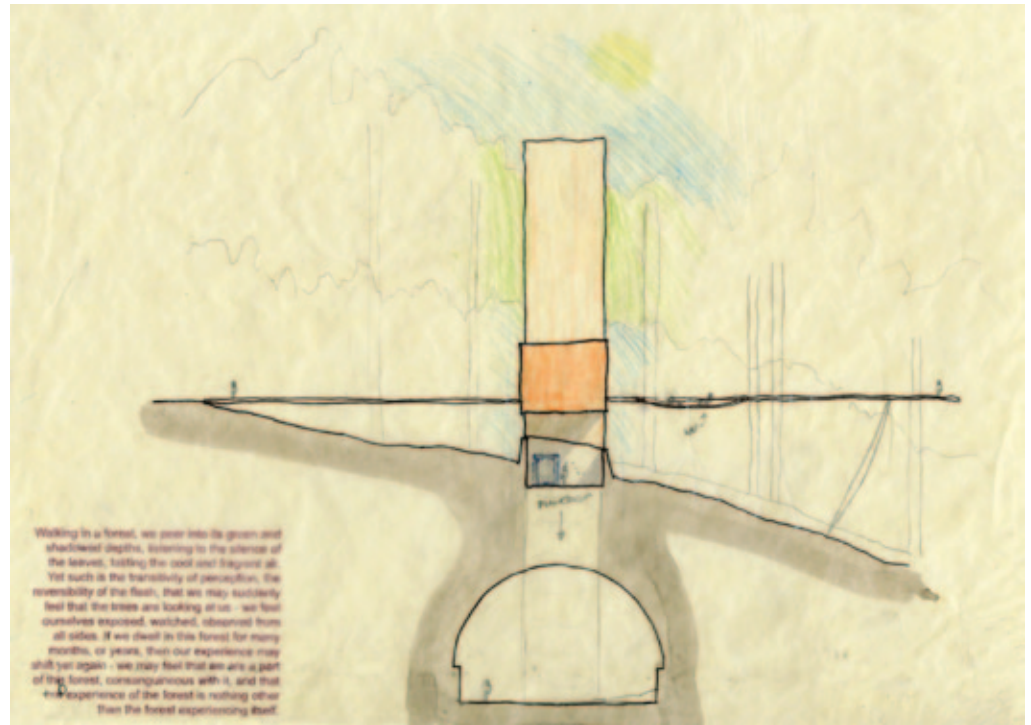
Figure 3. Morris Arboretum Tree Adventure - inspiration for the forest hammock.

Sketch of planetarium floor plan



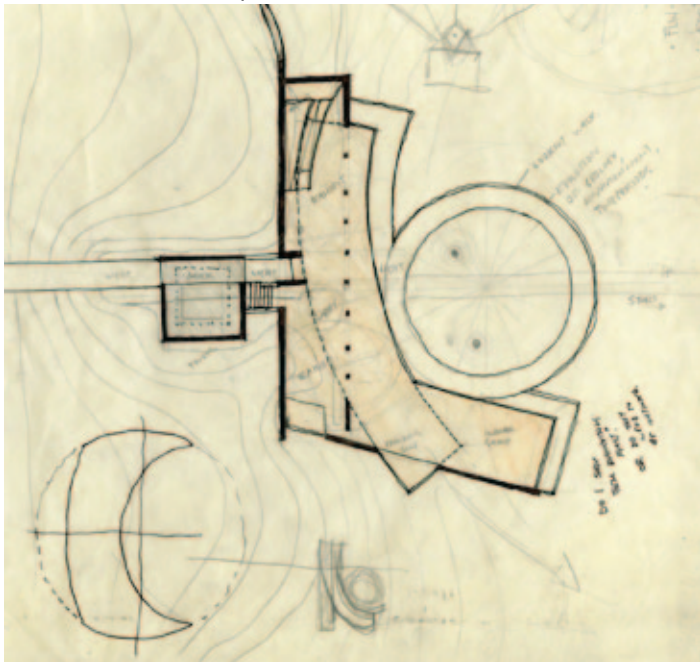
Sketch of exhibit floor plan with first instance of forest hammock.



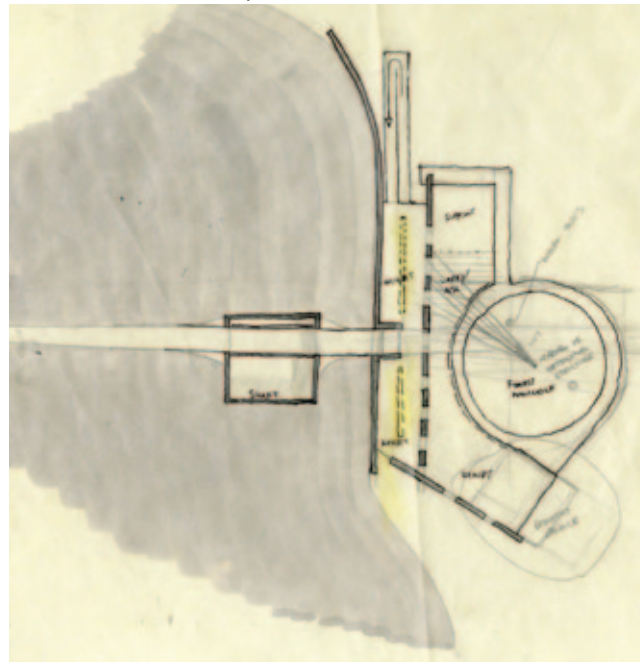


Sketch of diagrammatic section

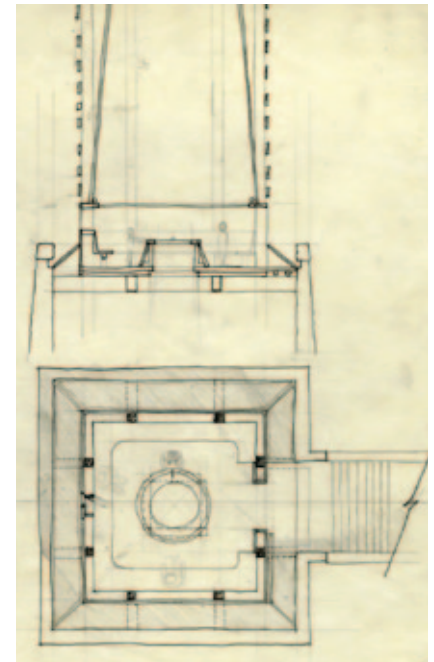
Sketch of exhibit floor plan with sun chart

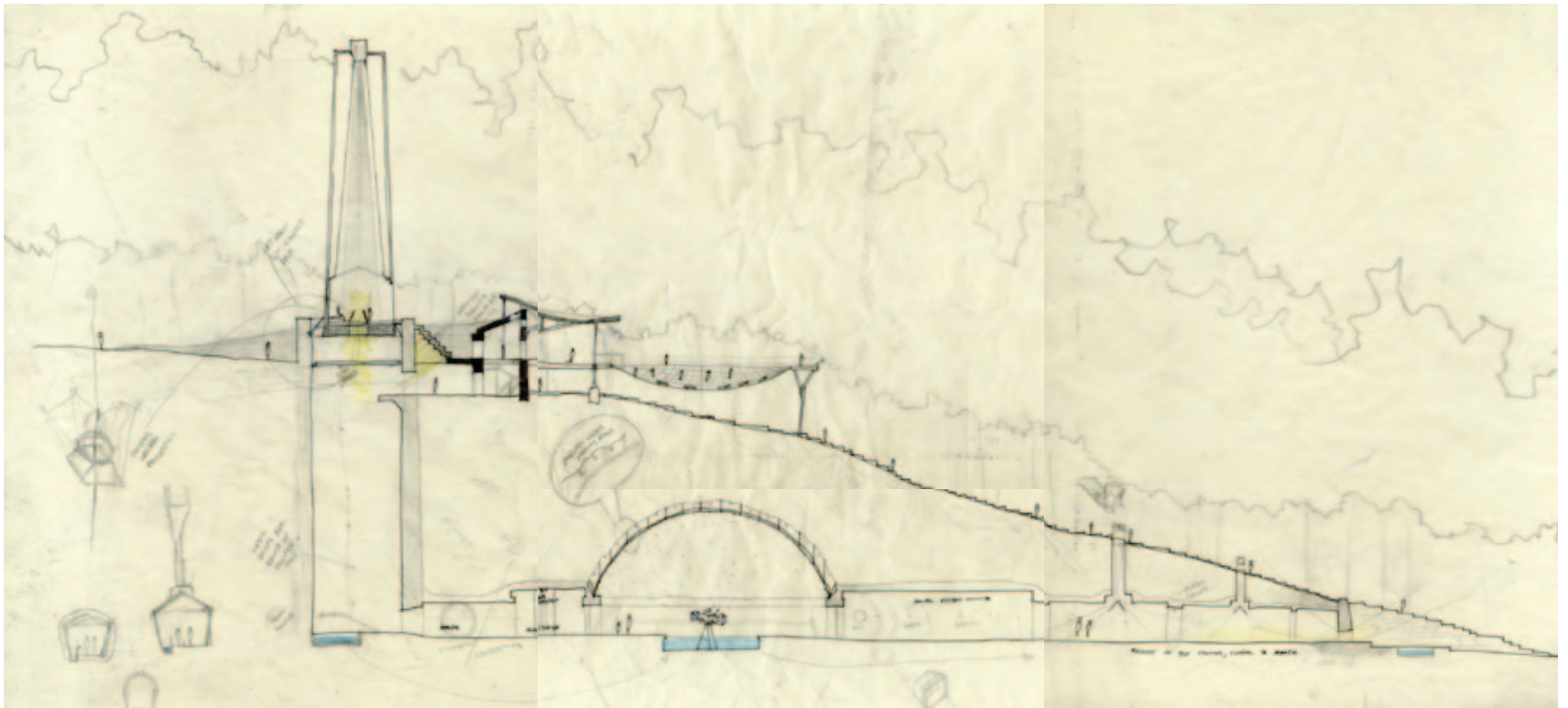


Sketch of exhibit floor plan



Sketch of star tower



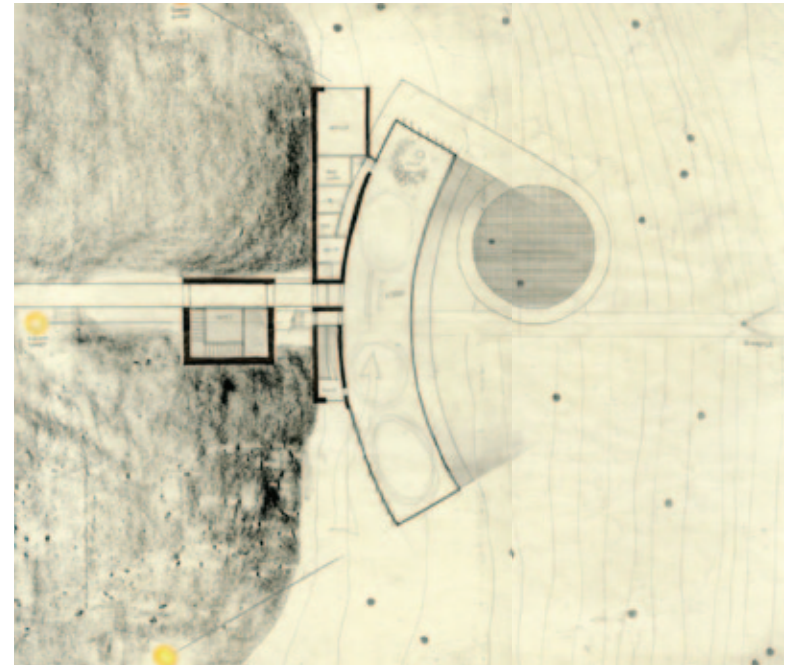


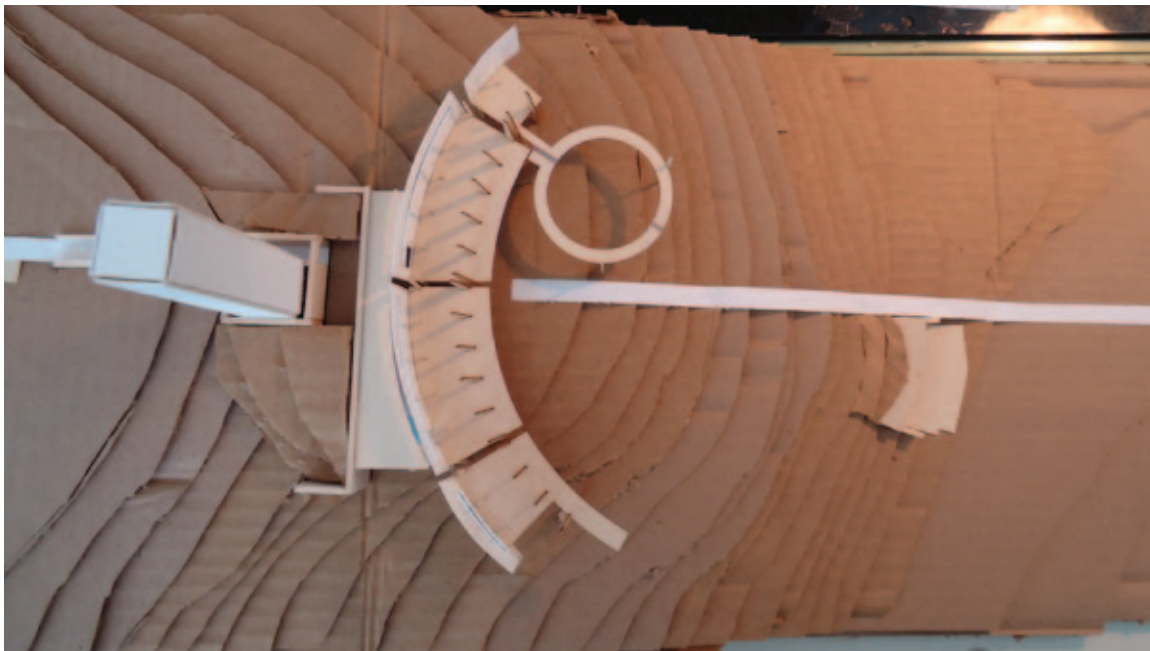
Section drawing

Figure 4: star map used to plot stars on Star Tower. [fair use]



Mid-term exhibit floor plan drawing with sun positions located





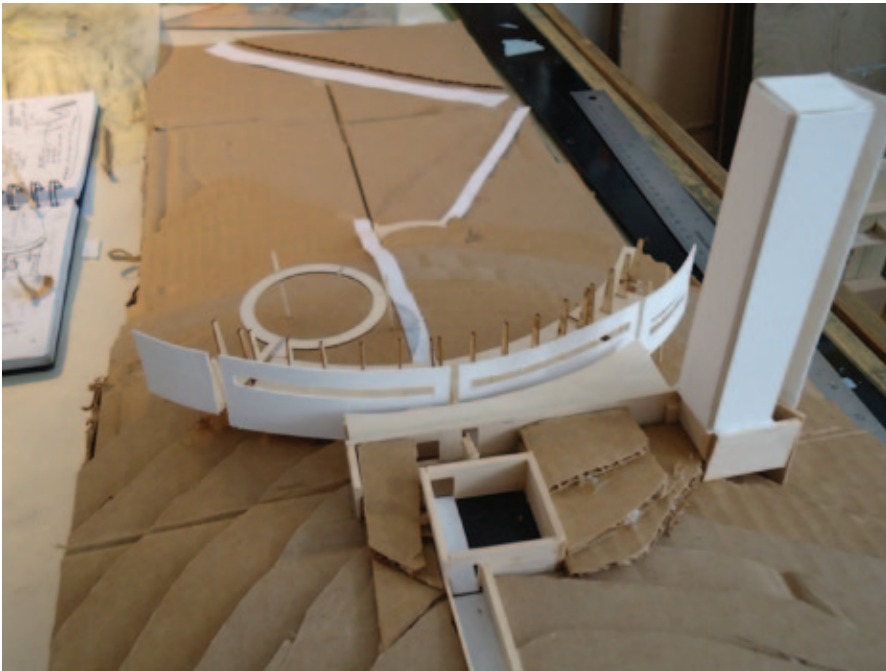
Working design model

Structural bay model



Sunset analysis of structural bay model





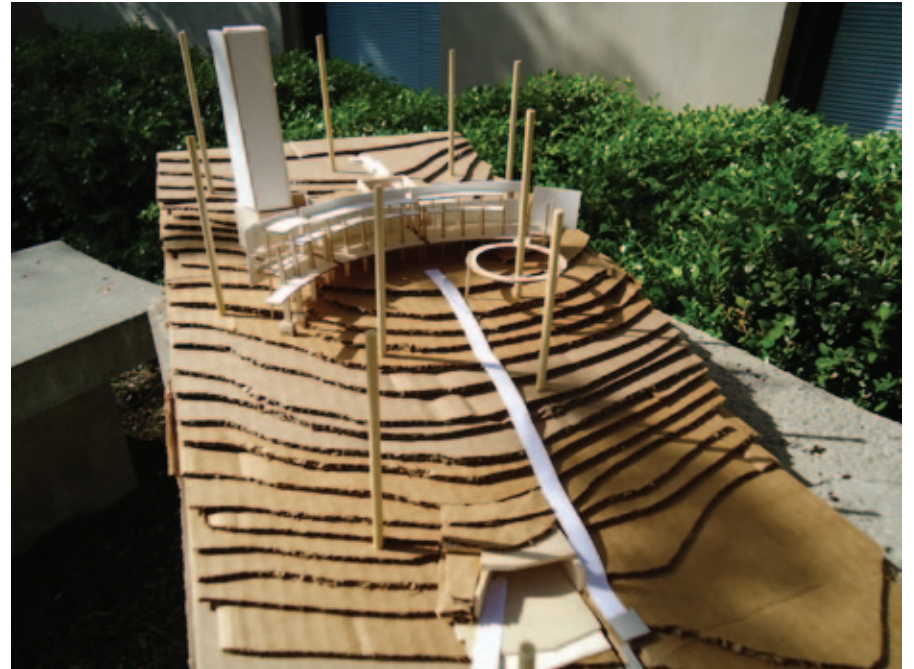
Working design model



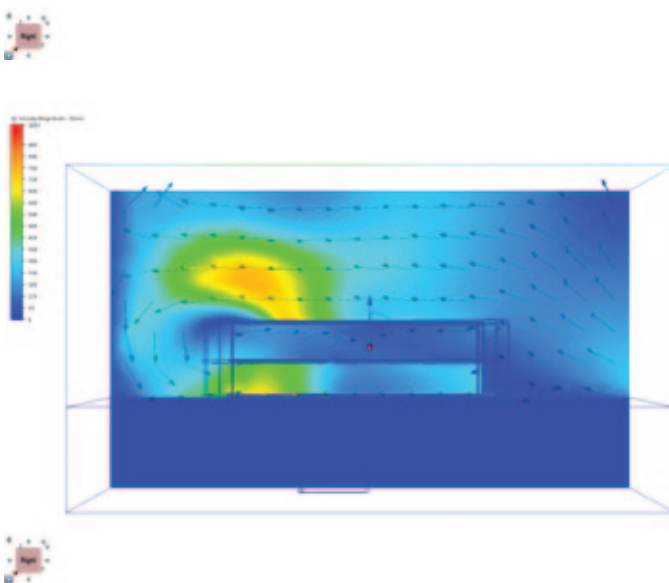
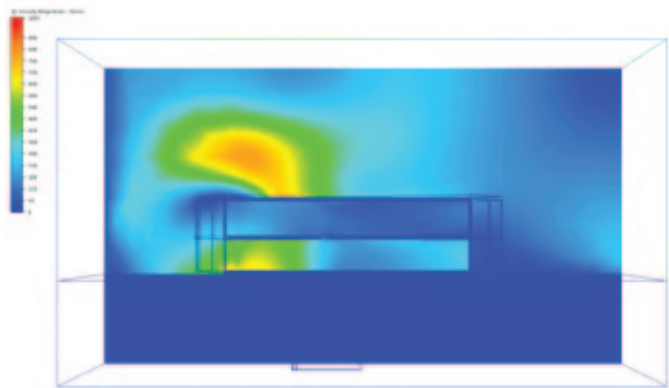
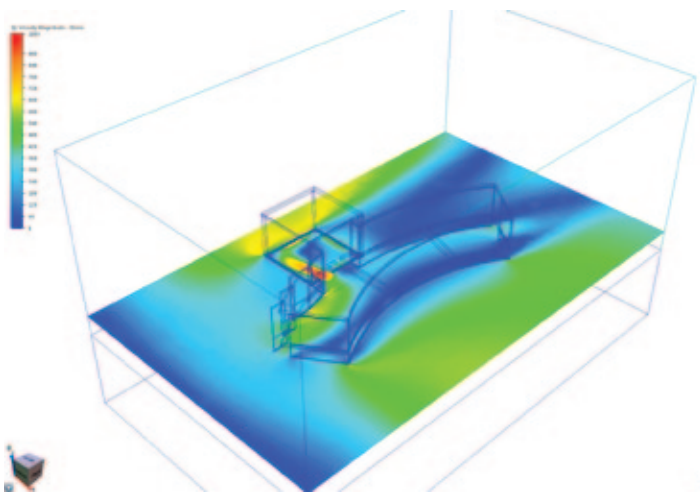
Working design model



Working design model detail



Working design model

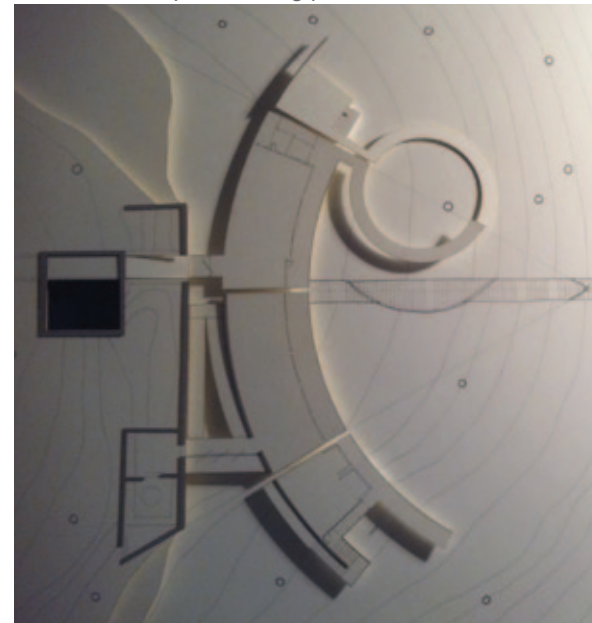


Computational Fluid Dynamic analysis of air movement. Simulation run to understand movement of cool air from planetarium level and ventilation in summer.



First mockup of drawing presentation

Second mockup of drawing presentation

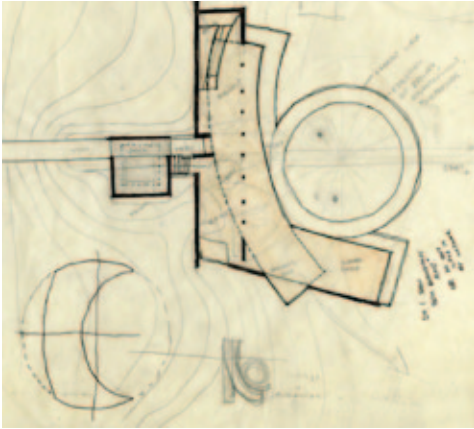


A REALIZED THOUGHT

Final drawings and models

“Architecture presents the drama of construction
silenced into matter, space and light.”

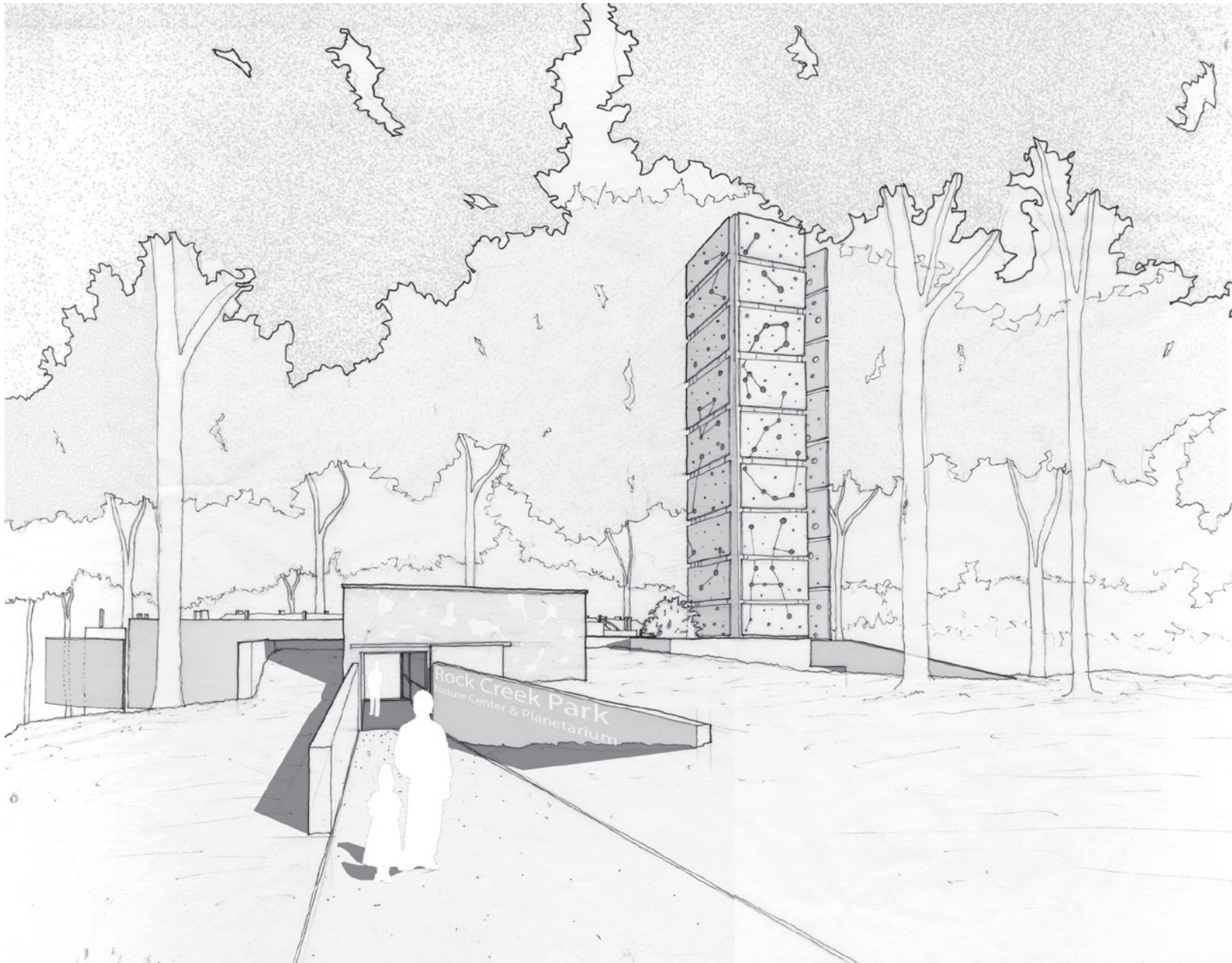
The Eyes of the Skin, Juhani Pallasmaa



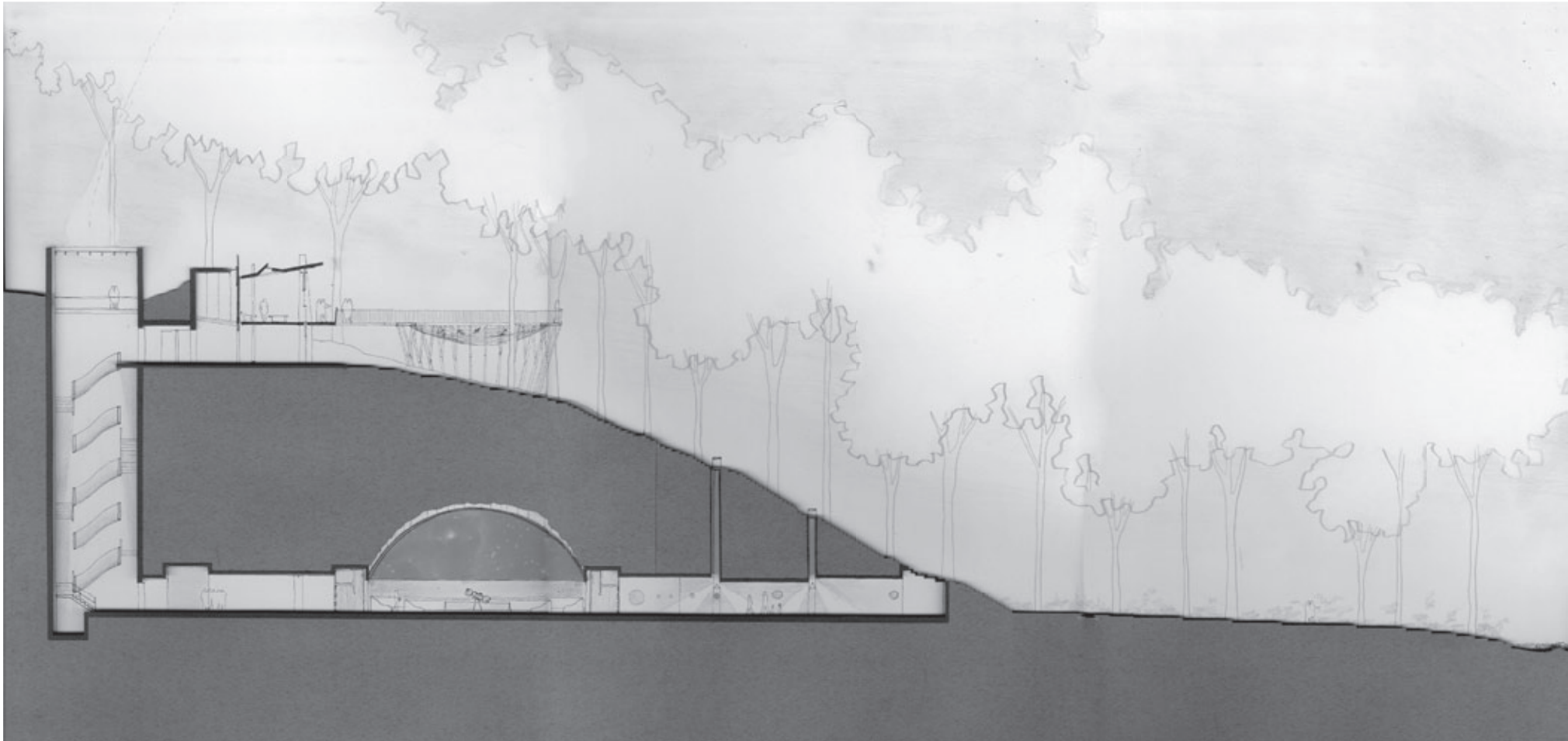
The final site design and orientation was inspired by the movement of the sun. The sun chart in the above sketch was rotated to align with the axis of the hill toward the East. This rotation led to an investigation into the location of the sunset throughout the year. The building is designed to chart the sunset from summer to winter solstice. At the solstice and equinox days, a prism marks the moment by separating and changing the direction of the light. The site plan addresses the need for an identity at the top of the hill and at the creek.



Site plan

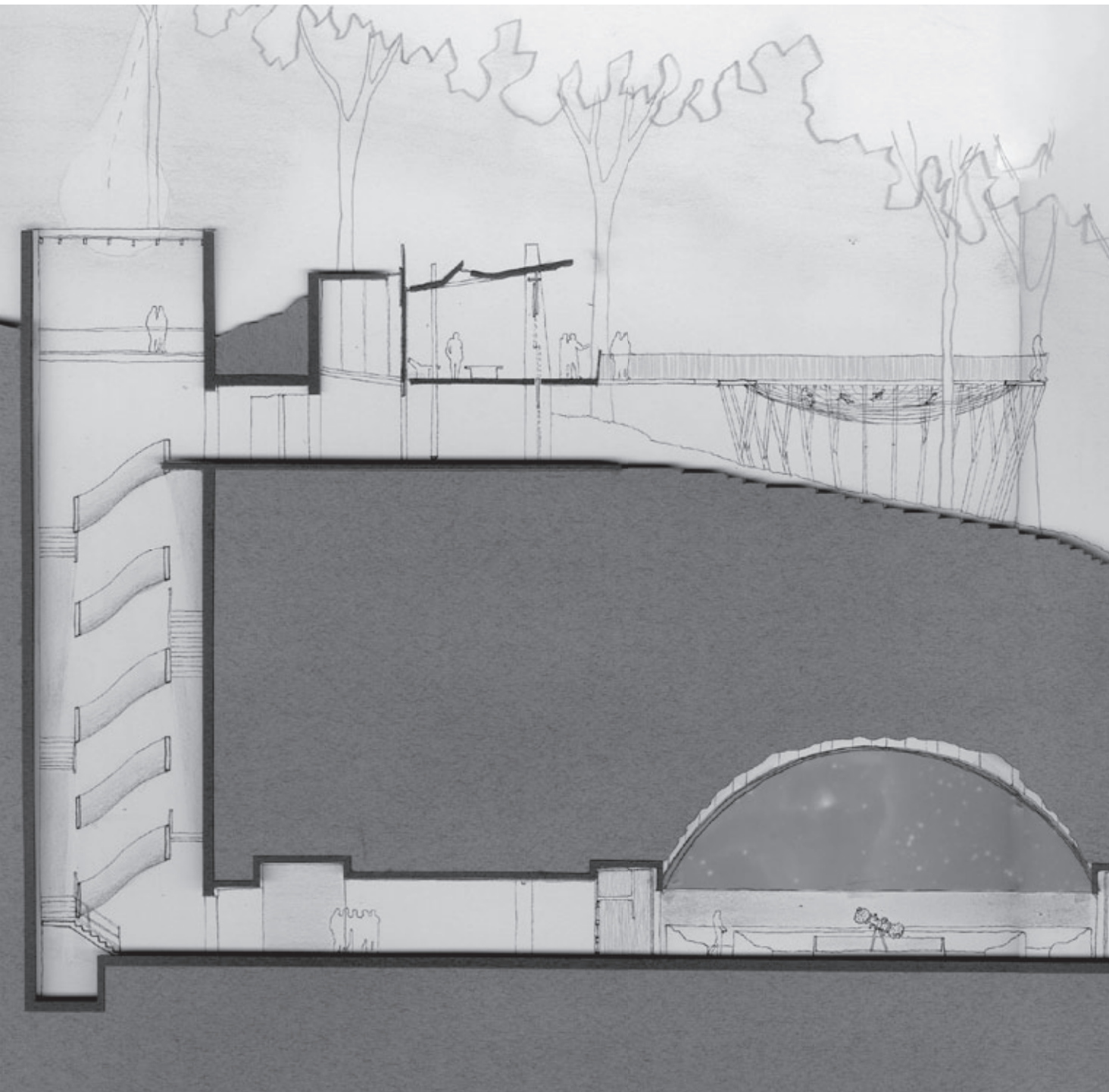


Entrance view from the top of the hill. The hill entrance dives into the earth before emerging above ground in the exhibit area.



Building section

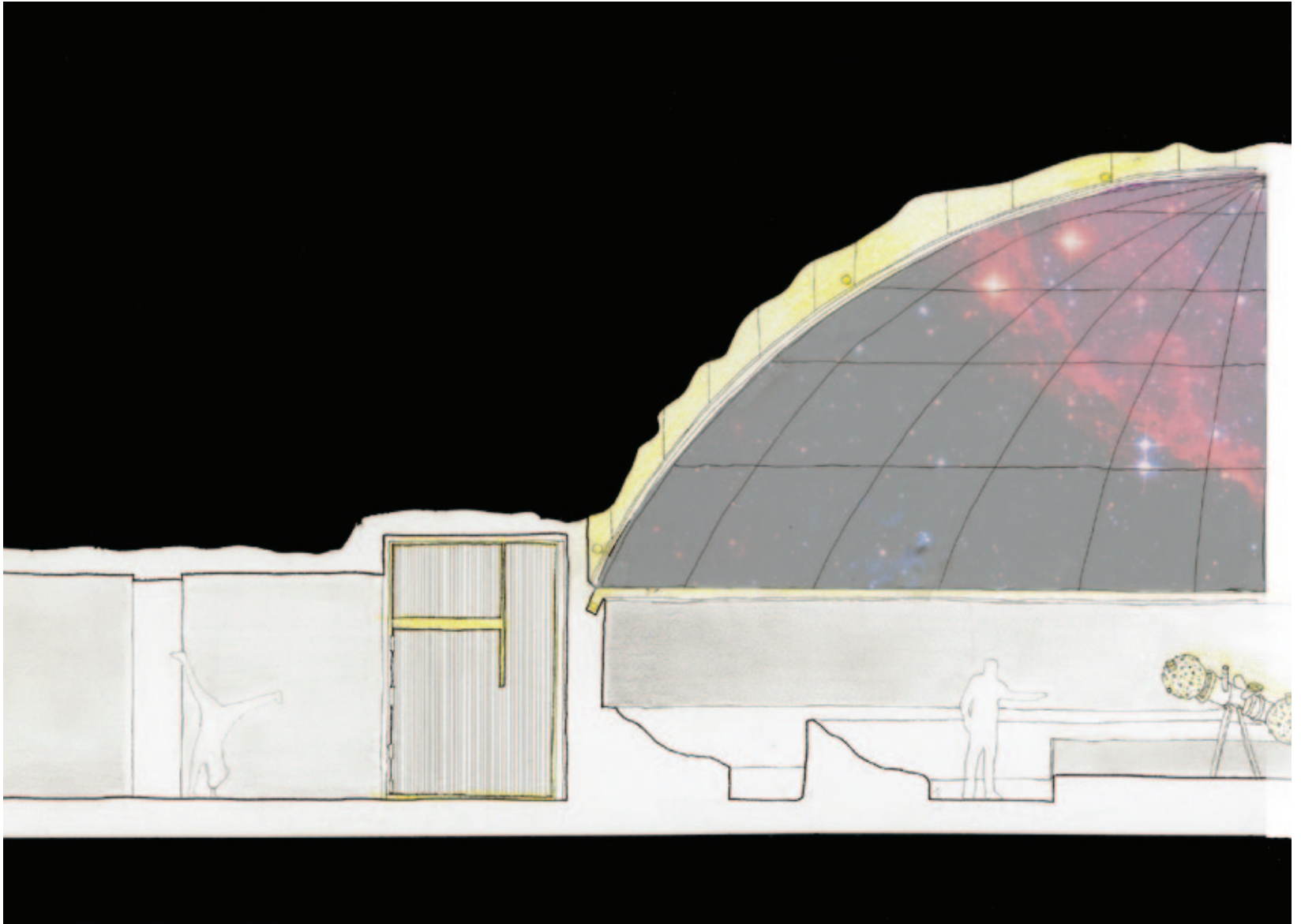
The section of the building is seen as a pairing of two worlds. Descending the stair shaft, one enters into a foreign world and leaves the known surface. In this way, one leaves the Earth completely, but moves deeper into the Earth itself. As a visitor emerges from the stair shaft, the series of spaces leading to the planetarium helps the visitor feel as though they are leaving the Earth and traveling into the greater cosmos. As one moves closer to the creek, the familiarity of the Earth returns through periscopes, first through sound only, then through light from the sun, and finally the visitor leaves the building and is confronted with the creek. Above ground, one leaves the surface of the Earth in a progression of spaces until they are relaxing in the forest hammock elevated into the canopy of the trees with only air below them.



Section detail

Detail showing progression of spaces from the surface to the planetarium below ground, and from the surface to the forest hammock above ground.

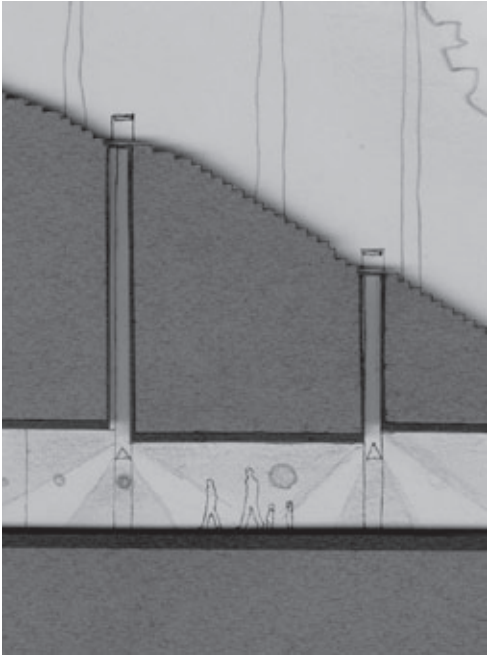




Planetarium detail

The planetarium screen is a metal mesh allowing lighting to reveal the rock above the space connecting the cosmos projected on the screen with the earth behind.



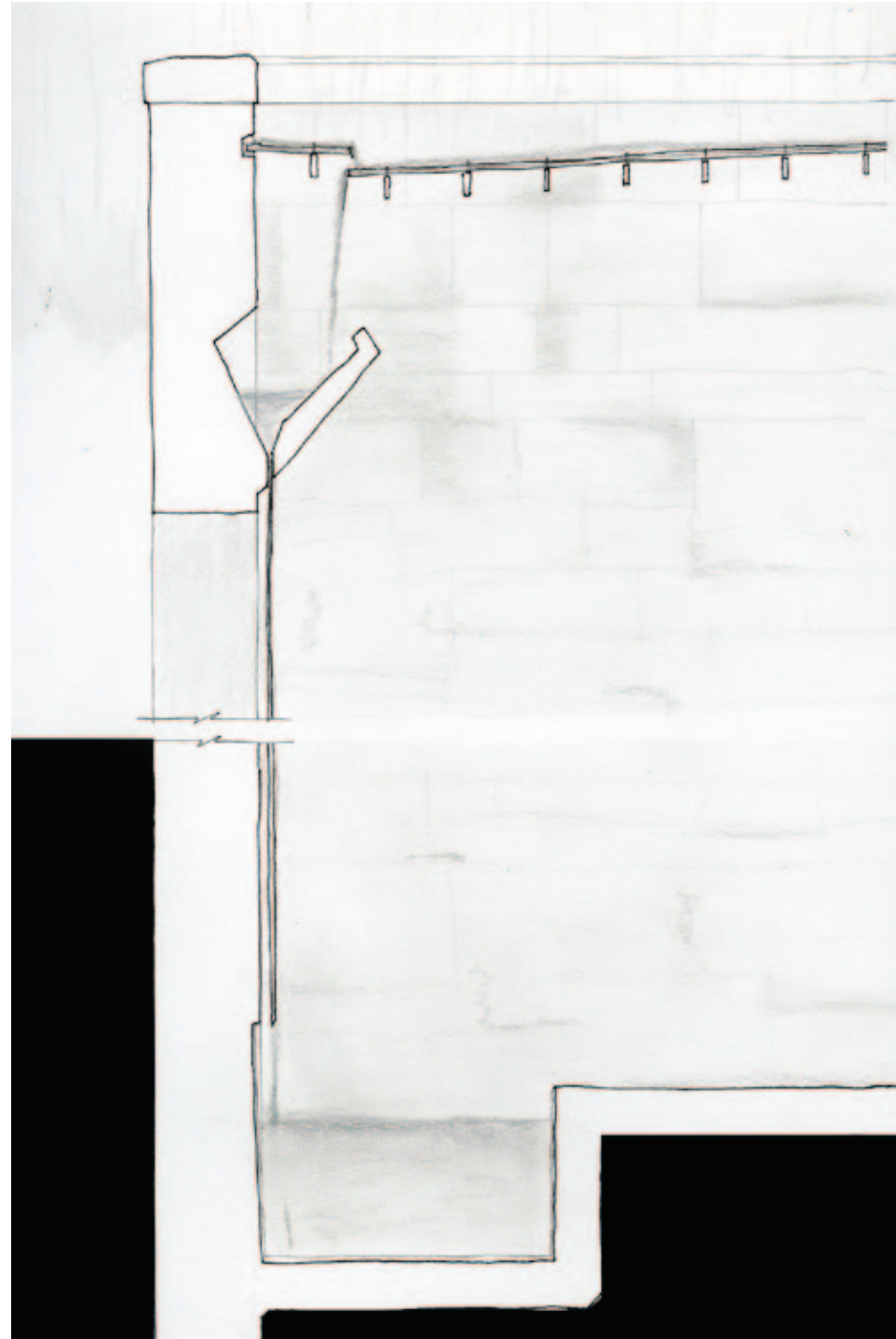


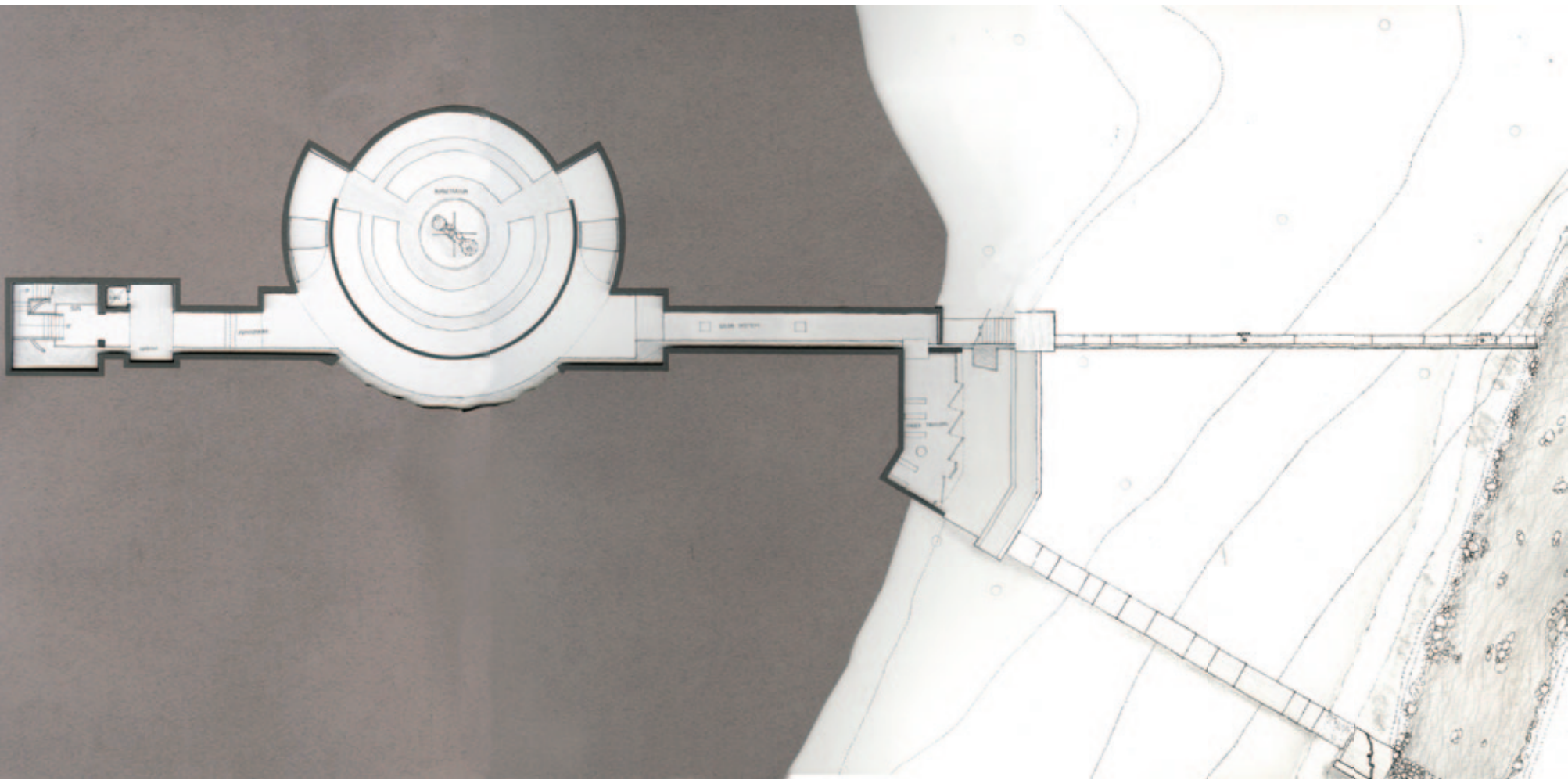
Tunnel periscope detail

The periscopes allow a controlled mental return to the earth after viewing the cosmos in the planetarium.

Rain drip detail

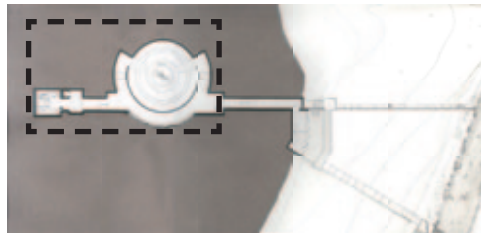
The sound of the dripping water at the bottom of the stair shaft echoes to the surface and carves the space through the ear, before the eyes have adjusted to the dim light.





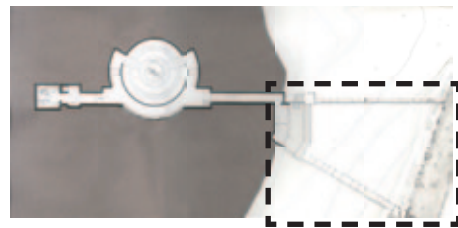
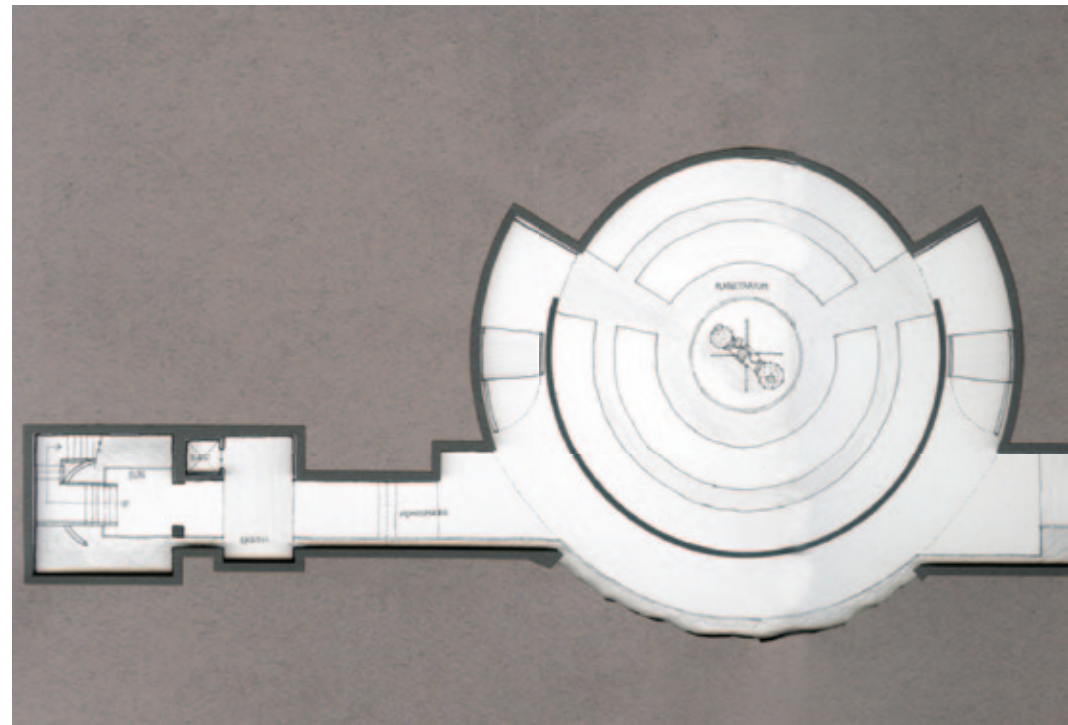
Planetarium floor plan

The Planetarium balances the idea of leaving the Earth while remaining buried deep within it. Along with the mesh projection screen to reveal the rock above, an exposed rock wall outside the planetarium further emphasizes this idea. As a visitor enters this level from the stair shaft, a stream of water from the surface guides the visitor through the spaces. The water flows toward the creek, pooling at the intersection of the building and the surface of the hill before leaving in a channel hollowed out of the ground providing the water a way to join the creek.



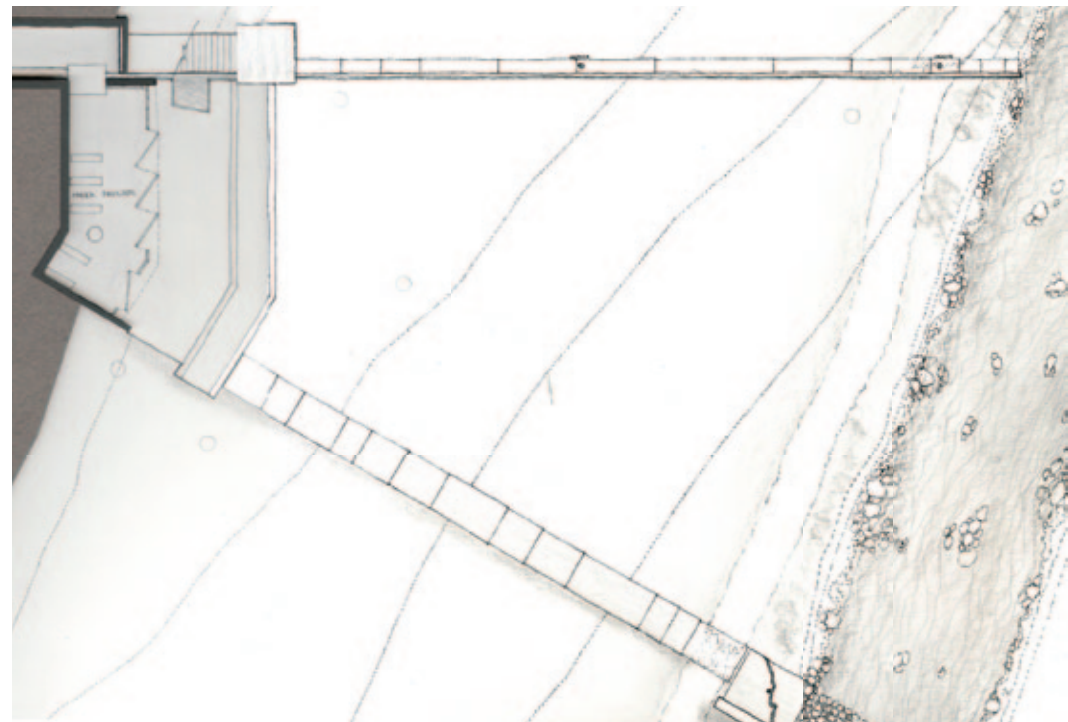
Planetarium floor plan detail

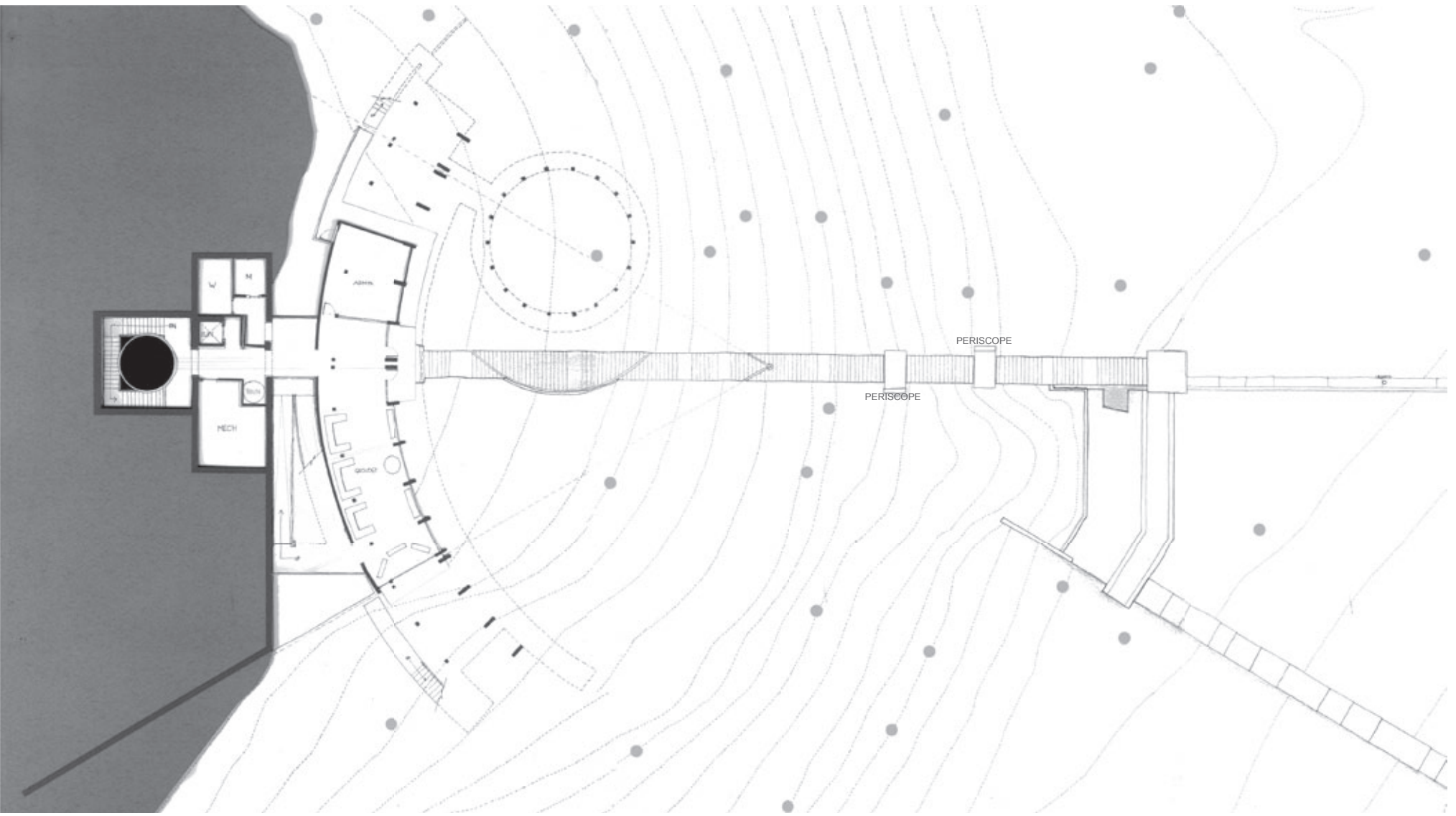
Detail of entrance sequence into the planetarium with a water course leading the path.



Planetarium floor plan detail

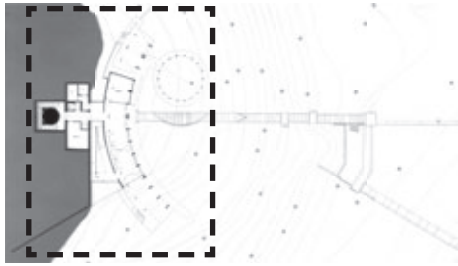
Semi-buried pavilion dedicated to the creek, offering exhibits and maps of the creek.





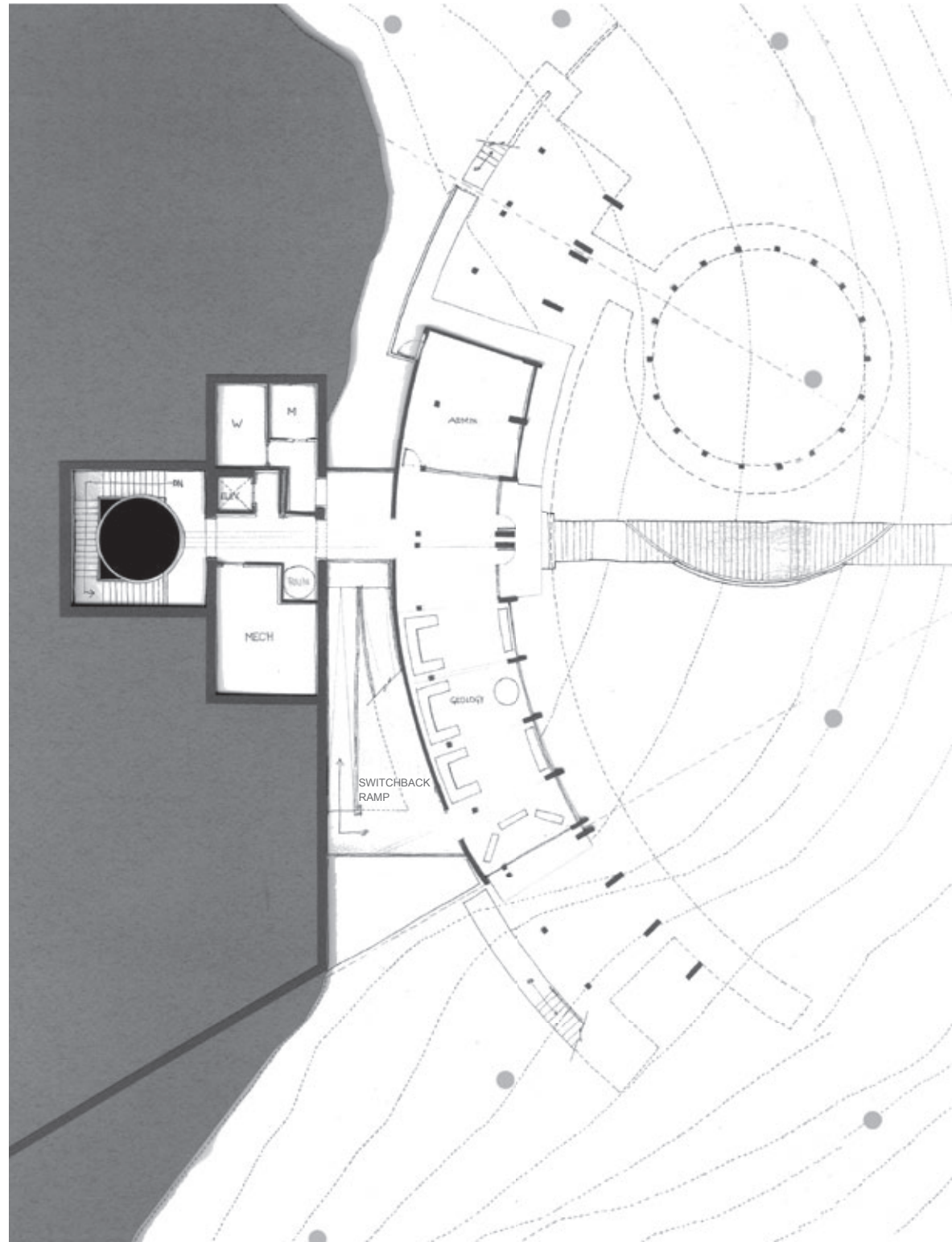
Ground floor plan

The ground floor connects the surface of the earth with the cosmos below. This level features exhibits related to this connection such as geology, seedling growth, topography, and stratum of soil. The stair pathway on the East-West axis provides visitors with a connection from the creek to the hill that allows them to peer into the periscopes to see below, and see the intersection of the solstice axes on the building above.



Ground floor plan detail

The ground floor connects with the exhibit hall above via a switchback ramp offering views north and south out of the building.



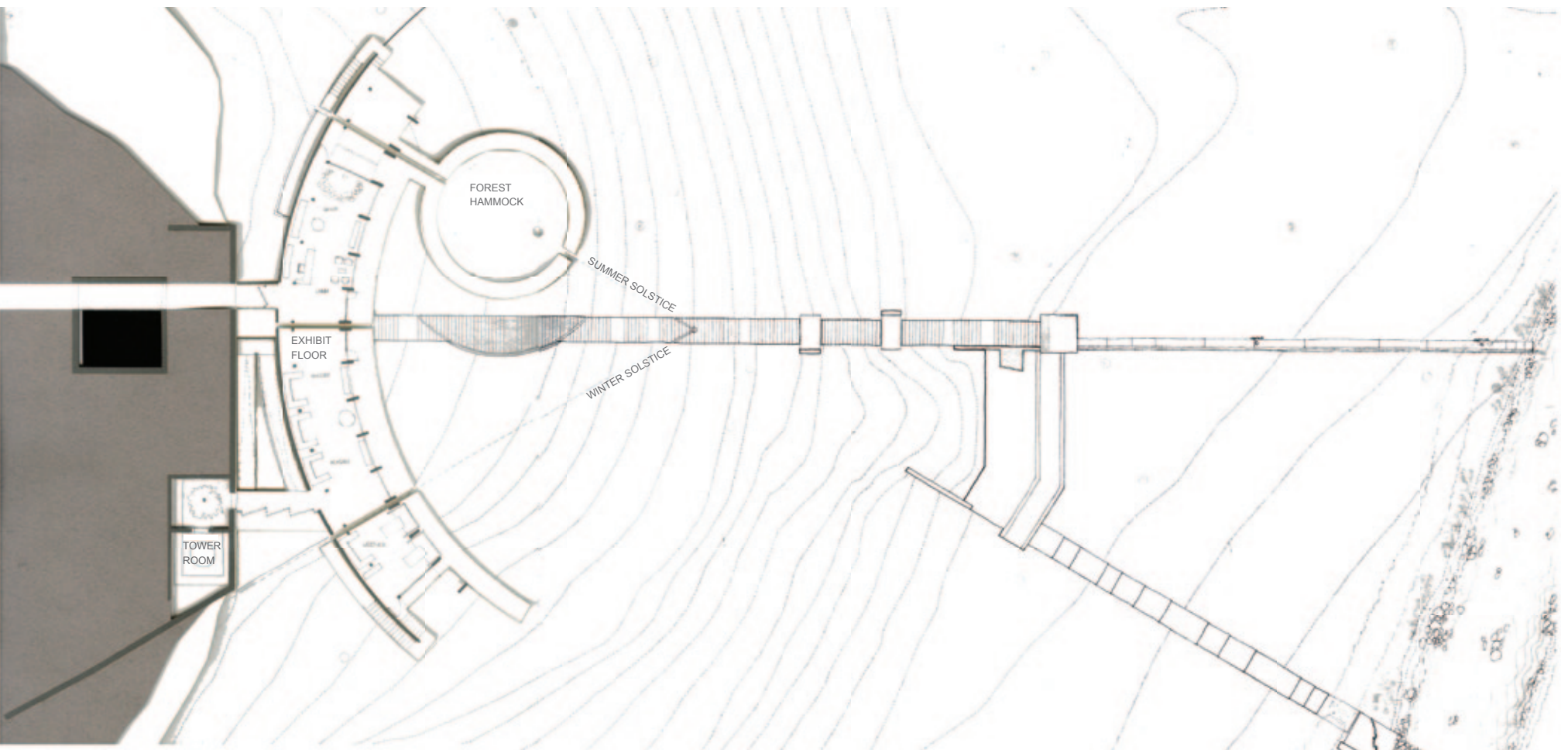


Exhibit floor plan

The ground floor connects the surface of the Earth with the sky above. This level features exhibits related to this connection such as tree species, the seasons, the climate, and the sun. This level also features an outdoor tower room accessed by entering into the earth behind the retaining wall. This room encloses a digital camera obscura allowing visitors to see the view from the top of the tower by day, and by night to see the stars. The curve of the exhibit hall charts the movement of the sun and the change in sunset location throughout the year. At the spring and winter solstices and the equinox, the sunset is marked by an opening in the structure allowing the final rays of light from those special days to enter the building and light a prism that allows visitors to witness this event. Finally, this level contains the forest hammock allowing visitors to lay in a net, listening to stories 30 feet in the air alongside the canopies of the trees.

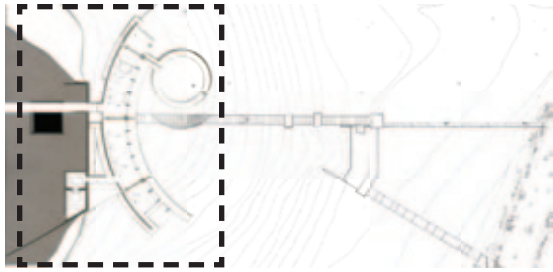
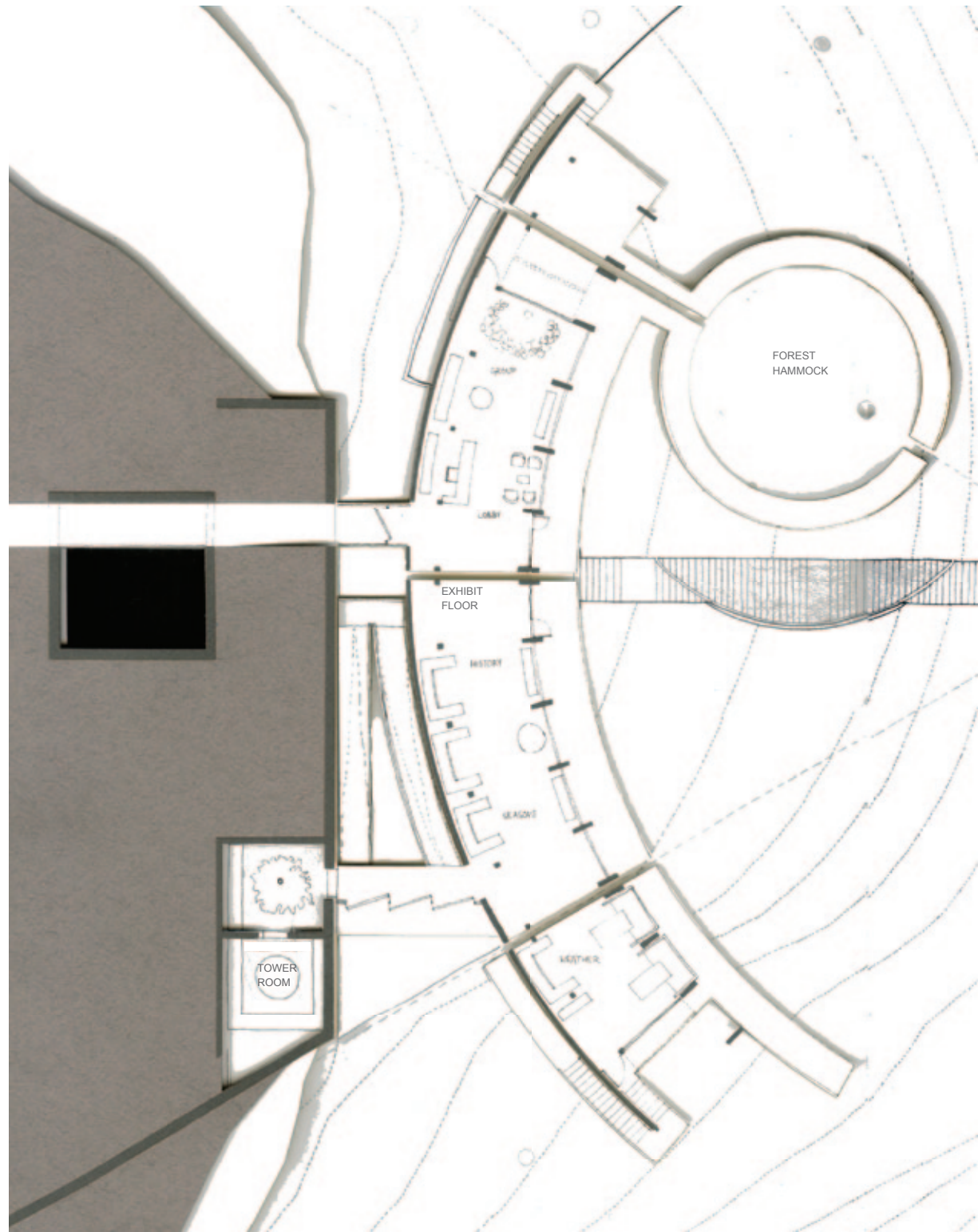
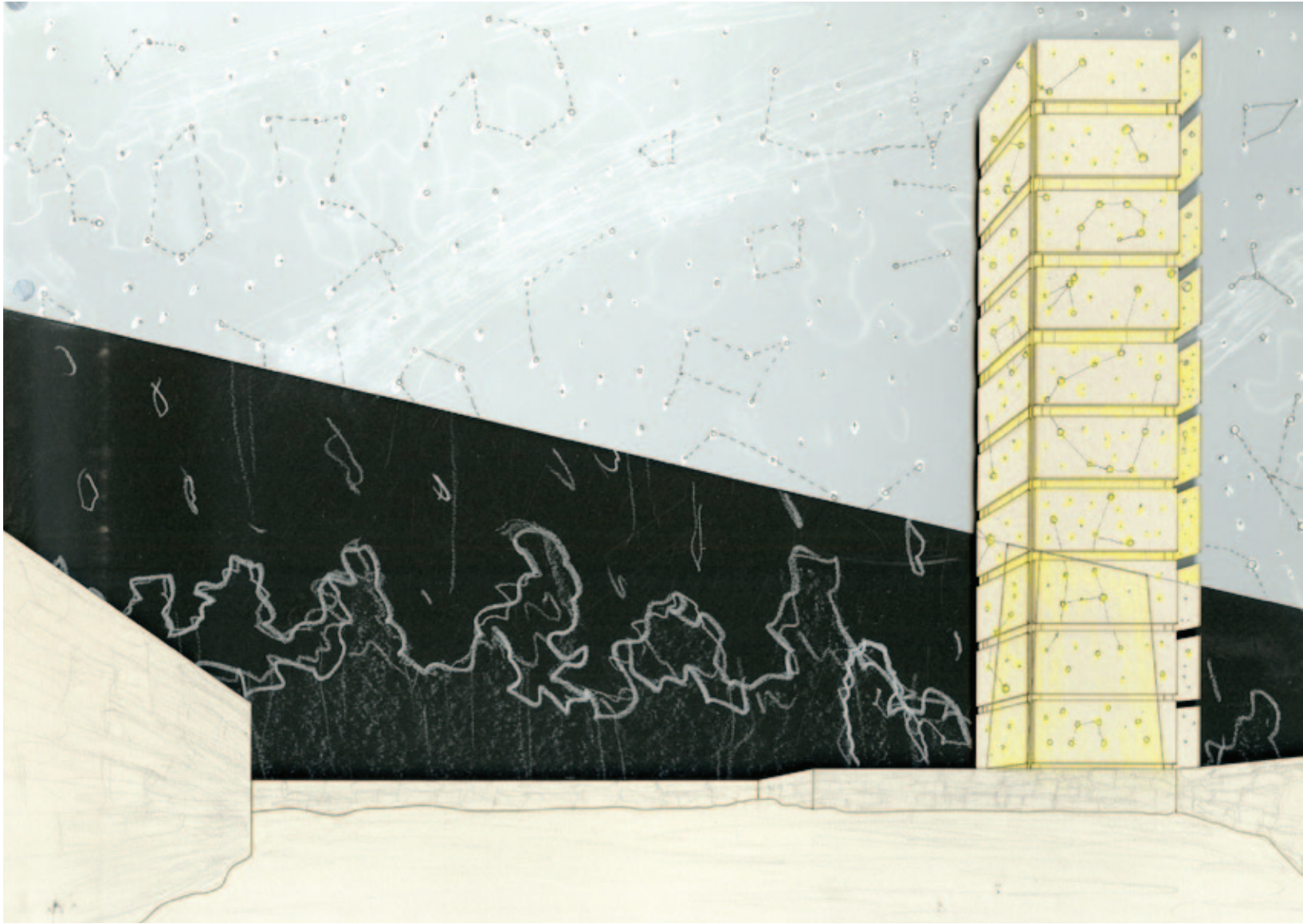


Exhibit floor plan detail

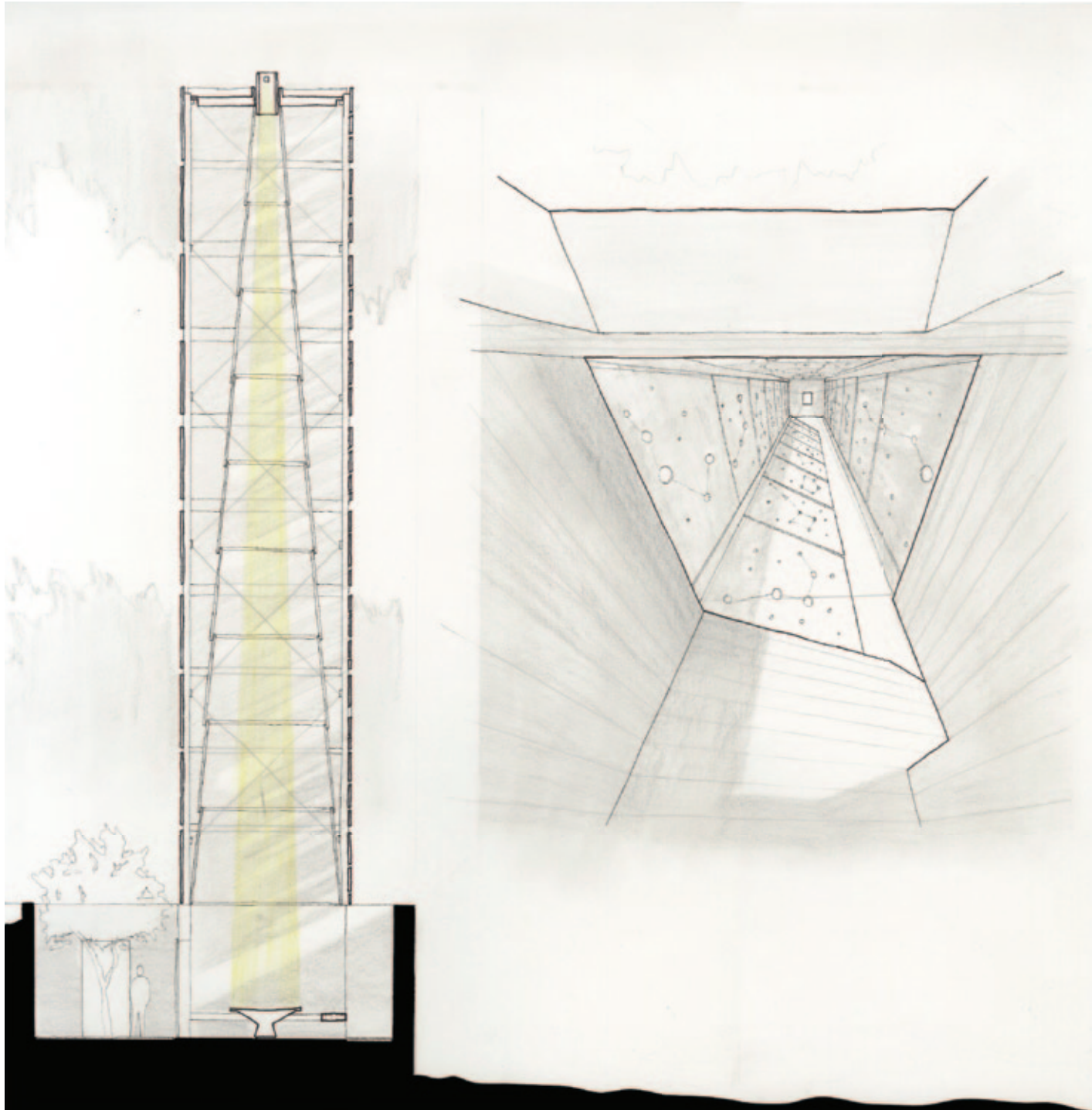
Enlarged view of the exhibit level of the building featuring the tower room, curved exhibit hall, and the forest hammock.





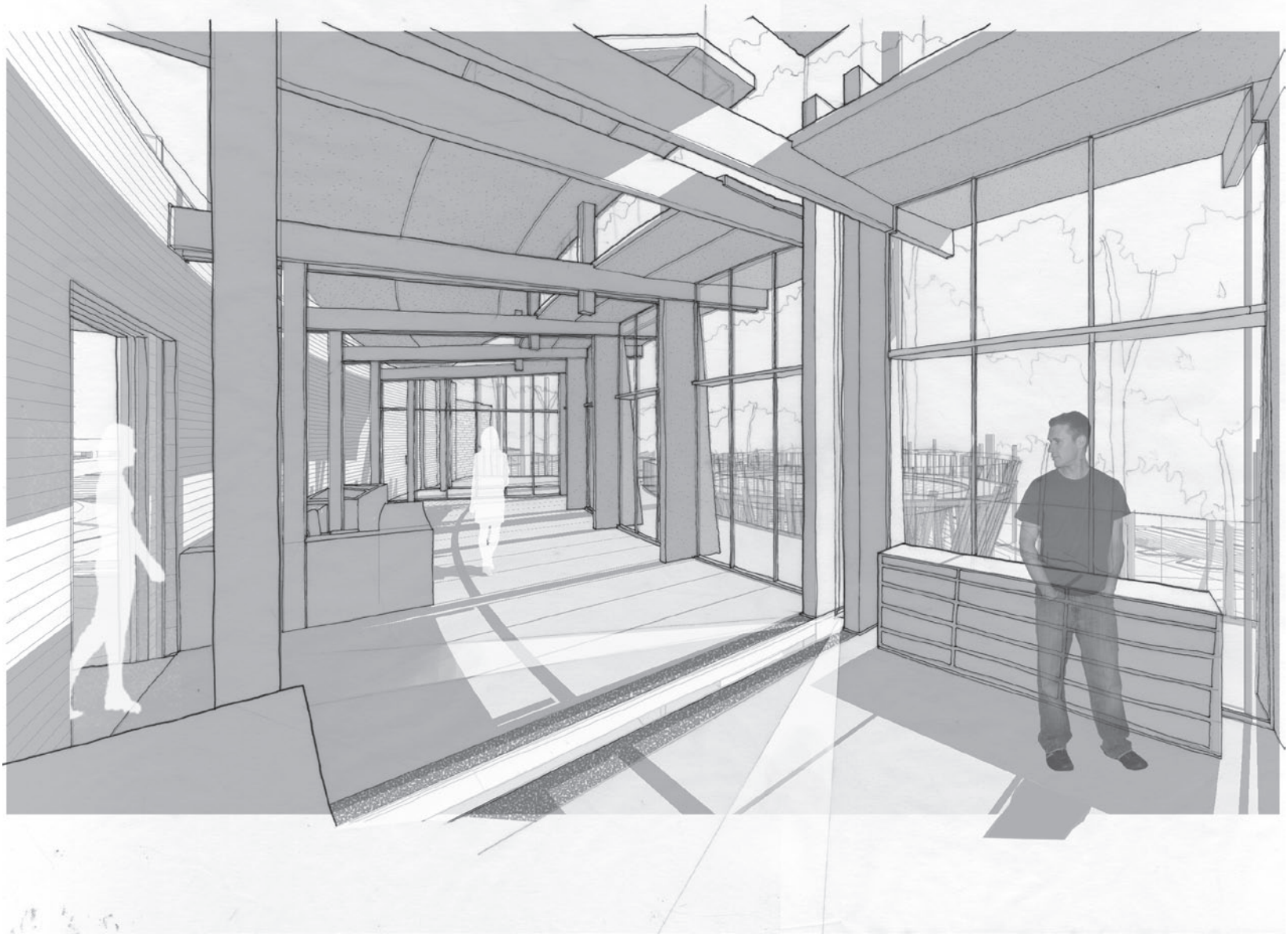
Day & night tower detail

Exterior view of the tower showing the star map engraved onto the exterior panels. At night, the interior lighting allows the stars to glow on its surface and acts as a beacon for the building in the forest.

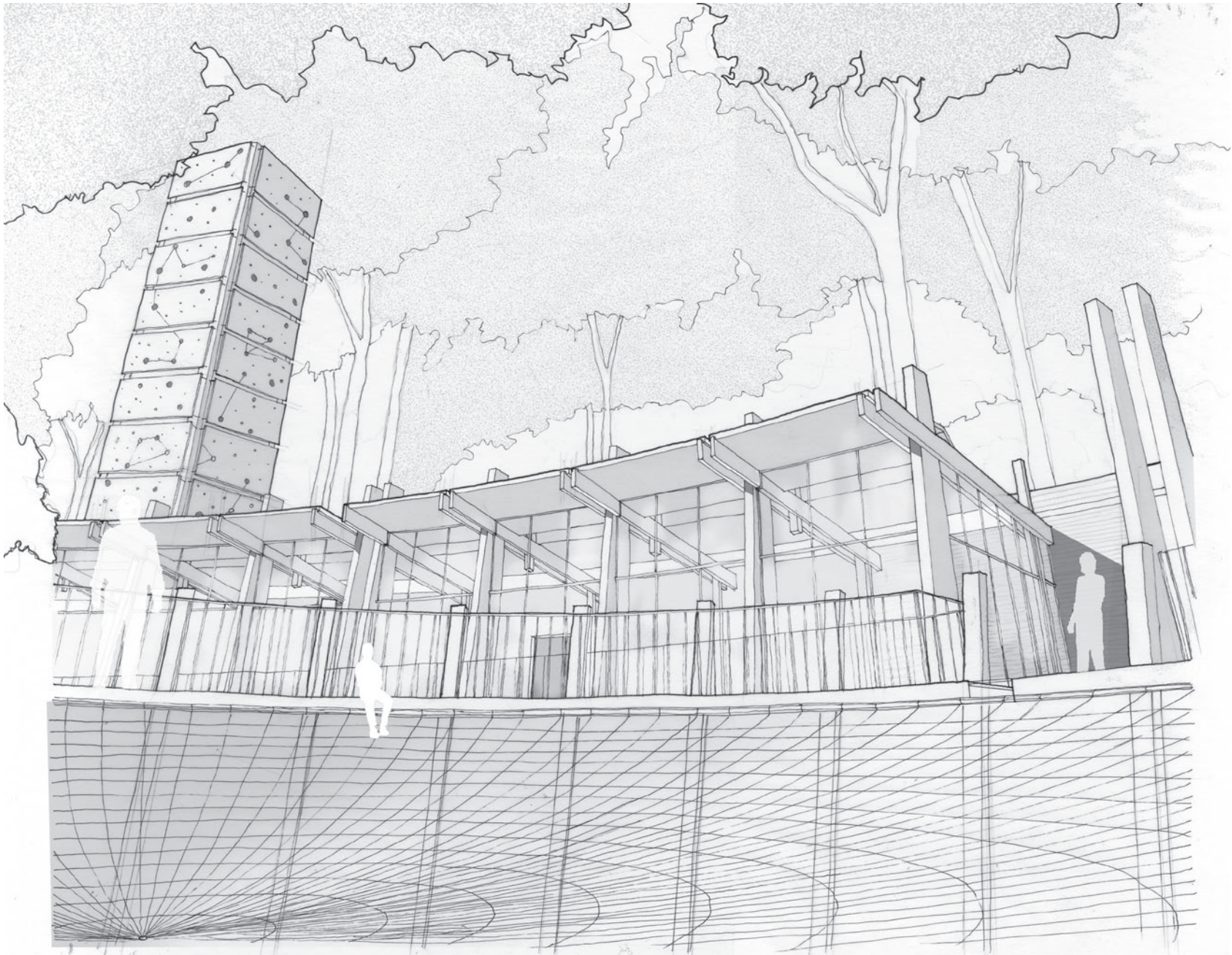


Tower detail

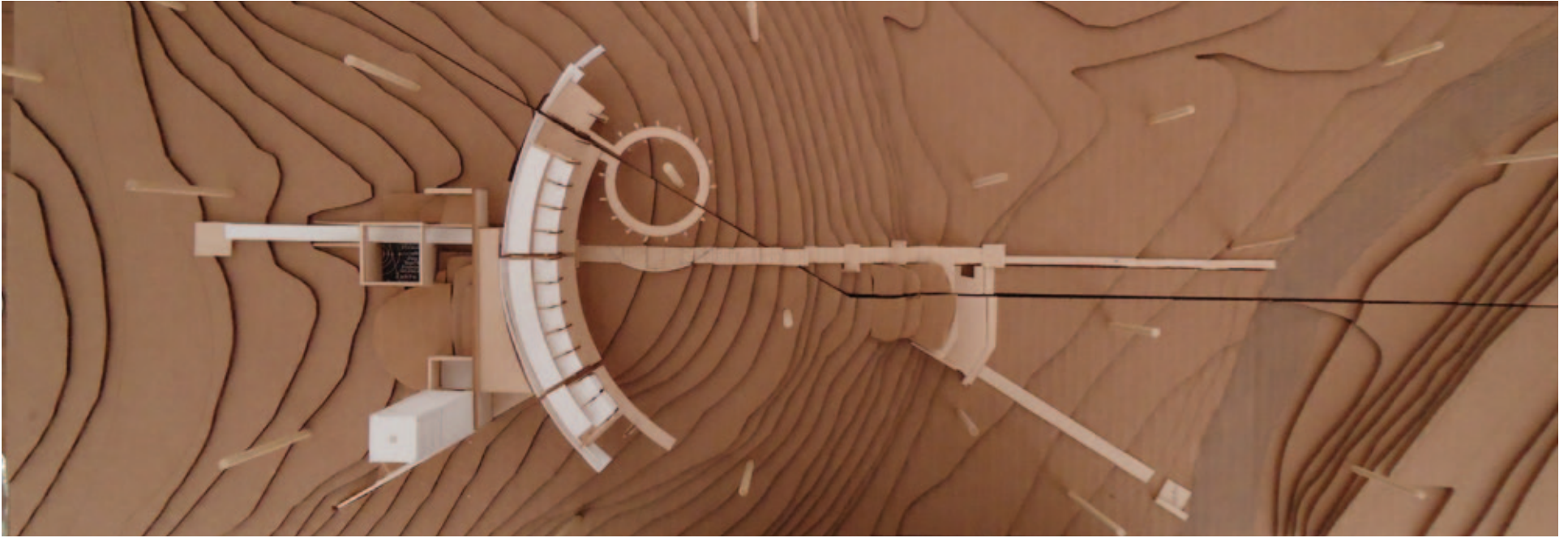
The interior of the tower room features a round table on which the surrounding view from the top of the tower is projected. The view looking up shows the shadows from the sun lighting the engraved star maps.



View of exhibit space overlooking the forest
while the sun strikes the solstice prism

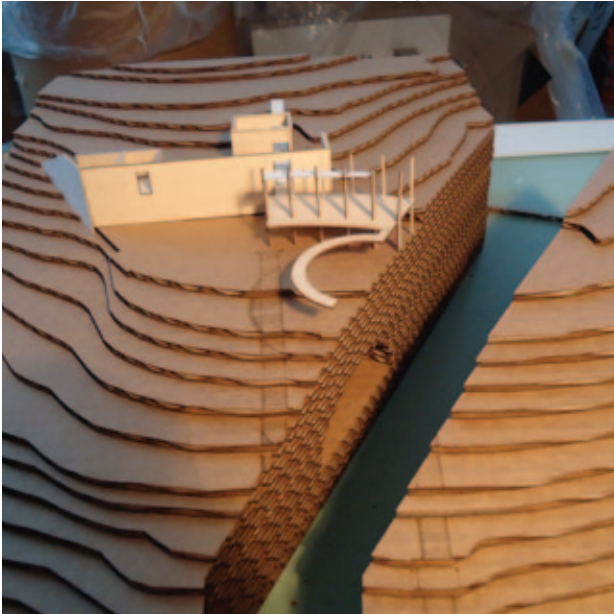


View from the forest hammock looking toward the tower

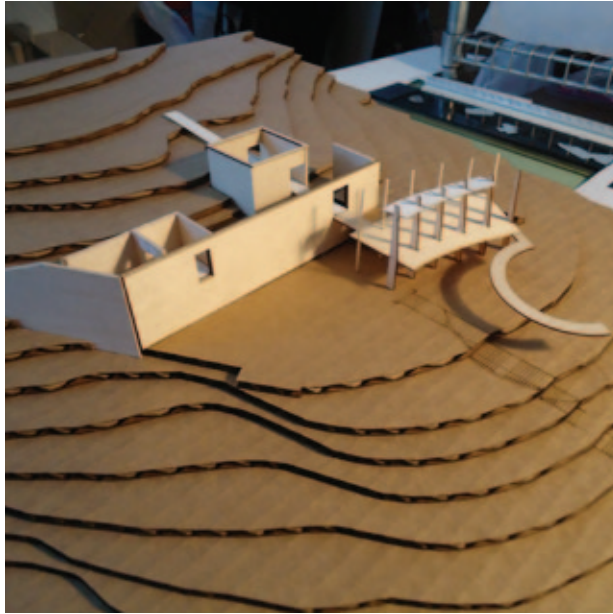


Final model

Final model under construction showing section



Final model under construction



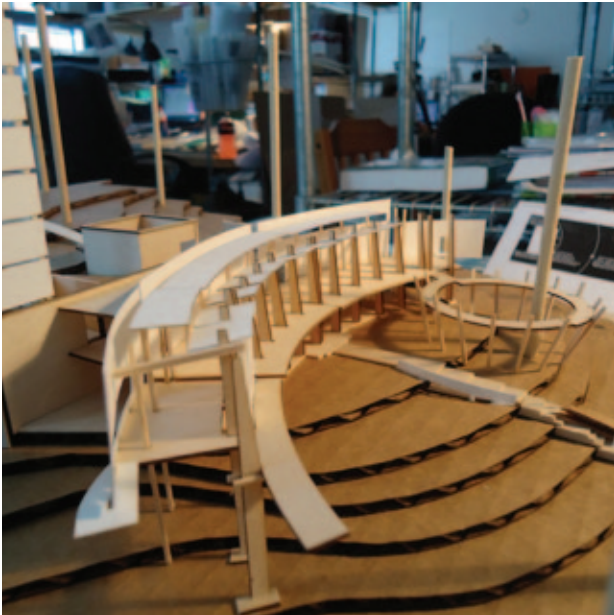
Final model view from top of the hill





Final model

Final model detail



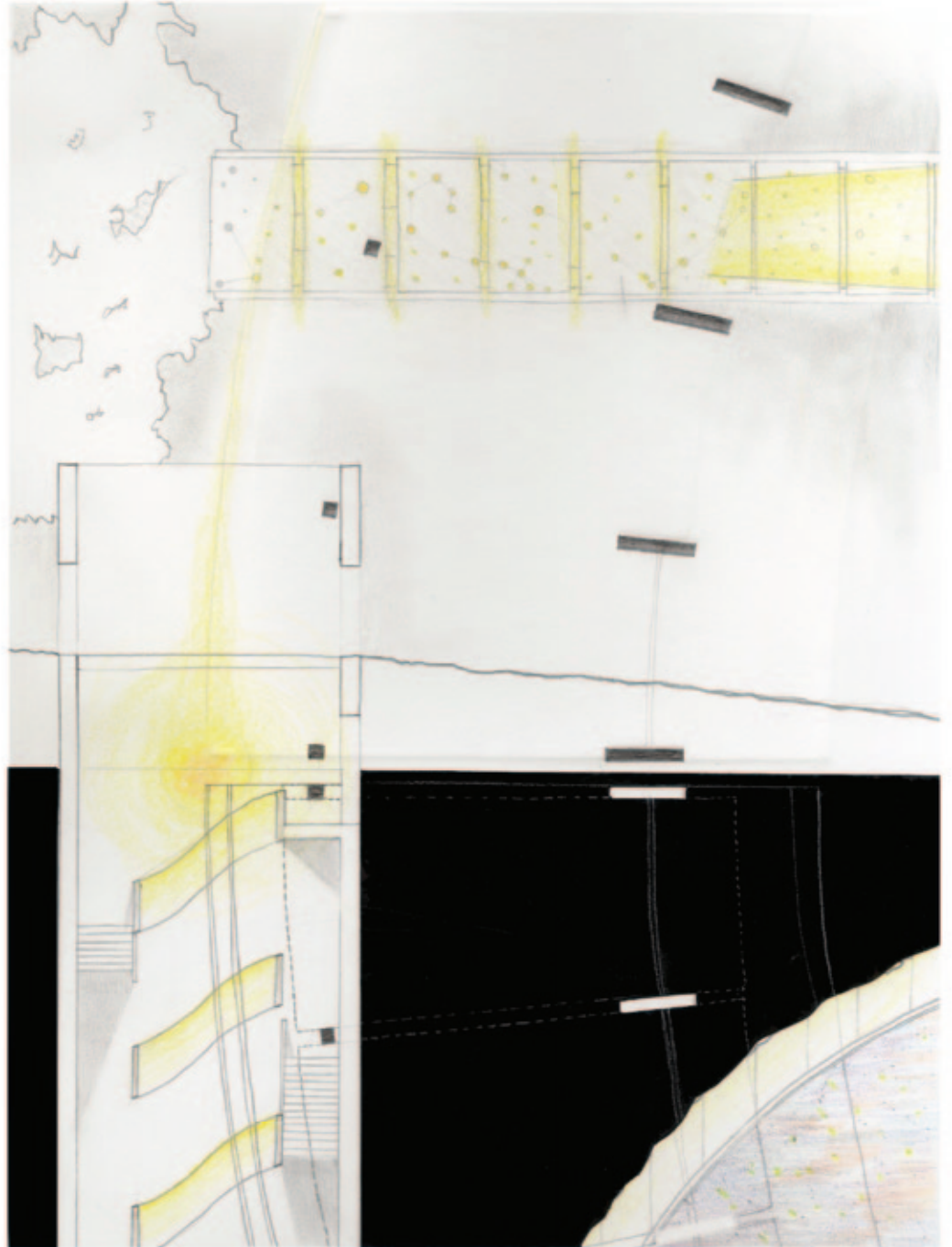
Final model interior view



Final model view from the creek



Hybrid drawing of pairings



IN CLOSING

This thesis explored the relationships of site and program through the pairings of sky and earth, light and dark, and Earth and cosmos. The proposed nature center and planetarium was moved to a site which more closely aligns with the factors making up Rock Creek Park. The site allowed the building to exist in many worlds of water and the forest which helps to highlight the setting to the visitor. The project allowed a focus on how the imagination can help educate by allowing the visitor to listen to gain information and see in new ways. Each facet of the design was considered by looking at how it can be slightly changed and adjusted to create something comfortable yet also new. By doing this, visitors can visit the building many times but each visit allows new interpretations and meanings.

Through hand drawing and modeling of both architectural and conceptual ideas, the project became an assemblage of abstract pieces of important quotes, feelings on hiking through the woods, and how architecture can inspire emotions and capture the imagination.

Finally, the result of this thesis is a project which lives above and below the Earth, located in both Rock Creek Park and the greater cosmos. It is connected to many places real and imagined, near and far, and in the past and present. It is an exploration of how architecture can connect many parts of the mind and many parts of a site into a cohesive whole.

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Pallasmaa, Juhani. *The Eyes of the Skin: Architecture and the Senses*. Chichester: Wiley-Academy, 2005. Print.

IMAGE CREDITS

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Figure 1 & 2: Nature Van (2 Photos). Photographer: Rowe, Abbie. 1952. NPS Historic Photograph Collection. Catalog Number: HPC-001308. [fair use].

Figure 3. Morris Arboretum Tree Adventure. Photographer: Warchol Paul. 2009. [fair use].

Figure 4: Star Map. Woods, David. "Apollo 15 Flight Journal." History Home. 1998. Web. 30 April. 2011. <<http://history.nasa.gov/>>. [fair use].