

THE ADAPTATION OF A THUNDER BAY GRAIN ELEVATOR

by

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Submitted in partial fulfilment of the requirements
for the degree of Master of Architecture

at

Dalhousie University
Halifax, Nova Scotia
March 2011

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DALHOUSIE UNIVERSITY
SCHOOL OF ARCHITECTURE

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Dated: March 22, 2011

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DALHOUSIE UNIVERSITY

Date: March 22, 2011

AUTHOR: Richard Gillies

TITLE: The Adaptation of a Thunder Bay Grain Elevator

DEPARTMENT OR SCHOOL: School of Architecture

DEGREE: MArch CONVOCATION: May YEAR: 2011

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CONTENTS

Abstract	v
Acknowledgements	vi
Chapter 1: Introduction	1
Thesis Question.....	1
Location: Thunder Bay	1
Elevator Construction	5
Functional, Aesthetic, Monumental, Mystery	12
Chapter 2: Design.....	17
Previous Adaptations of Grain Elevators	17
Quaker Square, Akron	19
Globe Mills, Sacramento.....	20
Strategy	22
Light.....	24
Subtraction.....	28
Addition.....	47
Walkthrough.....	54
Chapter 3: Conclusion	75
References	76

ABSTRACT

This thesis is an exploration of spatial possibilities within a concrete terminal grain elevator in Thunder Bay, Ontario, Canada. Informed by research into the history, function, and construction of grain elevators, this investigation develops an approach to adaptation that would inhabit the interior spaces while preserving the sense of wonder and intrigue inherent in these structures. Using a program defined only as the most basic requirements for habitation, spatial possibilities are investigated to augment the aesthetic, monumental, and mysterious qualities of the structure, without domesticating it.

ACKNOWLEDGEMENTS

I wish to thank the following people and organizations for their guidance and support in the development of this thesis:

Steve Parcell as thesis supervisor.

Steven Mannell as thesis advisor.

Thunder Bay City Archives

City of Thunder Bay Mapping and Planning Division

Thunder Bay Public Libraries

Northern Studies Research Centre at Lakehead University

Thunder Bay Historical Museum Society

Nancy Perozzo and The Friends of the Thunder Bay Grain Elevators

Dalhousie University Faculty of Graduate Studies for a research grant

CHAPTER 1: INTRODUCTION

Thesis Question

How can architecture create functional and aesthetic spaces within an abandoned grain elevator, while maintaining its monumental qualities and the sense of mystery that the structure invokes?

This thesis question contains four key words that will shape the investigation and discussion to follow: functional, aesthetic, monumental, and mystery. The design aspect of this thesis is focused on creating a set of formal moves that can support these four qualities. As an adaptation project, I will first provide a brief background of the grain elevator: why they exist in Thunder Bay, how they are constructed (which is closely related to their form), and how they function. This will allow me to then describe the specific elevator selected for this investigation, and move into a discussion of the four formal qualities driving the design process.

Location: Thunder Bay

The grain elevator is embedded in, works with and depends upon a wide variety of pre-existing networks – sources of grain, grain markets, transportation routes and the vehicles that travel on them, communication hubs, financial institutions, labor pools and energy sources – which in turn means that a grain elevator is only built and operated at certain carefully chosen places and at certain fortuitous times. (Brown 2009, 294)

The city of Thunder Bay, located on the western shore of Lake Superior (a region known as the Lakehead), has been a key location in the transportation of Canadian grain since the first grain elevator was opened in 1883. Formerly two cities of Fort William and Port Arthur, Thunder Bay was created by their amalgamation in 1970.

The Historical Atlas of Canada succinctly describes the movement of Canadian grain with the following text and accompanying image:

To transport the wheat more than a railway was needed. A complete transportation system had to be developed with storage and transshipment at the Lakehead (Thunder Bay), transport on the Great Lakes in large, special-purpose vessels (which after 1899 could benefit from deeper canals that bypassed Niagara Falls and the rapids of the upper St Lawrence), and efficient storage and transshipment again at the port of Montreal. Grain elevators were built at Georgian Bay ports and some grain was taken by rail over a shortcut to Montreal. Buffalo, NY, at the eastern end of Lake Erie, took increasing amounts of

Canadian grain, which was milled there 'in transit' or shipped to New York City in bond." (Kerr 1990, 31)

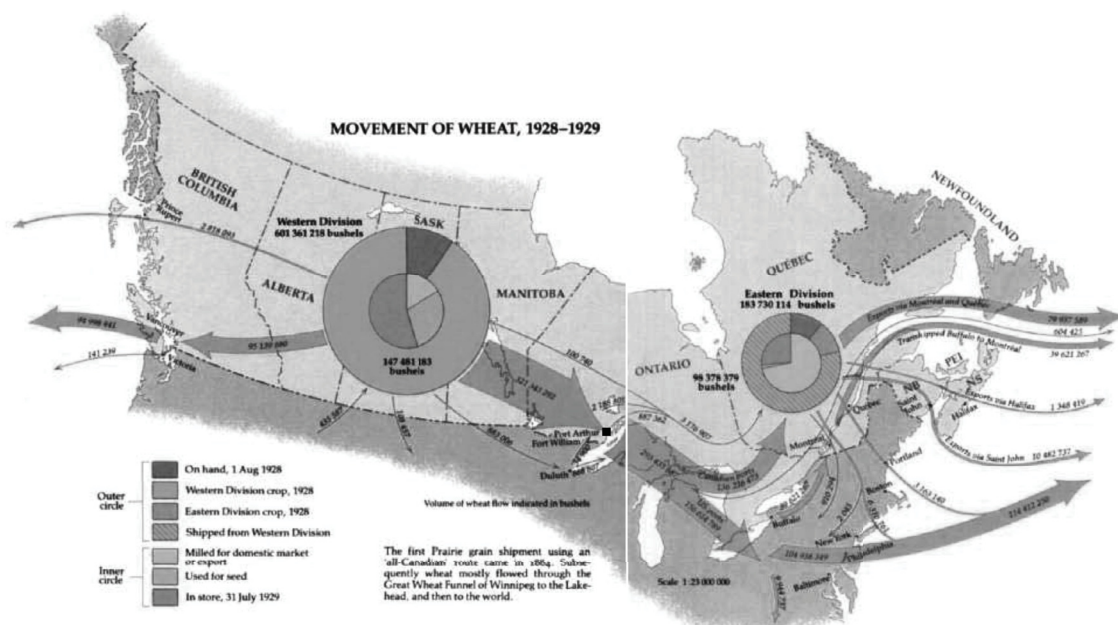


Figure 1: Showing the movement of Canadian wheat in 1929, the small black box at the end of the widest arrow indicates Thunder Bay. (Kerr 1990, 75)

The history of grain elevators can be traced back to Buffalo, New York in 1842, when entrepreneur Joseph Dart and engineer Robert Dunbar constructed the first grain elevator. This was a wooden structure which housed the elevator and a series of bins.

The heart of the new invention – a looped or 'never ending' conveyor belt, made out of canvas, upon which large buckets made out of iron had been attached at regular intervals; the whole thing enclosed within a long, straight rectangular box made out of wood and iron... (Brown 2009, 109)

It was not until 1883 that the Canadian Pacific Railway constructed the first grain elevator in Thunder Bay (Vervoort 1982, 30), known as the King's Elevator. This marked the first time that grain from the prairies could take an all-Canadian route to the eastern ports. Prior to 1883 grain was moved south through American routes (Vervoort 1990, 404). The Lakehead grain trade rapidly expanded in the following decades. Figure 2 illustrates the large number of grain elevators (27) located in the harbour in 1942.



Figure 2: The grain elevators in Thunder Bay in 1942. The black box indicates the location of the specific elevator being studied in this thesis. (Canadian Lakehead Harbours: Fort William and Port Arthur, Ontario, 1942)

In 1953 the opening of the St Lawrence Seaway spelled the end of Buffalo's position as a port of transshipment, as ocean vessels could now access the ports Fort William and Port Arthur (Thunder Bay), Duluth, and Chicago directly.

...the St Lawrence Seaway, which involved the deepening of the St Lawrence River channel and the construction of larger canals to allow the passage of bulk carriers and some ocean-going ships between the Great Lakes and the Atlantic. (Kerr 1990, 119)

However, as the fortunes of Buffalo fell, the port of Thunder Bay experienced steadily increasing grain shipments up to a maximum of 17.3 million tonnes in 1983 (approximately 660 million bushels), after which changing world markets resulted in more grain moving west through Vancouver.

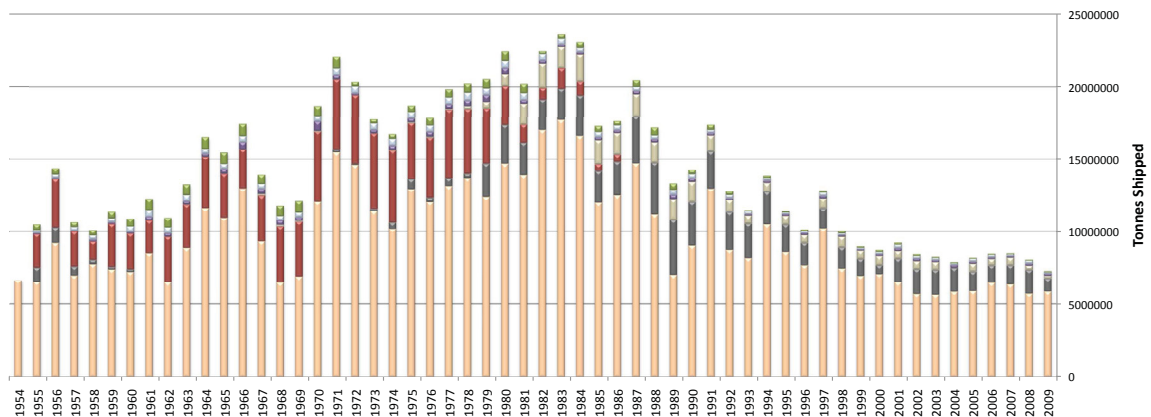


Figure 3: Bulk cargo moving through the port of Thunder Bay. (Port of Thunder Bay, 2009)

Elevator Construction

Before reinforced concrete became the unanimous material of choice for grain elevators, wood, steel and ceramic tile were commonly used. Wood construction defined the earliest grain elevators. In the case of the King's elevator the wooden crib technique was used: planks were placed horizontally with overlapping ends and nailed together (Vervoort 1990, 404). Thus the walls, when complete, were a mass of solid wood. However, by the turn of the century several new methods of building grain elevators emerged as engineers grappled with the problem of trying to create a fireproof structure. Steel elevators were initially thought to be the answer to this problem and many such elevators were constructed throughout North America in the first decade of the twentieth century (Brown 2009, 213),

and the first such steel elevator in Thunder Bay (Fort William) was constructed in 1902 (Vervoort 1990, 406). However, even though steel is not flammable, the heat generated by fire can weaken steel to the point where the structure fails. The Fort William elevator suffered a catastrophic fire soon after construction, with the steel reduced to a “tangled mess”, and was rebuilt in wood (Schneekloth 2007, 34).

At the turn of the century two new construction methods emerged for grain elevators: ceramic tile and reinforced concrete. Ceramic tile construction succeeded in creating fireproof structures. The “tiles” are curved brick blocks glazed on one face to increase their longevity. These are stacked in rings with steel reinforcing embedded in the mortar (Banham 1989, 134). However, tile bins possessed several disadvantages compared to reinforced concrete: “tile structures were expensive to build and maintain. The large number of mortar joints needing to be dressed slowed the process of construction and afterward required constant vigilance to prevent leaks” (Schneekloth 2007, 35).

As time illustrated, concrete became the material of choice: “The most important experiments in elevator construction involved reinforced concrete” (Vervoort 1990, 407). The origin of the cylindrical reinforced concrete bin can be traced to a single experimental concrete cylinder in Minneapolis constructed in 1899 by Frank Peavey and Charles Haglin (Banham 1989, 140). The bin was successfully filled and emptied that year, prompting them to construct a full-size elevator with 15 bins in Duluth in 1900. However, it suffered two collapses by 1903, possibly due to inexperience, faulty design and settlement of foundation (Banham 1989, 141).

The first successful example of a reinforced concrete grain elevator construction was the King’s storage annex completed by January 1904 (Vervoort 1990, 408). In addition to using a relatively new material, these elevators also employed a new method of construction: slip forming. This method used forms that were raised slowly on jack screws while the concrete was still plastic. In the case of the King’s elevator, falsework was constructed inside the bins to support the forms as they were raised. In later elevators the jacks and forms were supported on steel embedded in the concrete walls.

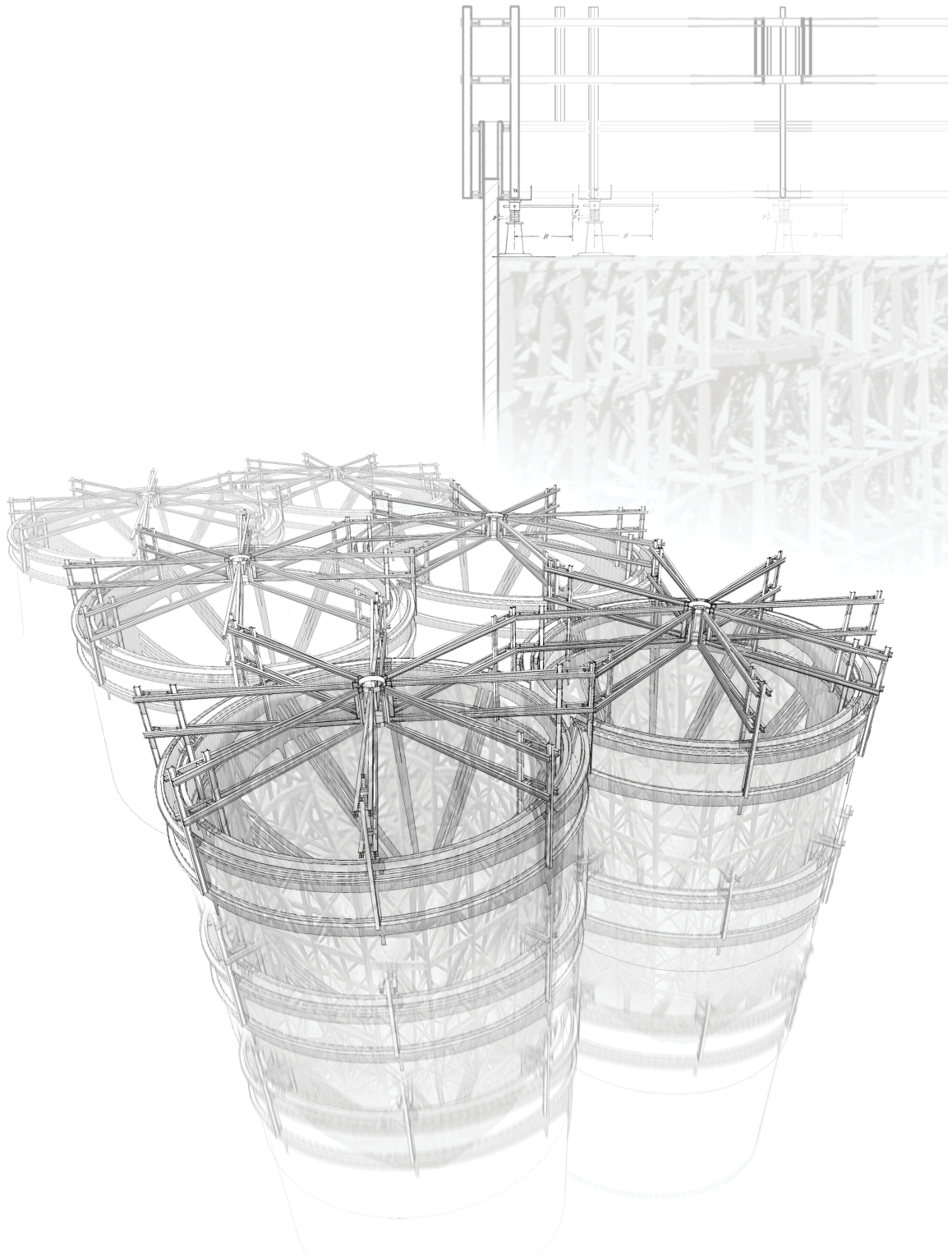


Figure 4: Conceptual drawing of the slip forms used for the King's elevator storage annex.

The original wooden elevator was demolished long ago, but the nine bins of the storage annex have been incorporated into the existing grain elevator now known as Manitoba Pool 2. This is the elevator selected for this investigation. This specific elevator was chosen primarily for its location in the city of Thunder Bay. It is a prominent waterfront location, on a site with massive potential for future development, near a new marina development and the north core of the city (formerly Port Arthur). Formally the simple, almost archetypal geometry with a single workhouse tower connected via bridges to a cluster of 33 cylindrical bins provides an inspiring structure for adaptations. The historical aspects of this site are significant: it is the site of the first grain elevator on the Lakehead, and the nine bins closest to the workhouse are the first (successful) reinforced concrete grain bins built with slip forms in the world (Brown 2009, 225). However, the focus of this thesis is on the formal possibilities for adapting the existing structure.

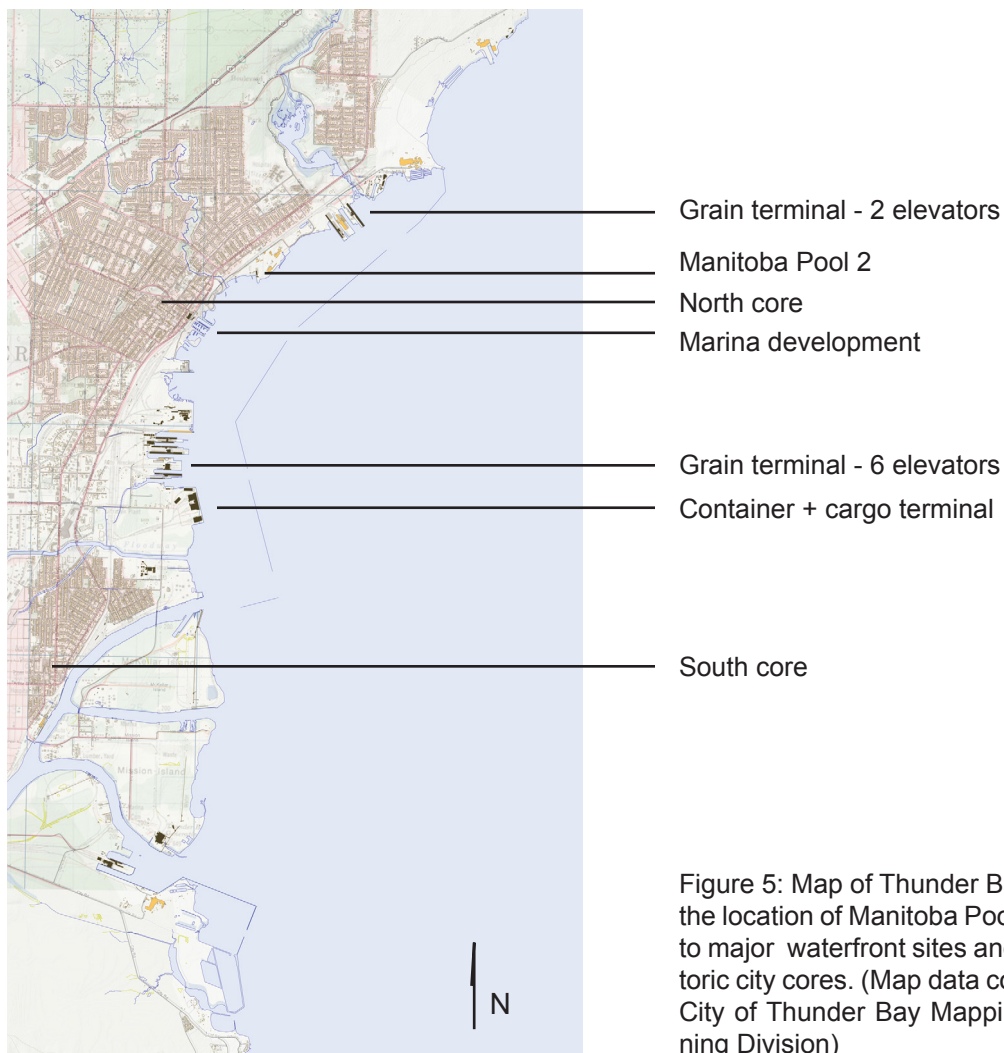


Figure 5: Map of Thunder Bay illustrating the location of Manitoba Pool 2 in relation to major waterfront sites and the two historic city cores. (Map data courtesy of the City of Thunder Bay Mapping and Planning Division)

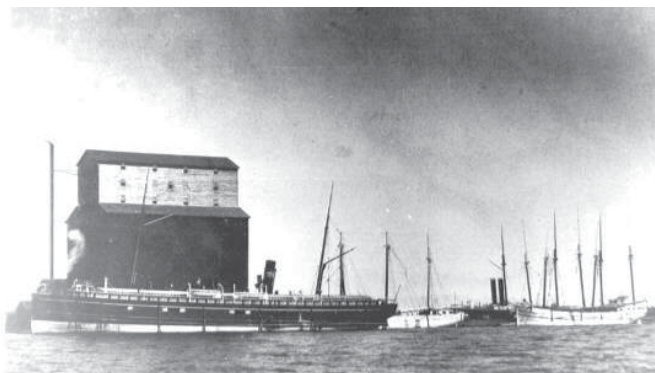


Figure 6: King's elevator in 1880's.
(Courtesy of the Thunder Bay Historical Museum Society)

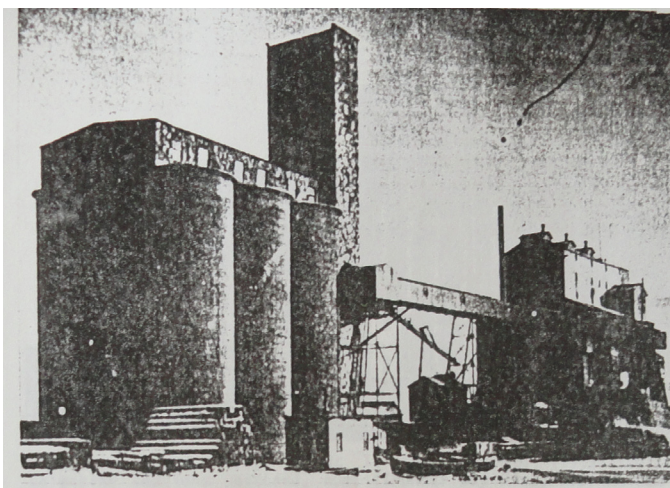


Figure 7: King's elevator in 1904.
(Courtesy of the Thunder Bay Historical Museum Society)

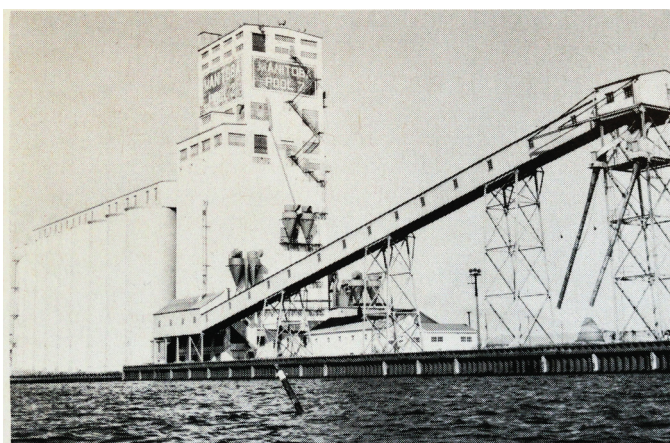


Figure 8: Manitoba Pool 2, 1971.
(*The Terminal Grain Elevators*, 1971)

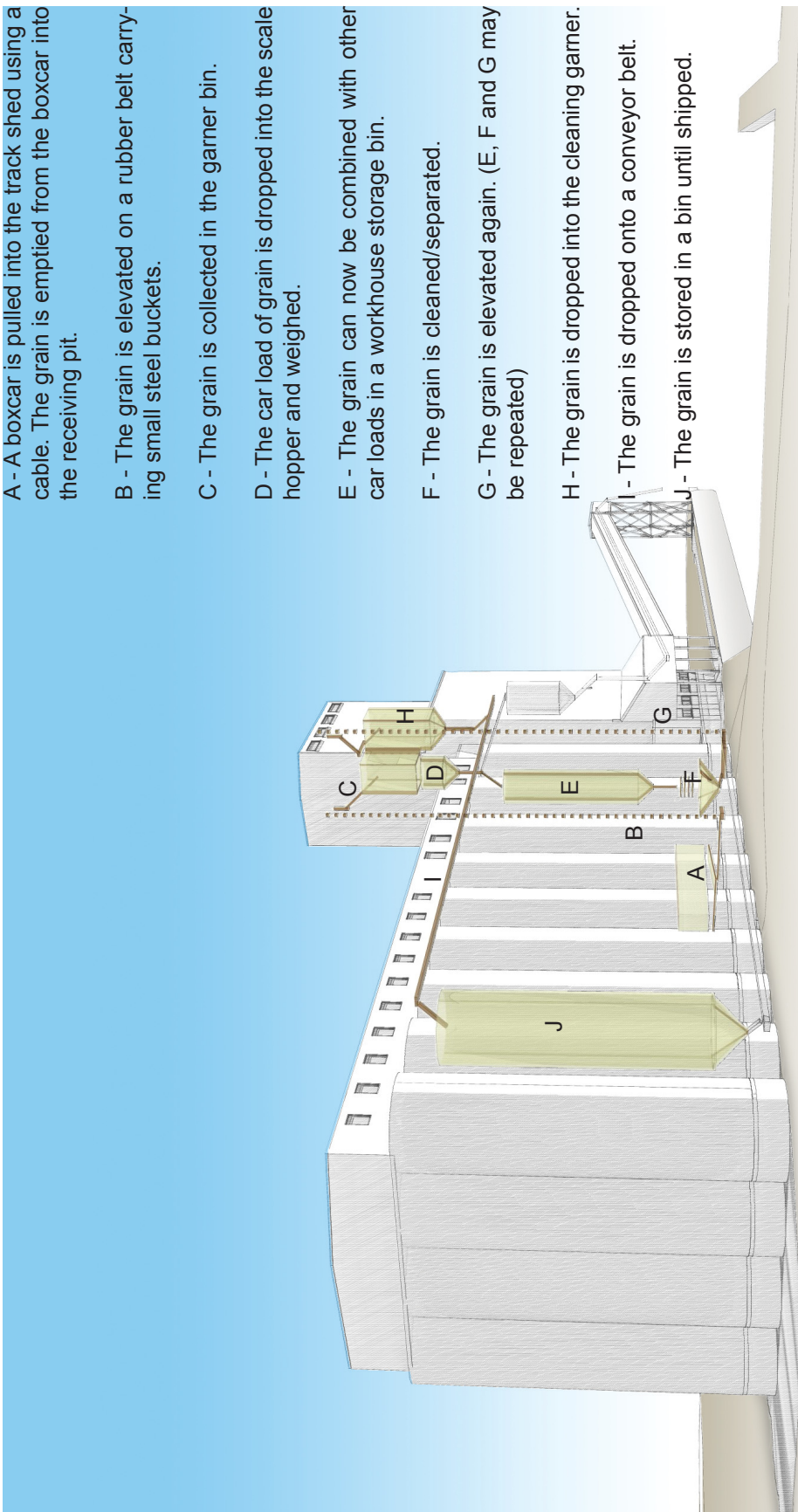


Figure 9: The path of grain through the elevator, from delivery by train to storage in the bins.

Continued from page 9:

K - The grain is emptied from the storage bin.

L - It is carried by a conveyor belt back to the workhouse.

M - The grain is elevated.

N - It is placed in the shipping garner.

O - The grain is weighed in the scale hopper.

P - It is stored briefly in the shipping bin.

Q - The grain is dropped onto a conveyor taking it to the loading gallery.

R - The grain is transferred through a loading spout to the ship.

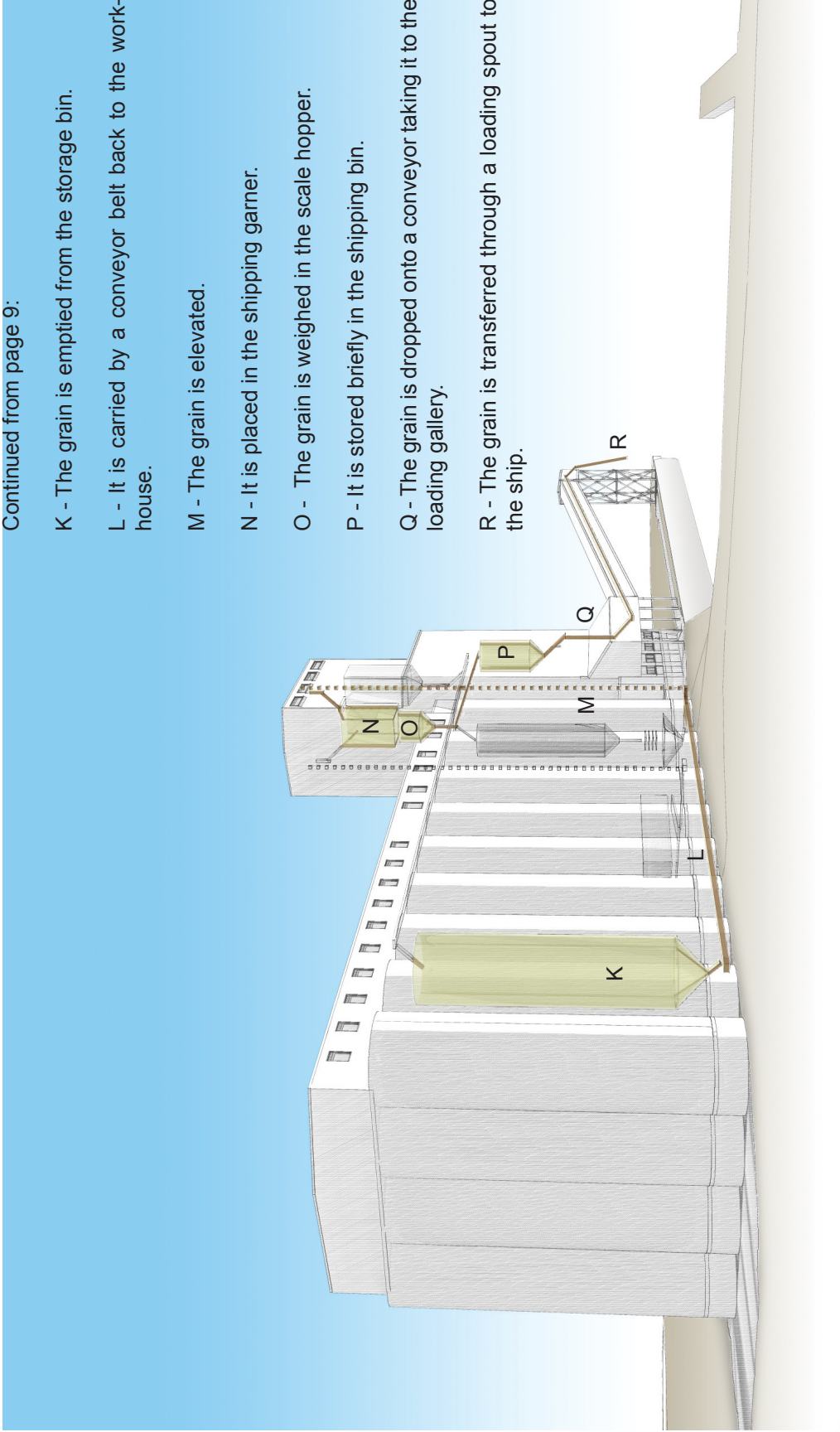


Figure 10: The path of grain through the elevator, showing removal from storage bins to placement in the hold of a ship.



Figure 11: Composite image of a photograph of Manitoba Pool 2 with two sections overlaid. (Sections from: *The Terminal Grain Elevators, 1971*)

Functional, Aesthetic, Monumental, Mysterious

The approach taken to the concept of “functional” in this design replaces the common practice of starting with a program. Generally with adaptive reuse projects, “one of the inherent qualities of old buildings is their ability to generate ideas for reuse based on their inherent qualities” (Langenbach 1977, 95). However, the unique qualities of grain elevators seriously challenge anyone wishing to discover ideas for reuse. Without a doubt, the program that takes maximum efficiency from the form of a grain elevator is the original purpose of grain storage (or a similar granular bulk material). Few other buildings could claim to be so specialized because “the subject at hand is a machine/building that was assembled with a very specific set of purposes in mind” (Brown 2009, 364). One could approach this structure as an empty vessel needing to be filled with a new program. The decades-long search for the ideal post-industrial program to fill the unique spaces of grain elevators has yielded little beyond climbing walls and condominiums. In this case, “the architect is left with the task of giving each room an appropriate degree of autonomy while indicating its place in the whole plan and its connection with adjacent rooms to the desirable extent” (Arnheim 1977, 100). As opposed to searching for the ideally matched program(s), one could start with a program and go through the exercise of trying to adjust and organize the spaces in some logical way, i.e. trying to fit an arbitrary program into the structure. This design investigation lies somewhere between these two approaches. There is the sense of starting with a program; however, it is defined in terms of some fundamental qualities of architecture:

Light: develop a strategy for bringing natural light into the currently unlit spaces

Threshold: create entrance and exit conditions

Movement: develop a strategy for the movement of people and services through the structure

Space: provide a range of room areas, from roughly office sized (4m x 4m) to larger assembly size (20m x 40m)

Enrichment: Providing spaces that provoke and inspire the inhabitants.

In starting with this “first principles” approach to program, there is an assumption that there is such a thing as a good, habitable space without an extremely specific purpose. However, there is the possibility that in creating these useable spaces, more specific programs will emerge.

Old buildings representative of a community’s history and character have the power to excite people to develop economic and educational activities which would not have otherwise even been thought of. (Langenbach 1977, 97)

Defining aesthetic spaces opens up perhaps one of the oldest debates in architecture. In discussing form and function, Rudolf Arnheim states, “Form ... is not simply the physical facilitation of function. Rather, it translates an object’s functions into the language of perceptual expression” (Arnheim 1977, 263), and defines beauty as “a way of perfecting expression” (Arnheim 1977, 256). I would add to this definition a requirement for emotional engagement. In the context of this design project, the goal of beauty and expression would be in the creation of atmosphere, which, according to Henry Plummer, “is based on a close harmony of tones, enveloping space in an overall feeling and mood” (Plummer 2003, 68). He goes on to say, “[Atmosphere] takes tangible form in the air of a monumental space, such as a thirteenth century Gothic cathedral or St. Peter’s in Rome” (Plummer 2003, 76). In all of this, the key to the creation of aesthetic spaces is in the treatment of light. As stated by Le Corbusier, “The elements of architecture are light and shade, walls and space” (Le Corbusier 1998, 177). The introduction of light into space has enormous potential, “the arrival of light out of darkness, and its evolution through time, continue to arouse a spiritual feeling of awe and wonder, reminding us of light’s daily miracle – to revive a sleeping world with signs of life, by setting it into motion” (Plummer 2003, 102).

In *American Colossus* William Brown begins to describe the monumental and mysterious qualities of grain elevators when he writes:

In addition to their primary functions (unloading, transshipping and storing grain in bulk), grain elevators inevitably find themselves tasked with three others: being visual landmarks; being screens upon which people project their fears, fantasies and memories; and being privileged vantage points from which one can see the entire surrounding region. (Brown 2009, 65)

The function of acting as a screen upon which people project their fears, fantasies and memories begins to address the mysterious quality inherent in these structures. I strongly agree with Peter Quartermaine when he says, “The challenge, and one not often recognized by contemporary ‘waterfront development’ architecture, is to retain elements of that mystery” (Quartermaine 1999, 9). I would even say that it is an overriding imperative of this design investigation. Addressing the qualities of “mystery” is related to the previous aesthetic discussion. Is there such a thing as an aesthetic of mystery? While discussing the work of Antoni Gaudi, René Magritte makes the point that “a strange or new style calls into question nothing but a formal preoccupation, not mystery, which has no form” (Torczyner 1977, 136). In this sense an amorphous blob is mysterious only in the sense of not knowing what it is. The more engaging sense of mystery is created in unusual combinations of familiar objects, which then can create any number of questions based on their associated knowledge/expectations.

In regards to his own work Magritte describes inspiration as arising “by uniting what the world offers us in an order that evokes mystery” (Torczyner 1977, 201). Magritte would begin his work with an object framed as a question and then proceed through drawing to discover the other objects that, when paired with it, would create mystery. In describing his process, “They involved the images obtained through voluntary and conscious research based on some object that has been taken as a question” (Torczyner 1977, 200). Grain elevators could be viewed under this light in two ways. Firstly, the grain elevator can be treated as a single object, and it needs to find a second (or third) object to be placed near it in an unexpected way to evoke the sense of mystery that Magritte talks about. In this sense the problem would be framed as “the question of the grain elevator” and the answer would be some unknown object(s). The second way to view the grain elevator, and the position taken in this thesis, is to see it as already being a collection of familiar forms combined in an order that evokes mystery. In this sense the grain elevator offers us an unusual order of familiar objects brought together. The grain bins are simply concrete cylinders; however, they are usually capped by a long, low space with a pitched roof. This space would look at home in any low-density industrial park. The work house rises like an office building or apartment tower, and yet it includes few windows and is also capped with a pitched roof structure. The two masses are then joined with bridges about 28m (8 stories) above the ground, which are simply iron-clad trusses. Individually, any of

the elements could be placed on a site and not garner a second glance. It is the combination, the ordering, of familiar elements into this strange assembly that evokes the mystery. Some elements are at a domestic scale, inviting the viewer to imagine inhabiting them, while other elements are vast, windowless expanses of concrete that require the viewer to rely purely on imagination to see inside. The monumental qualities of the structure are partially a result of the sense of scale. Although scale might be misinterpreted as mere size, it is the relationship between objects that generates a sense of scale. In this way the windows and other small features allow for a sense of proportion to be developed. In a larger context, the flat terrain, smaller adjacent structures, and the expanse of the lake provide a contrast to the vertical nature of the elevator. This contrast produces an enhanced sense of scale. If there were taller adjacent structures, its scale would be reduced: it would appear smaller.



Figure 12: Manitoba Pool 2, Thunder Bay, 2010

In beginning to consider intervention on such a structure, the building cuts of Gordon Matta-Clark offer insights into the effects of scale. In the work of Matta-Clark, “Familiar sequences of spaces and movements are replaced with new possibilities that simultaneously expand the visual space within and through the building” (Walker 2009, 17). His work revealed “too many elements of the building and deprived his audience of any fixed point to relativize that space” (Lee 2000, 140). Lee suggests that his work begins to be linked to ideas of the sublime. Edmund Burke offers the definition of the sublime as that which causes a combination of astonishment and terror, and he provides an inventory of some elements of the sublime in his work *On the Sublime and Beautiful*. The sublime can be further deconstructed as a disconnected relationship between reason and the imagination that results in a lack of comprehension and sense of awe. Related to scale, the mind fails to rationalize the components by which a reading of scale is assessed (Lee 2000, 141). This definition suggests that the sublime would not require physical vastness if a sense of scale could be created to to evoke similar emotions.

And what such an experience of scale enacts is a checking of the viewer’s critical judgement, the degree of the subject’s capacity to take cognitive measure of the proportion of things and the environmental surround. (Lee 2000, 140)

The qualities of the monumental and mysterious are in essence qualities of the sublime. The design moves should therefore have the goal of creating spaces that defy immediate comprehension, suggest immeasurable scale, and perhaps instill a little fear.

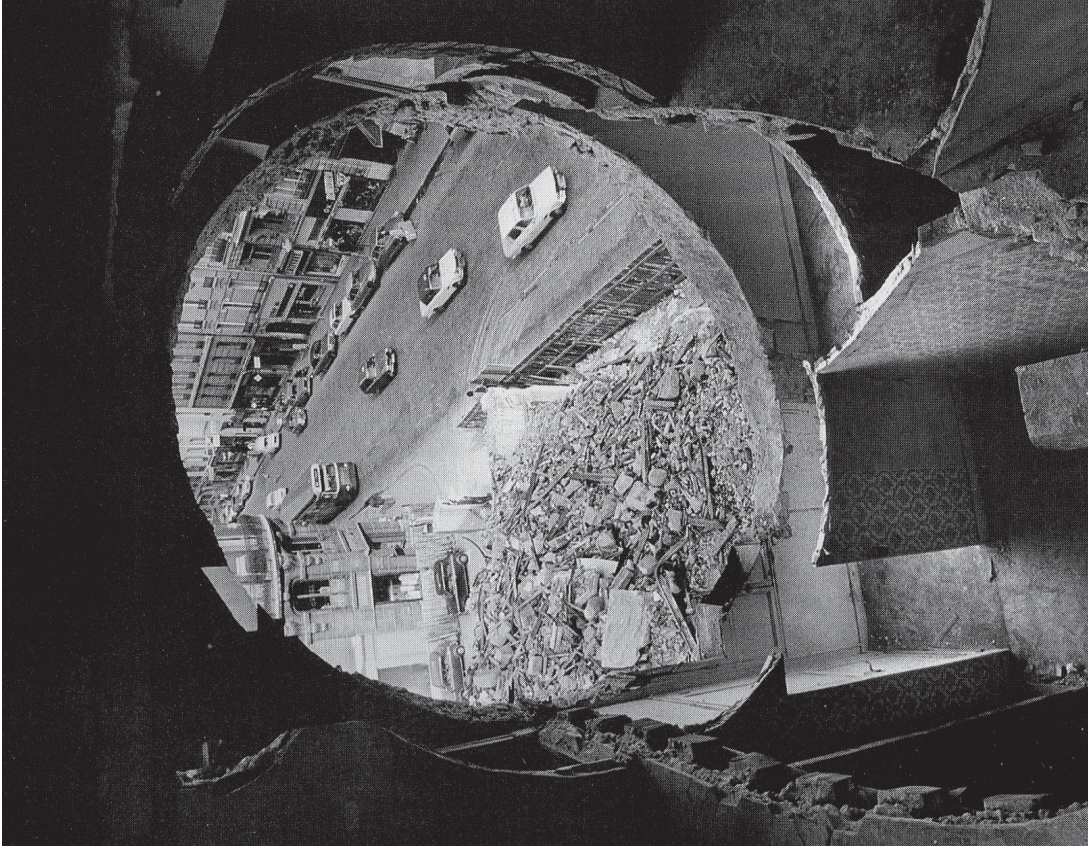


Figure 13: Gordon Matta-Clark, *Conical Intersect*, 1975.
(Lee 2000, 182)



Figure 14: Gordon Matta-Clark, *Office Baroque*, 1977.
(Lee 2000, 229)

CHAPTER 2: DESIGN

The design process is based on providing the five functions laid out in the introduction: light, threshold, movement, space, and enrichment. As design moves address one (or more) of these functions they can be evaluated against the four qualities in the thesis question: functional, aesthetic, monumental, and mystery.

Previous Adaptations of Grain Elevators

Referencing only built projects, Michael Frisch contributes a chapter in *Reconsidering Concrete Atlantis*, and summarizes the previous approaches to reusing grain elevators:

Some of these projects have kept the grain storage portion of the building inactive, opting to occupy what had been the public access areas of the operation. Others have taken invasive steps, opening up bin walls to provide windows and balconies for use by people who will occupy the former storage spaces. In yet another approach, installations have kept the entire grain elevator intact while generating a new use with something placed within the storage bins. (Schneekloth 2007, 109)

Starting with the fully intact approach, the Silophone (Montreal) and Moulin à Images (Quebec) offer two examples of alternative uses that have minimal impact on the structure. The Silophone is:

a design using the silo as a musical instrument, fitting the approximately one hundred foot high by twenty-five foot in diameter bins with sound producing equipment allowing music to be created in the unique acoustics of the concrete cylinders. The instrument was configured to accept sound from telephone transmission or from an Internet website, thus allowing for public interaction. Once transmitted into the silo, the sound was transformed into an unparalleled acoustic experience by the immense spaces that produced a reverberation time of over twenty seconds. In addition to the interactive element, the Silophone drew thousands of visitors to the waterfront to experience live concerts as the instrument was played by noted musicians. (Schneekloth 2007, 112)



Figure 15: Silo #5, Montreal - The home of the Silophone (McIntosh and Madan 2000)

The Moulin à Images in Quebec City uses projectors and the side of the Bunge grain elevator as a screen to project art work in the summer evenings.



Figure 16: Robert Lepage, Moulin à Images, Quebec City (The Image Mill)

Silo Point in Baltimore takes perhaps the most invasive approach to adaptive reuse. The concrete frame of the main workhouse remains, but the majority of storage spaces were replaced with new construction. A few silos were left standing at the corners to hint at what used to exist.



Figure 17: Silo Point, Baltimore by Turner Developments (Silo Point)

Quaker Square, Akron

An early example of the adaptive reuse of a grain elevator was the conversion of the Quaker Oats mill and silos in Akron, Ohio into a Hilton Hotel in 1980 (Quaker Square 2007). Given the requirements for a multitude of rooms with windows and balconies, it is unavoidable that the monolithic qualities of the silos would have to be sacrificed.

Even if one is concerned with the loss of integrity of the slip-form built concrete walls or bothered by the mahogany Colonial décor of the hotel rooms, it should be noted that this adaptive reuse does make use of the actual bin space, 'storing' people in the exact places that housed 1.5 million bushels of grain. (Schneekloth 2007, 111)



Figure 18: Quaker Square, Akron Ohio
(Quaker Square NE 2007)

Globe Mills, Sacramento

The Globe Mills complex in Sacramento is a more positive example of reuse that retains most of the qualities of the original structure. In terms of the exterior, this was simply done by avoiding any penetrations to the silos. The silos are used where their qualities are most suitable: for vertical circulation of stairs and elevators. This unfortunately results in the majority of the silos remaining vacant.



Figure 19: The Globe Mills at night.
(Globe Mills 2008)

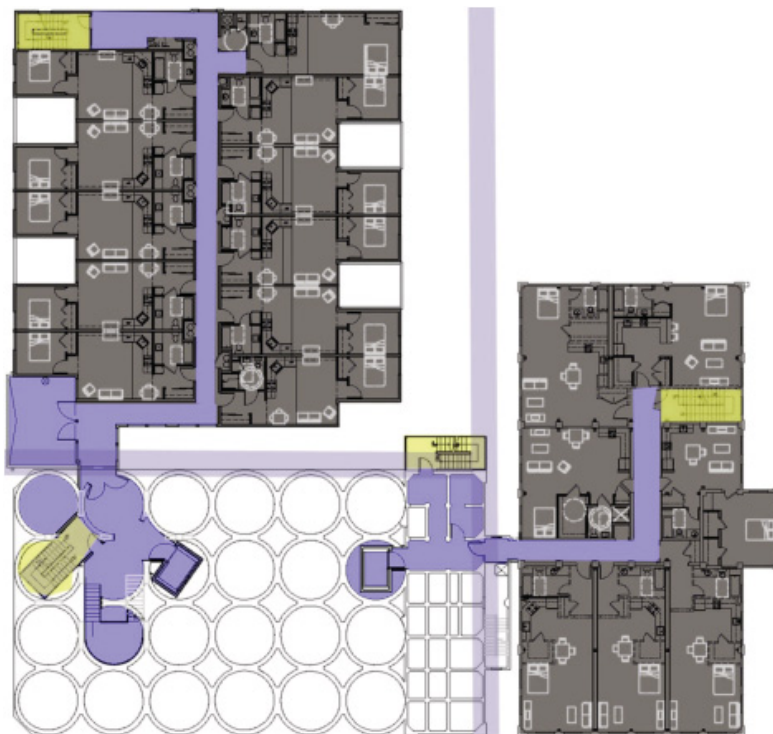


Figure 20: Plan of the Globe Mills
(Globe Mills 2008)

The creation of stair wells in the Globe Mills silos offers the most inspiration to me for the spatial possibilities of the silo spaces. Quaker square also makes similar cuts into the silos for doors, windows and balconies, but the subdivision of space and application of interior finishes make the inhabitant unaware of the reshaping. The construction images on this page show that just a series of rectangular cuts makes for interesting space. They also illustrate the large amount of concrete that can be removed without compromising the structure.



Figure 21: A view down the cuts in the silo for stairs.
(Globe Mills 2008)



Figure 22: A view up the cuts in the silo for stairs.
(Globe Mills 2008)

Strategy

The existing spaces of the building can be divided into two categories: those that are designed to allow human use/occupancy, and those that are meant for machines and grain storage. The distinction between these spaces is clearly defined by the amount of daylight provided, and the ease with which they may be accessed. These spaces are shown in the sectional drawing, figure 23. The goal of this design is creating habitable spaces throughout the entire structure. I feel that opening up most of the storage spaces for human occupation is necessary to exploit the full potential of the “problem of the grain elevator”. However, this must be done in a way that does not domesticate the structure, as illustrated by Quaker Square. The daylit spaces are already easily accessible, have good light qualities and usefully sized floor areas, and so this thesis will initially focus on the spatial possibilities created by the need for light, movement, and different sized spaces within the storage spaces marked black in figure 23.

The design study begins with the first and most basic necessity of a space: how do you get people and light into it? In the context of a series of concrete cells a related question would be: how do you move between the spaces? The design moves required to allow for entrance and movement into and between these existing sealed spaces must begin with a process of subtraction. Holes have to be cut somewhere. As soon as holes are cut, light and air are also immediately introduced. Cutting will therefore form the second of three main stages in this design:

1. Studying the existing building.
2. Subtractive moves that prepare the building for habitation.
3. Additive moves that enable people to move through it and inhabit it.

Step 1 is in essence the Introduction to this report, and so the following studies will be addressing step 2: the kinds of moves that can be made to create connected habitable spaces.

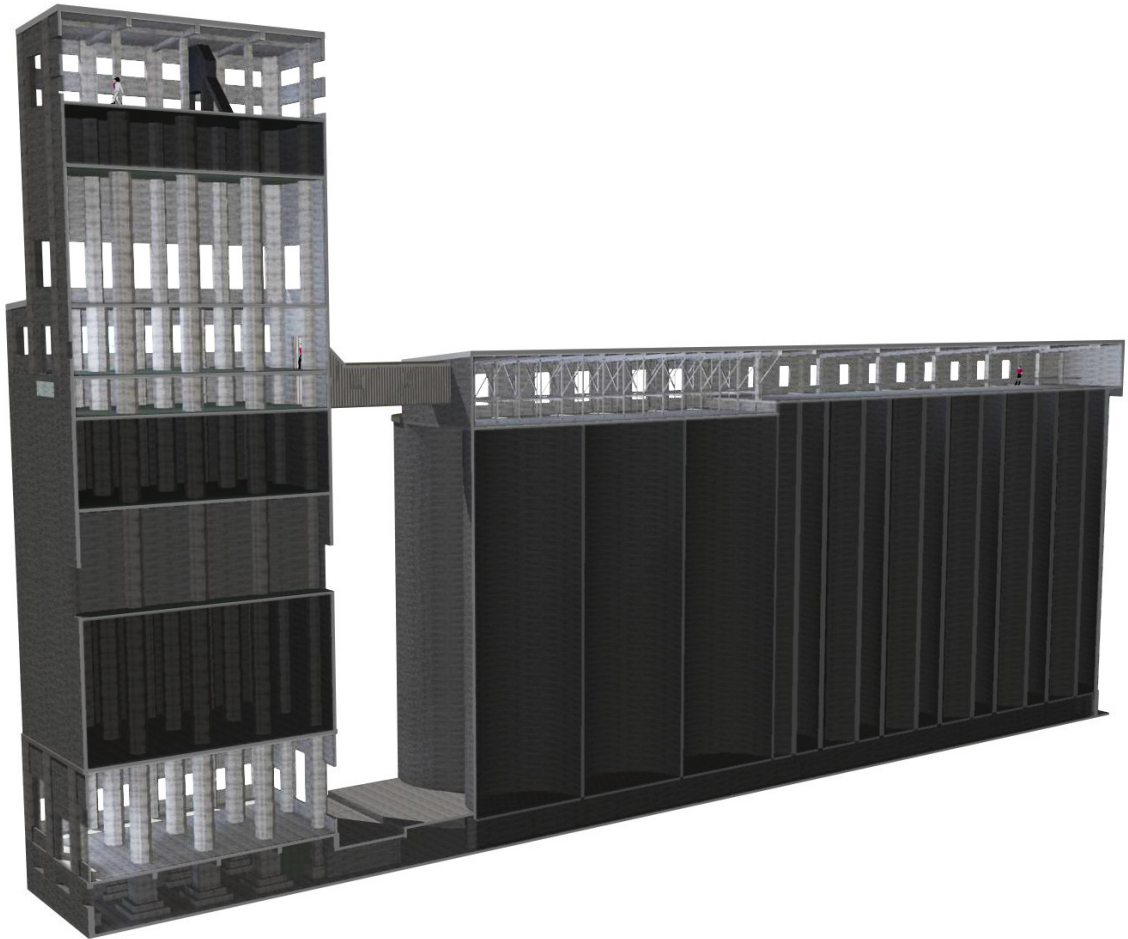


Figure 23: A simplified section of Manitoba Pool 2 showing the dark machine/storage spaces vs. the daylight work spaces. The darker spaces require the most drastic intervention (careful demolition and removal) to make them habitable, and so these spaces form the bulk of the study in this thesis.

Light

How can natural light be introduced into the unlit storage spaces, without domesticating the exterior into a recognizable pattern of windows? One lighting solution is to deliver 100% artificial and keep the exterior of the silos intact. I feel this is an unsatisfactory solution, and Henry Plummer offers this fitting justification for natural light,

The flood of even anonymous light was never really even or anonymous, due to waxing and waning effects of weather, shifting angles of sun, and changing hues of sky. Often the simpler in palette and more severe a building form was, the more nature's moods became amplified. (Plummer 2003, 30)

This series of studies over the next few pages look at the lighting effects produced by puncturing small openings into the silo walls, and then larger openings in the roof.

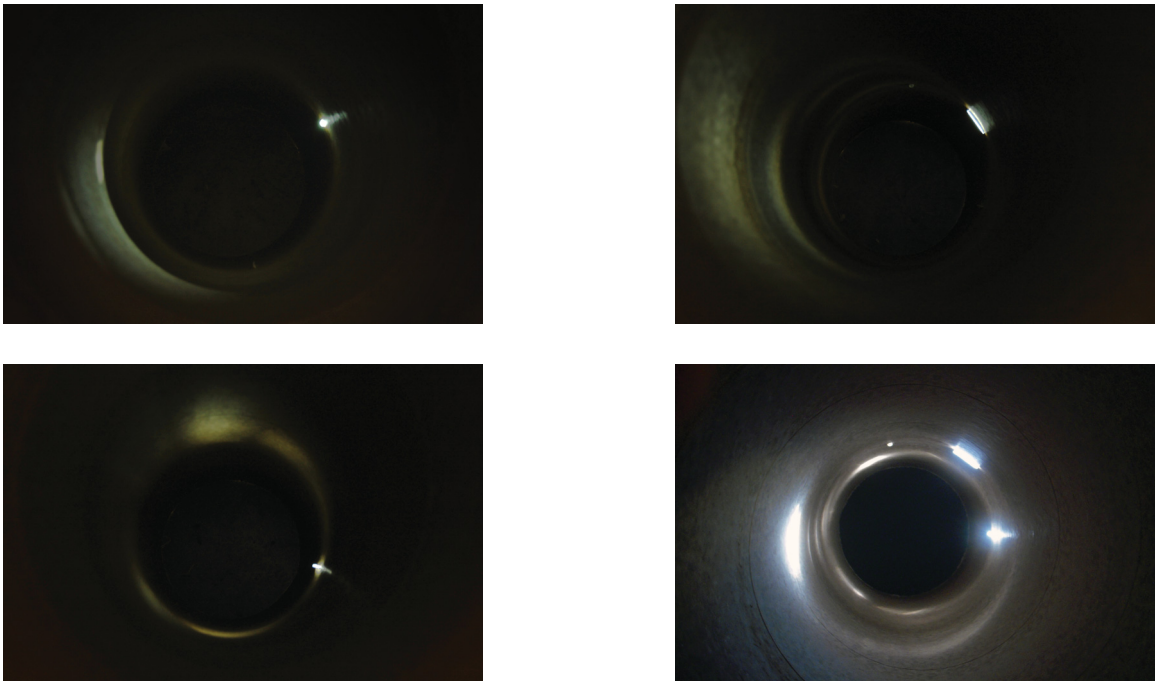


Figure 24: Light studies: pin holes and slits.

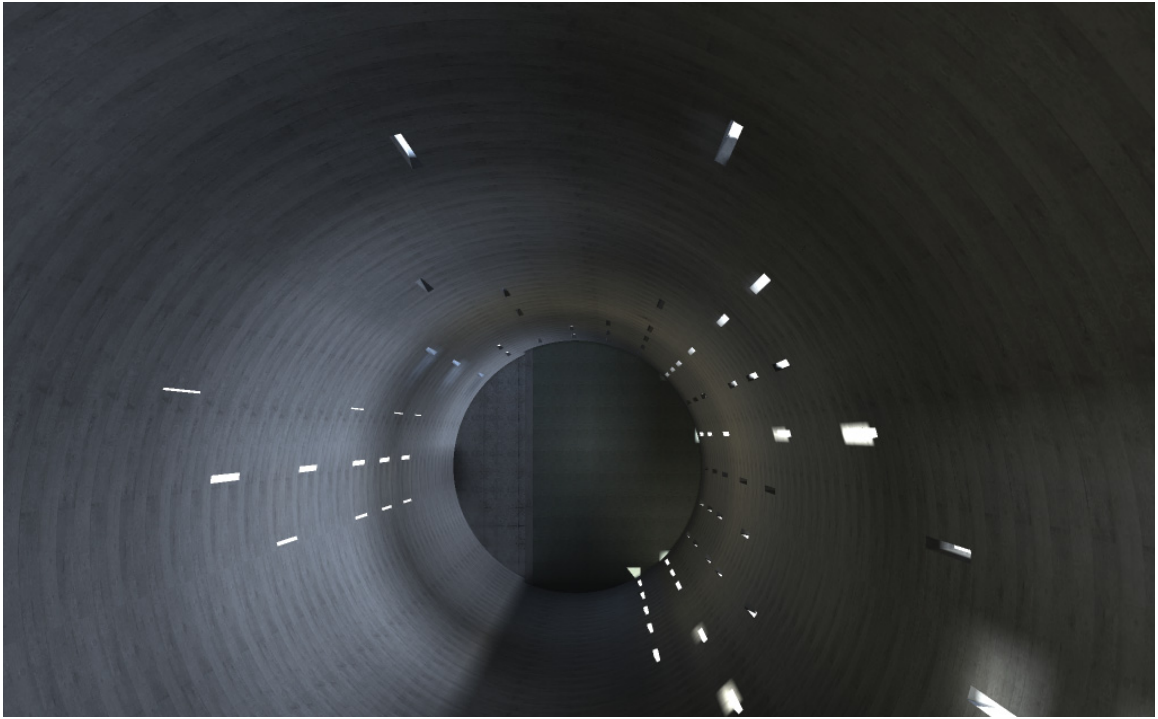


Figure 25: A digital light study with a series of slits

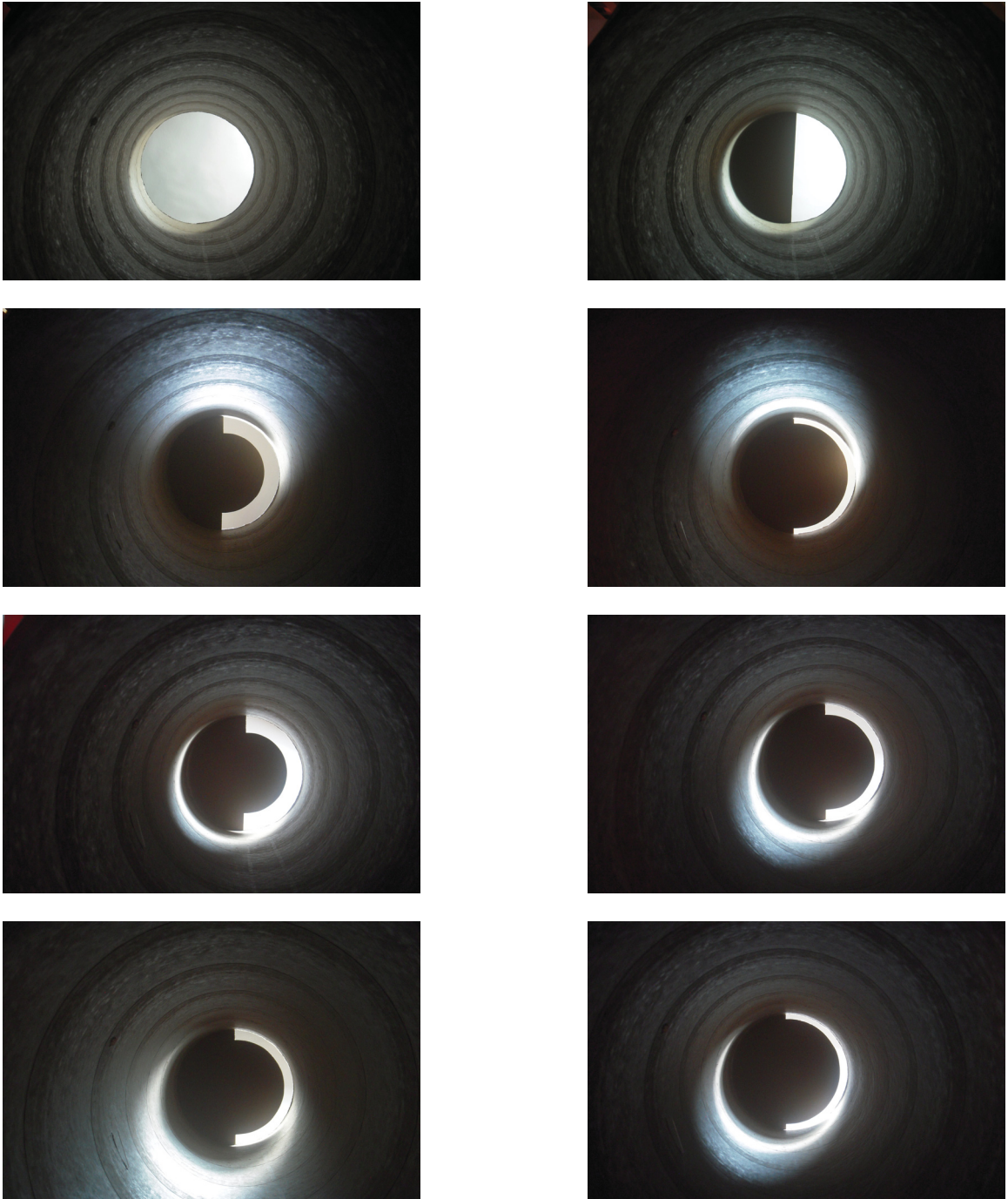


Figure 26: These studies look at varying the amount of opening in the roof of the silos

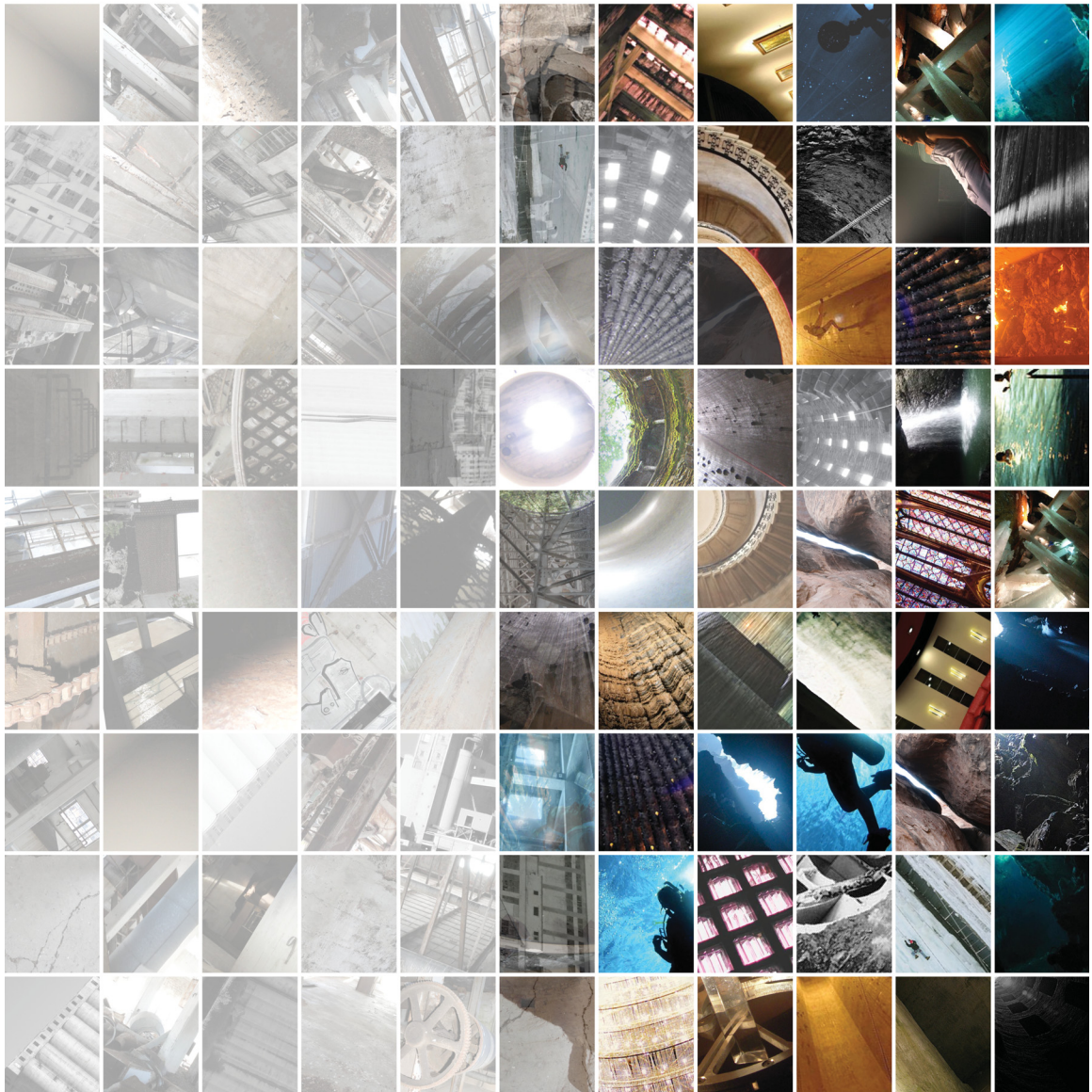


Figure 27: A digital photomontage looking at qualities of light and colour that could be created.

Subtraction

Cutting an opening into one silo from another could be as simple as a small rectangular door. Alternatively, a larger cut now joins the two spaces more completely, and perhaps continues into more silos, creating a series of linked spaces. Bernard Tschumi's sketch in figure 28 is a useful summary of the possible sectional approaches to making spaces in a mass. Of the two columns of sketches, the "Flows & Voids" column on the right offers the most insight into dealing with the three-dimensional qualities of the concrete silos. In this regard the work of Matta-Clark offers some insight. His work is "not just an isolated hole or cut but related cuts unifying the space and disengaging points of support" (Walker 2009, 162). As opposed to the rectilinear floors/walls of the buildings within which Matta-Clark operated, the grid of cylindrical grain bins offers a completely different matrix within which to shape spaces. As Stephen Walker states, "Matta-Clark's work did not set out to overcome this legibility, but rather to supplement it with another complexity and thus demonstrate that space could be something else" (Walker 2009, 56). I propose to create spaces within the grain elevator that reveal the unique existing structure, but also search for "something else" in qualities of the sublime.

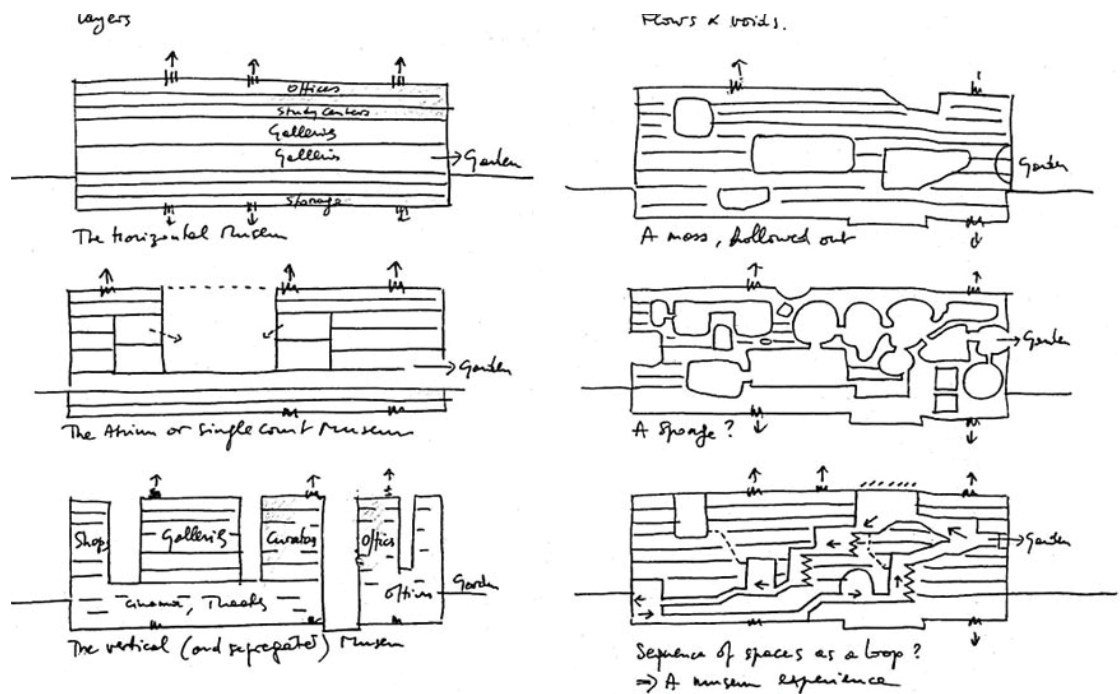


Figure 28: Sketches of layers and voids by Bernard Tschumi.
(Tschumi 1997)

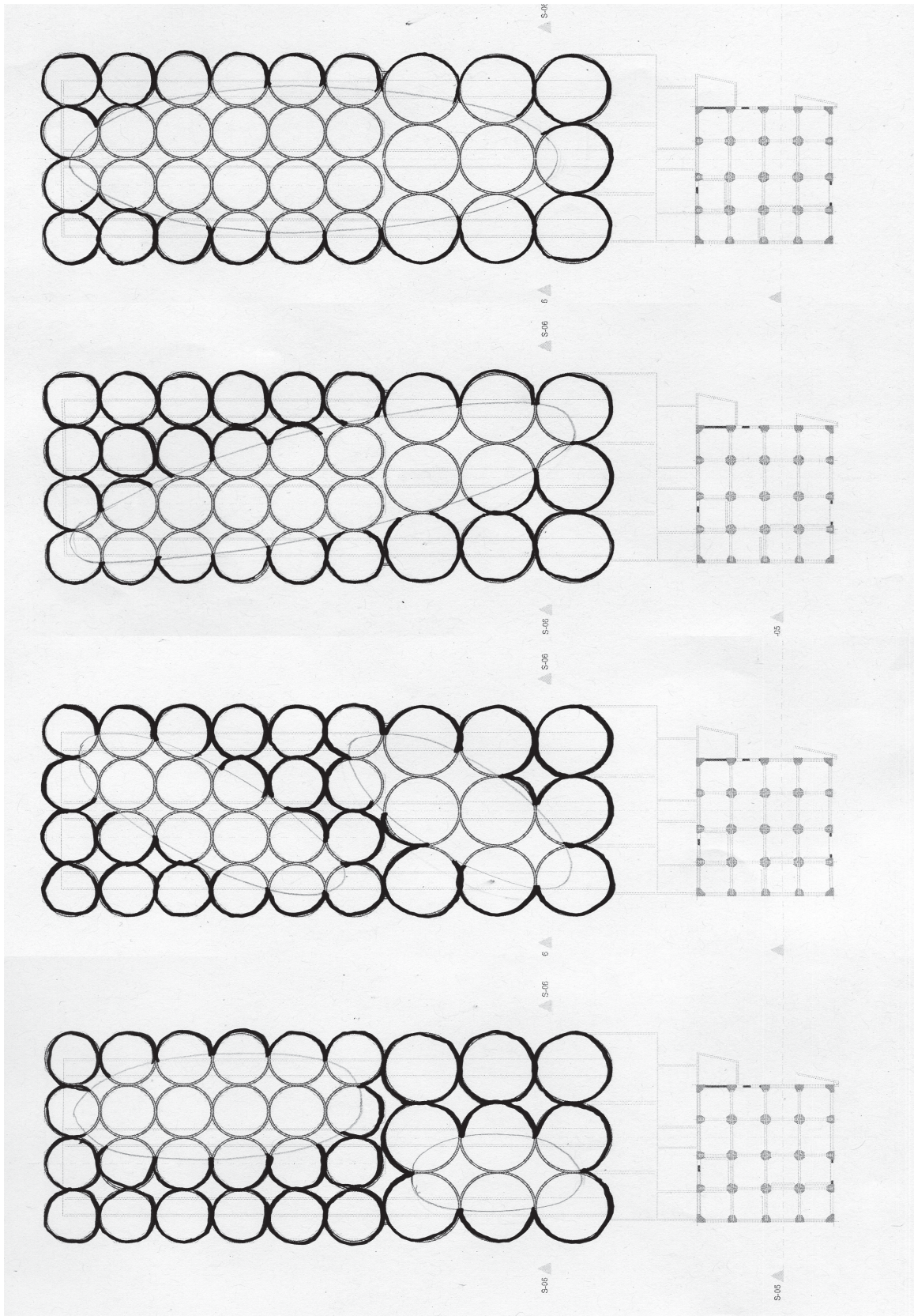


Figure 29: Plan studies of elliptical spaces removed from the silos.

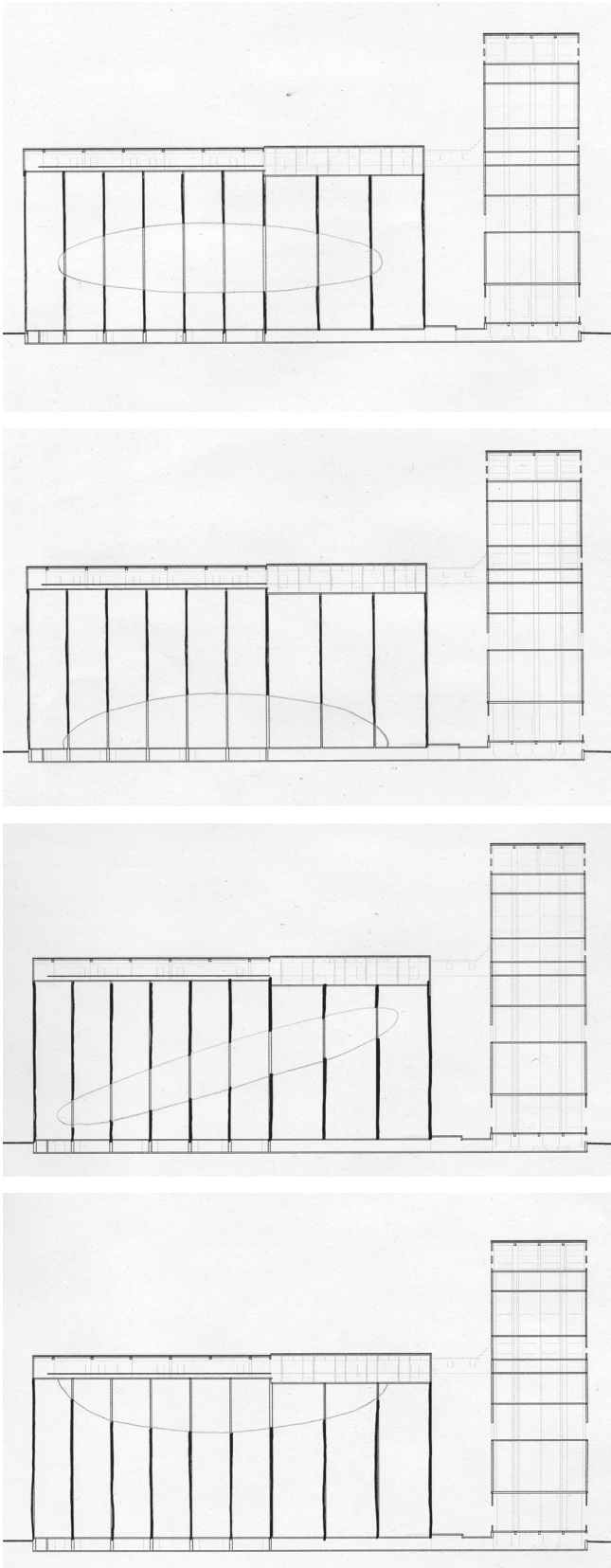


Figure 30: Section studies of elliptical spaces removed from the silos.

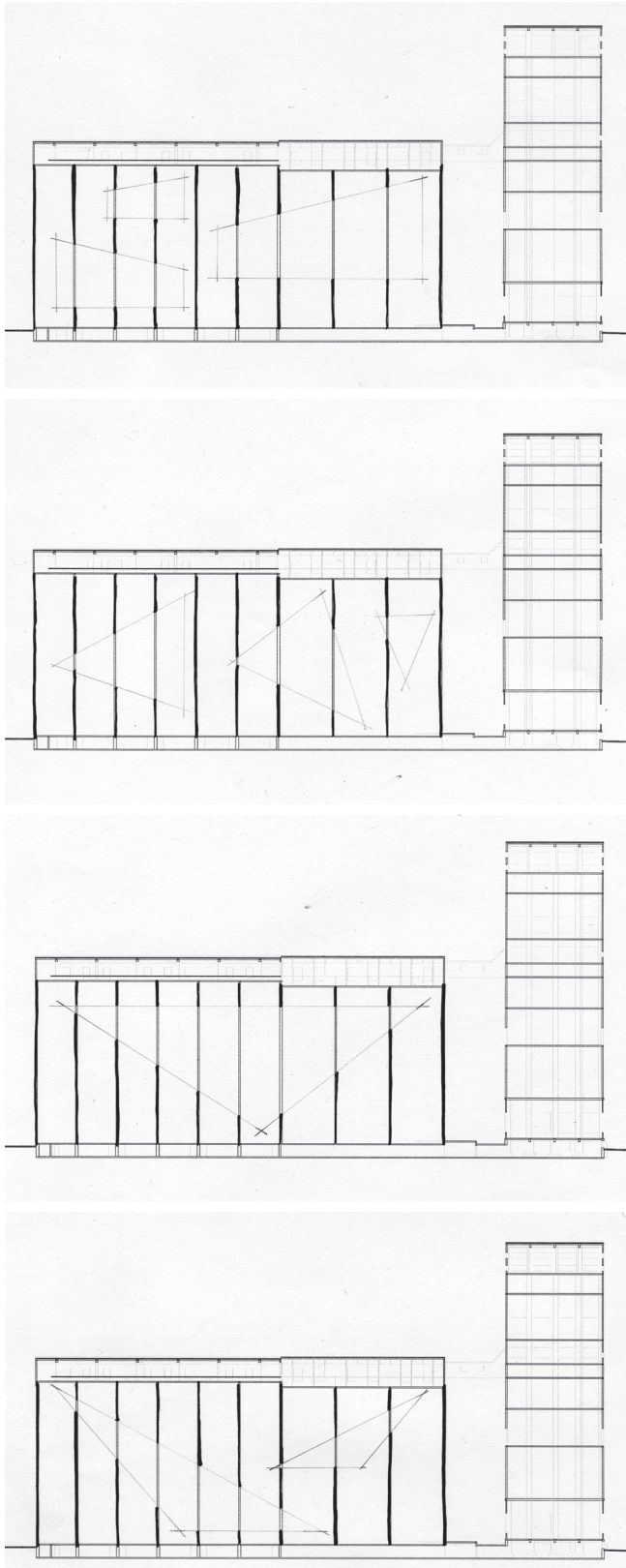


Figure 31: A sectional study of trapezoids and triangles.

The initial two-dimensional subtractive moves were a simple starting point to begin to understand the kinds of spaces that can be created. Many more of these studies were performed, but as the following pages will illustrate, two-dimensional studies fail to express the full effect of cutting into the silo geometry. Moving to a digital model, and seeing the results of these cuts in perspective, turned the investigation into a process of discovery. The carving of one shape would lead to an idea about carving another. It revealed some of the spatial qualities that could emerge when a matrix of 28m-tall concrete cylinders is intersected by another volume. The following selection of images trace this exploration.



Figure 32: A large semi-elliptical room.

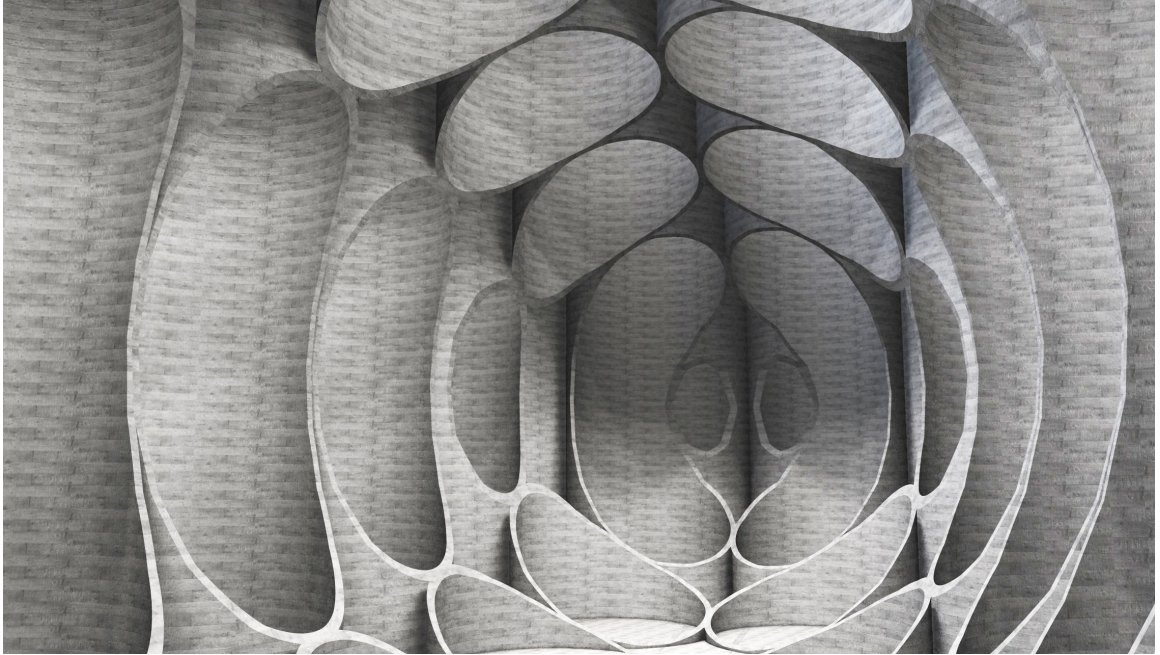


Figure 33: A fully elliptical room.

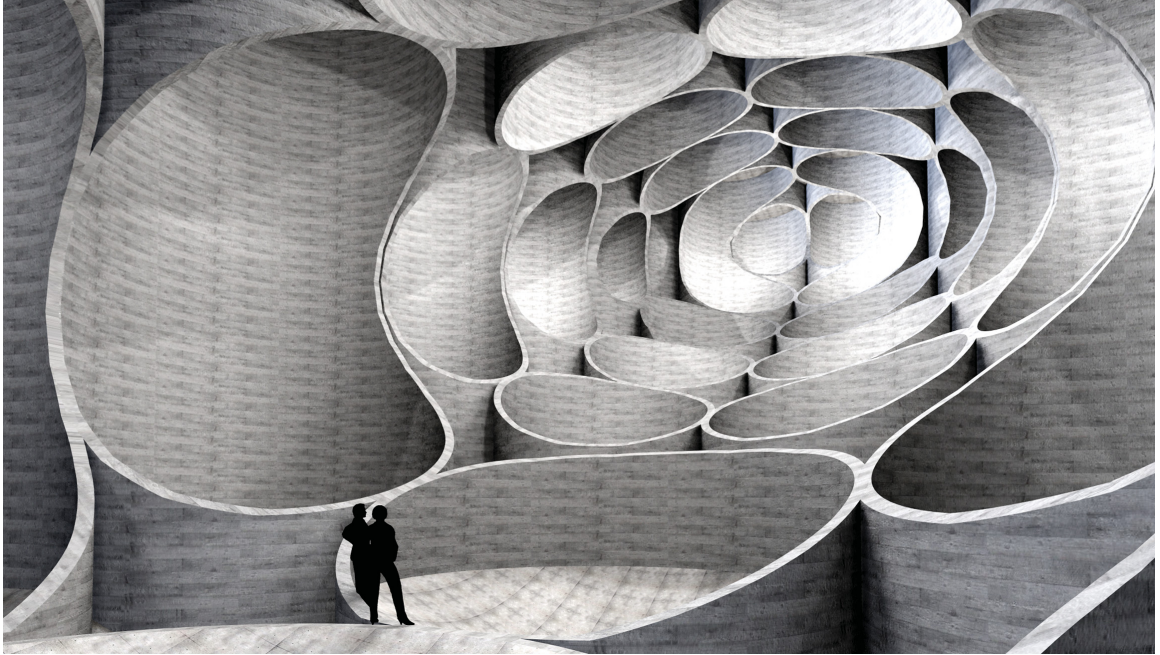


Figure 34: Tilting the ellipse up towards a source of light.

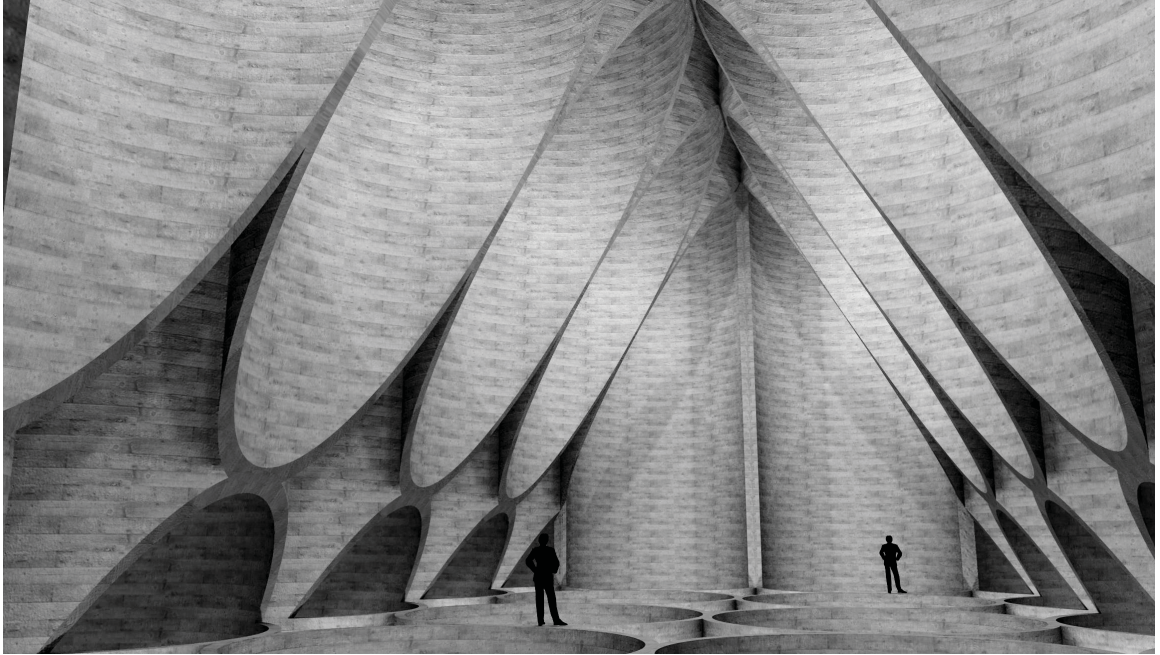


Figure 35: A triangular room.

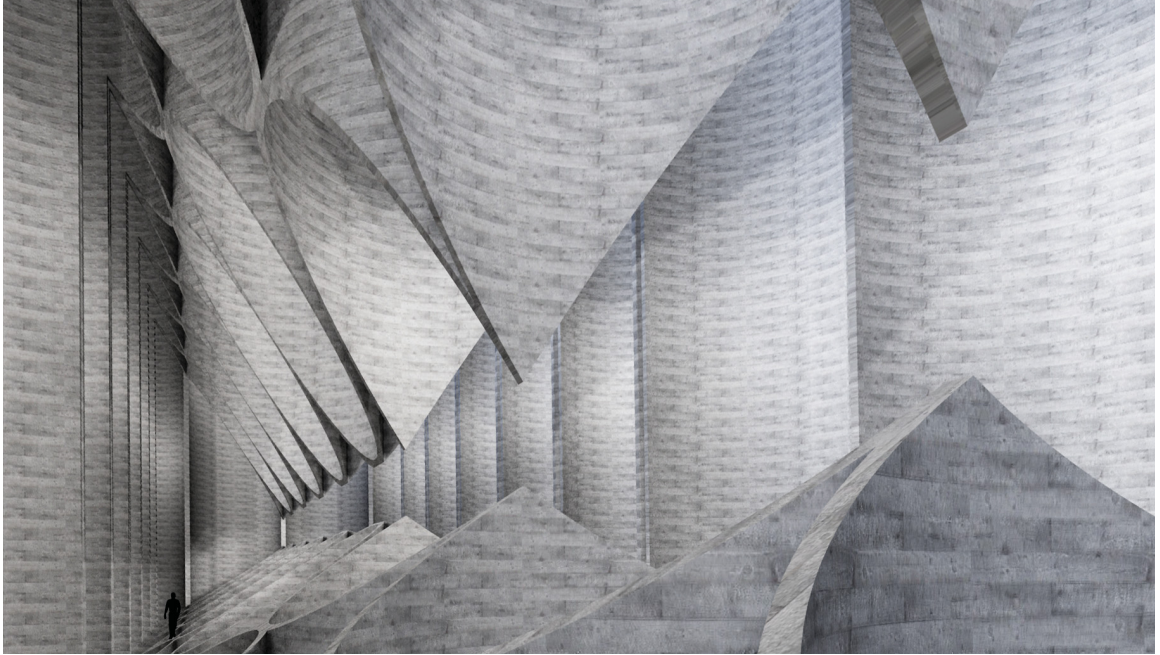


Figure 36: Two triangular rooms, connected.

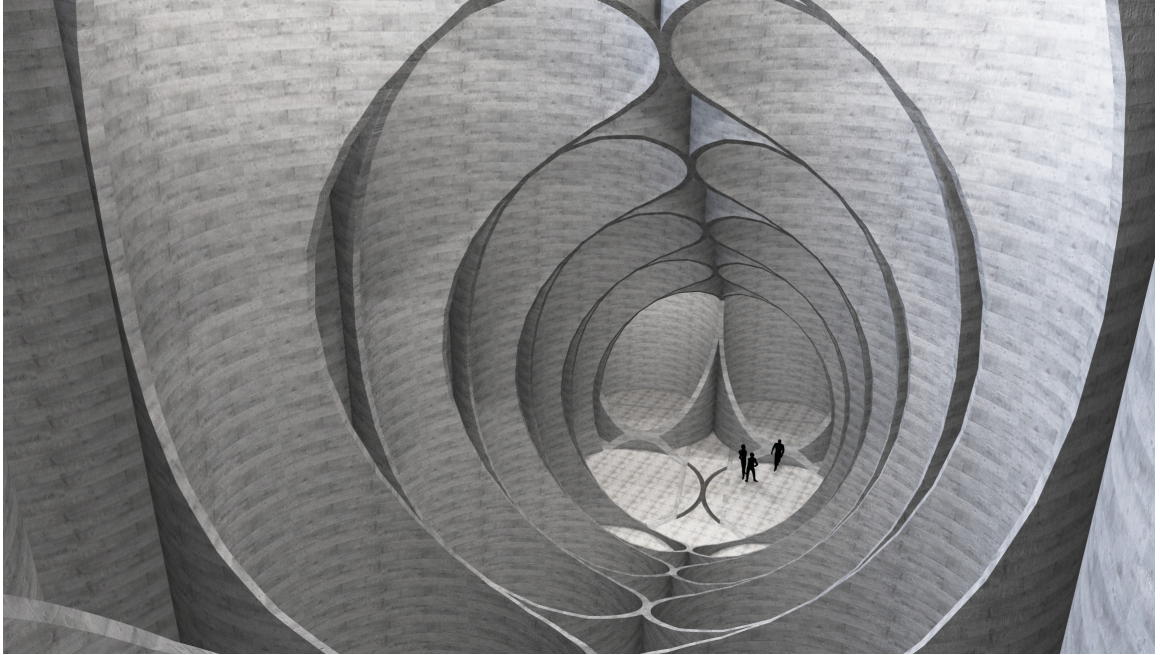


Figure 37: Looking down a cylindrical cut.



Figure 38: Two curving tubular cuts.

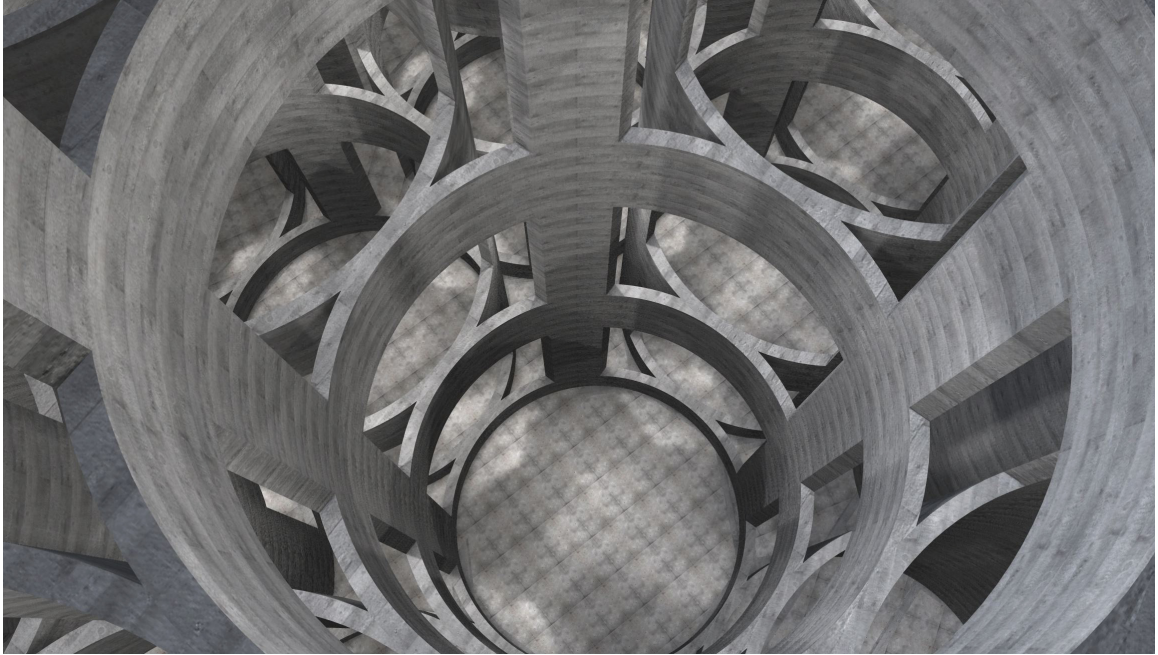


Figure 39: Looking down into a lattice of rectangular cuts.



Figure 40: A hall cut through to the full height of the silos.

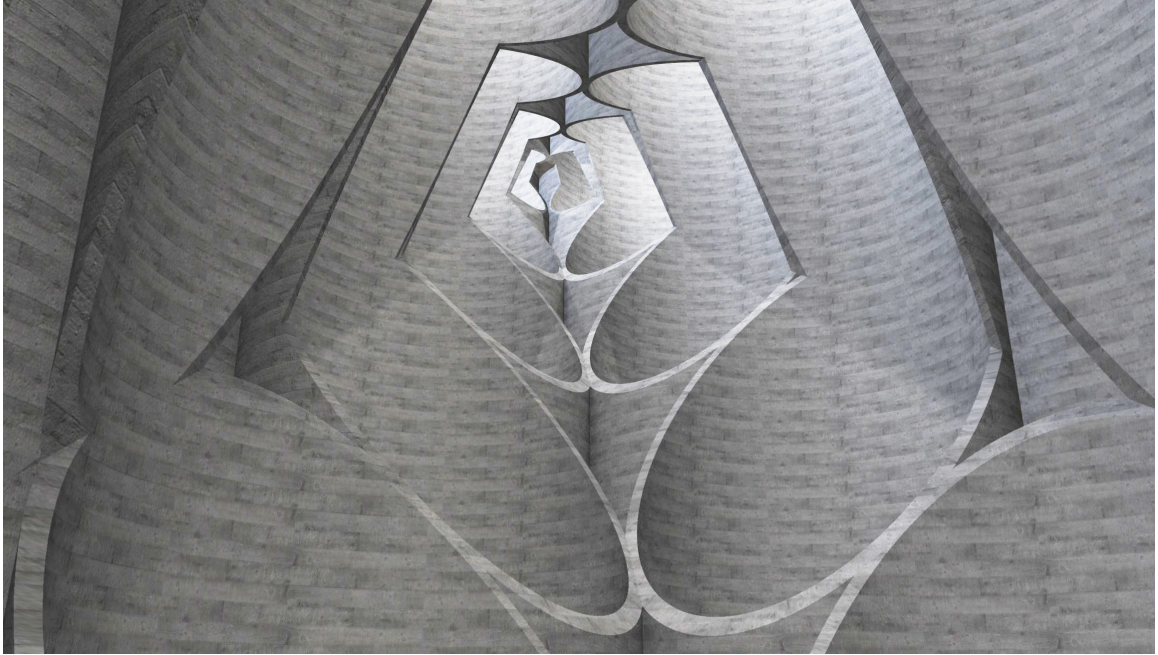


Figure 41: A tapered pentagon.

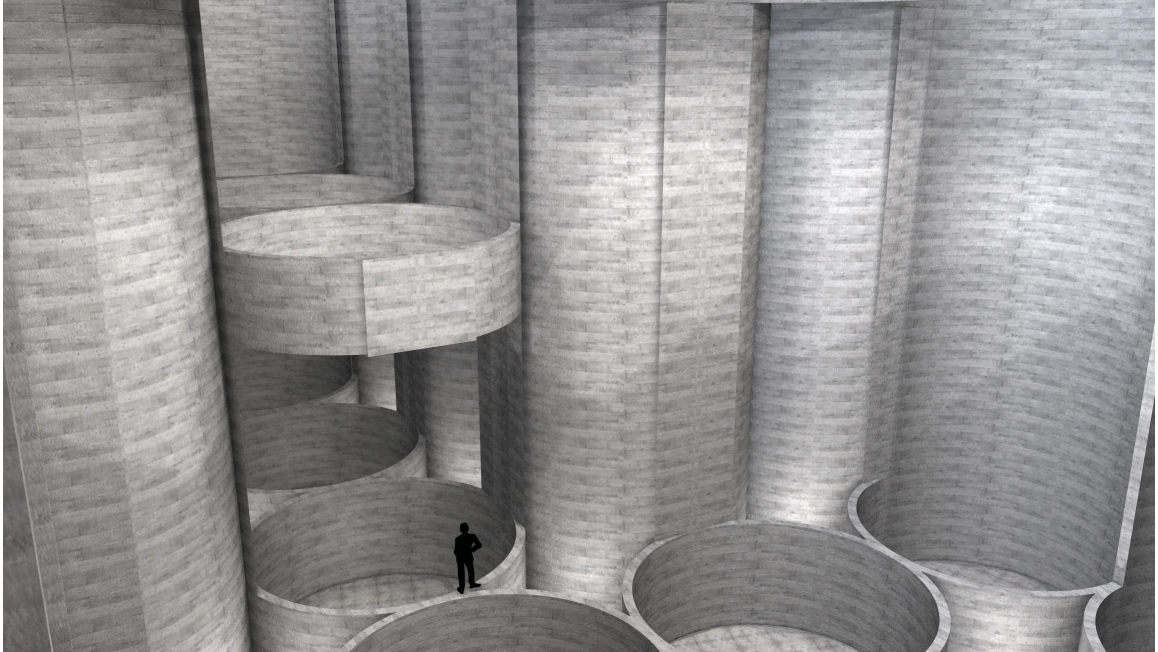


Figure 42: A hall created by removing whole silos.

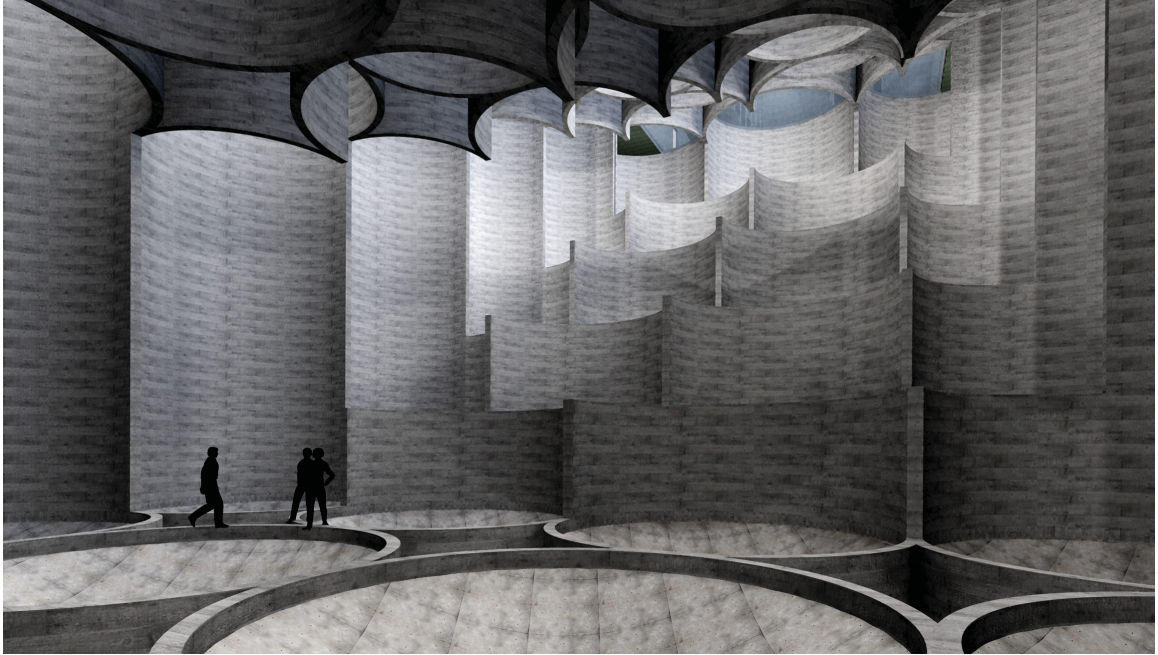


Figure 43: A stepped cut.

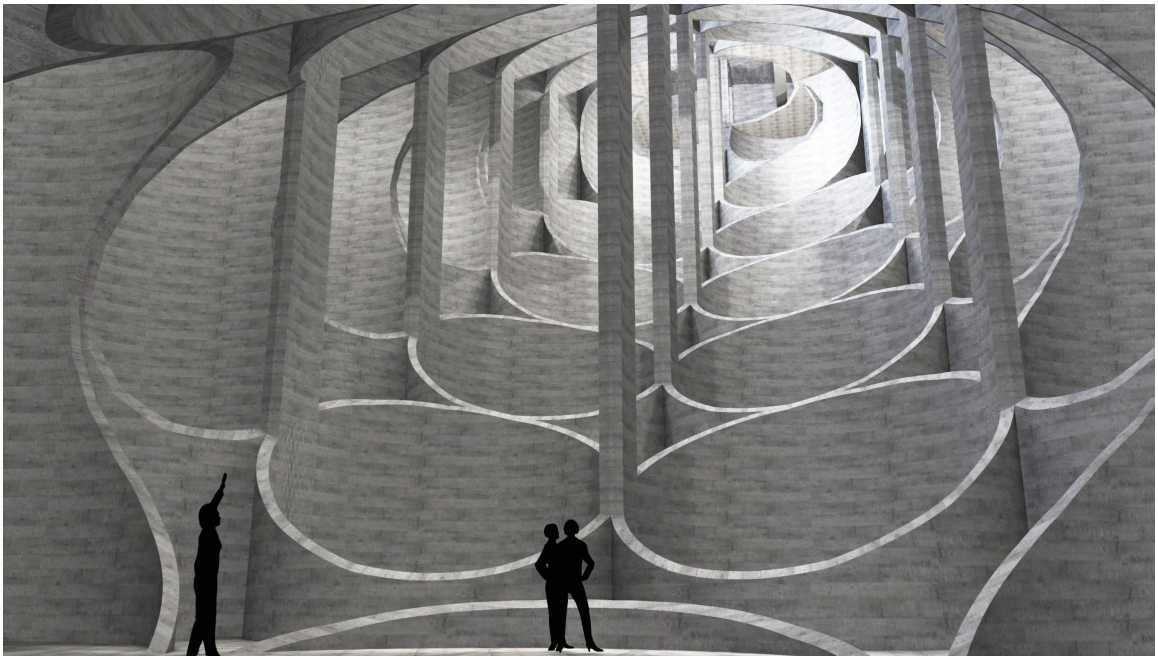


Figure 44: An inclined elliptical cut with partial walls preserved as columns.

Alongside the main silo annex is a series of storage bins in the workhouse. There are far fewer of these bins and they are much smaller and rectangular in plan. When these storage bins were cut with geometric solids, like in the cylindrical silos, the results were much less satisfying. Images of spaces carved from a handful of rectangular bins look like a weak imitation when placed next to images from inside the 33 concrete silos. Therefore, different subtractive moves were used in the workhouse: subtractive cuts and inserted platforms.

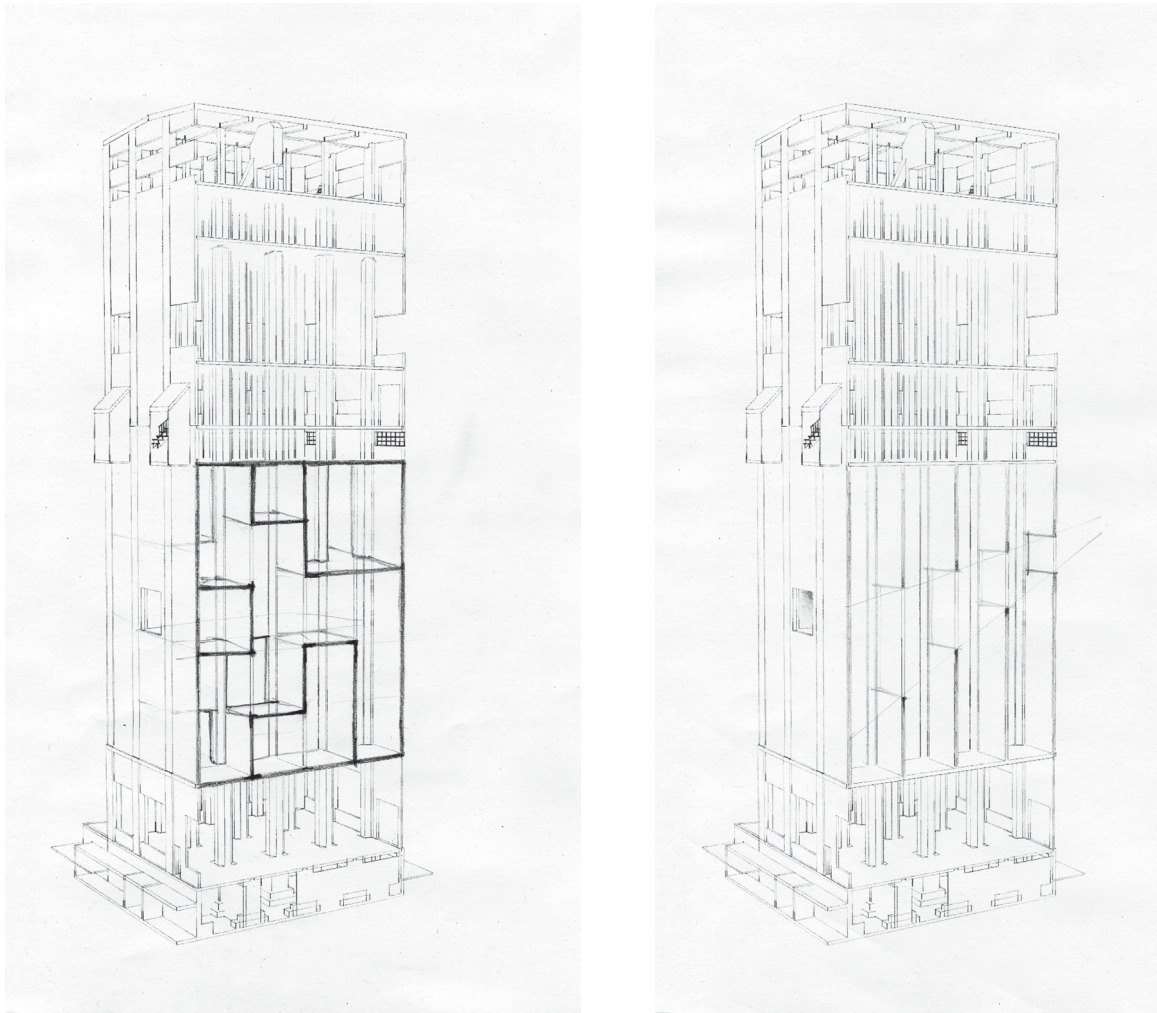


Figure 45: Two options for altering the storage bins within the workhouse and elevator building. Cutting the concrete and building platforms at the same time creates dynamic interconnected spaces despite a very small footprint.



Figure 46: Several trapezoids have intersected the bins.



Figure 47: A series of rectangular openings are cut in the bin walls, floors are added at the base of the cut, and a diagonal slice is made in the exterior wall.

There is no end to the number of iterations of cuts and carved spaces that could be generated within the concrete silos, and no doubt many interesting possibilities are still undiscovered by this thesis. To move forward in the design process required selecting from this wide array of options. Disregarding function (for a moment), and focusing on the aesthetic, monumental, and mysterious qualities of space, led to the emergence of two themes that promote these qualities. The first theme is the idea of moving towards a source of light.

Throughout architectural history, the invitation to movement has generally been based on a rhythmic flow of light and dark space, or a beckoning light viewed from darkness. (Plummer 2003, 94)

The renderings describing spaces that contain a focal source of light are more engaging, particularly if the source of light is either obscured or too bright to be distinguished. The second theme is creating a sense of immense scale. Cuts that are geometrically regular reveal the repetitive structure of the concrete, and convey a sense of distance and perspective.

Three subtractive moves for the round silos and one move for the rectangular bins were selected, based on the potential for emphasis on light and scale. The next phase takes the selected spaces and considers how these two ideas might be exploited: what is the most aesthetic, monumental, and mysterious space that can be made using light and scale?

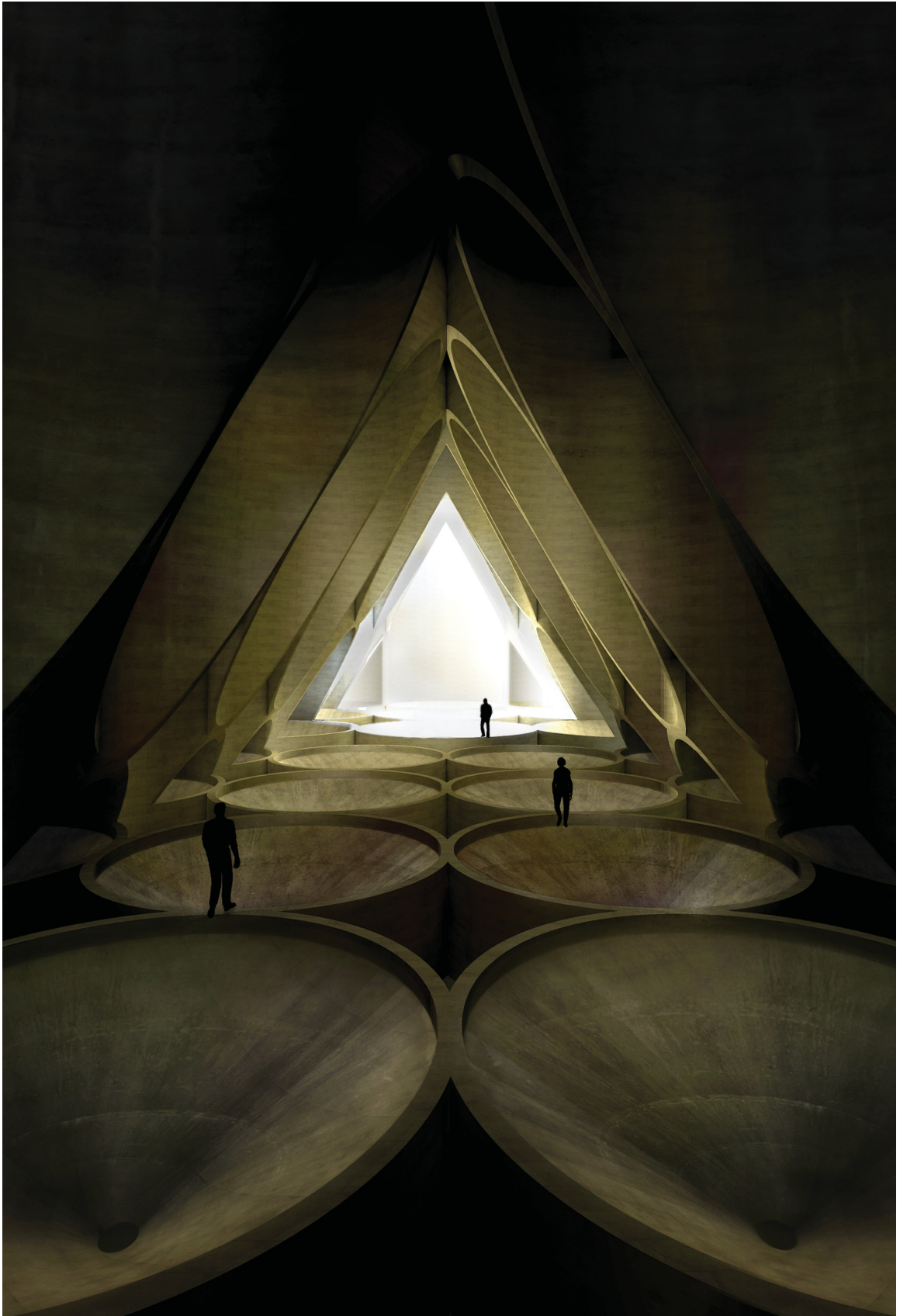


Figure 48: Option A: The long triangular hall.



Figure 49: Option B: The meeting of two inclined curved cylinders. This image explores softer, tinted light on concrete in spaces with no visible end.

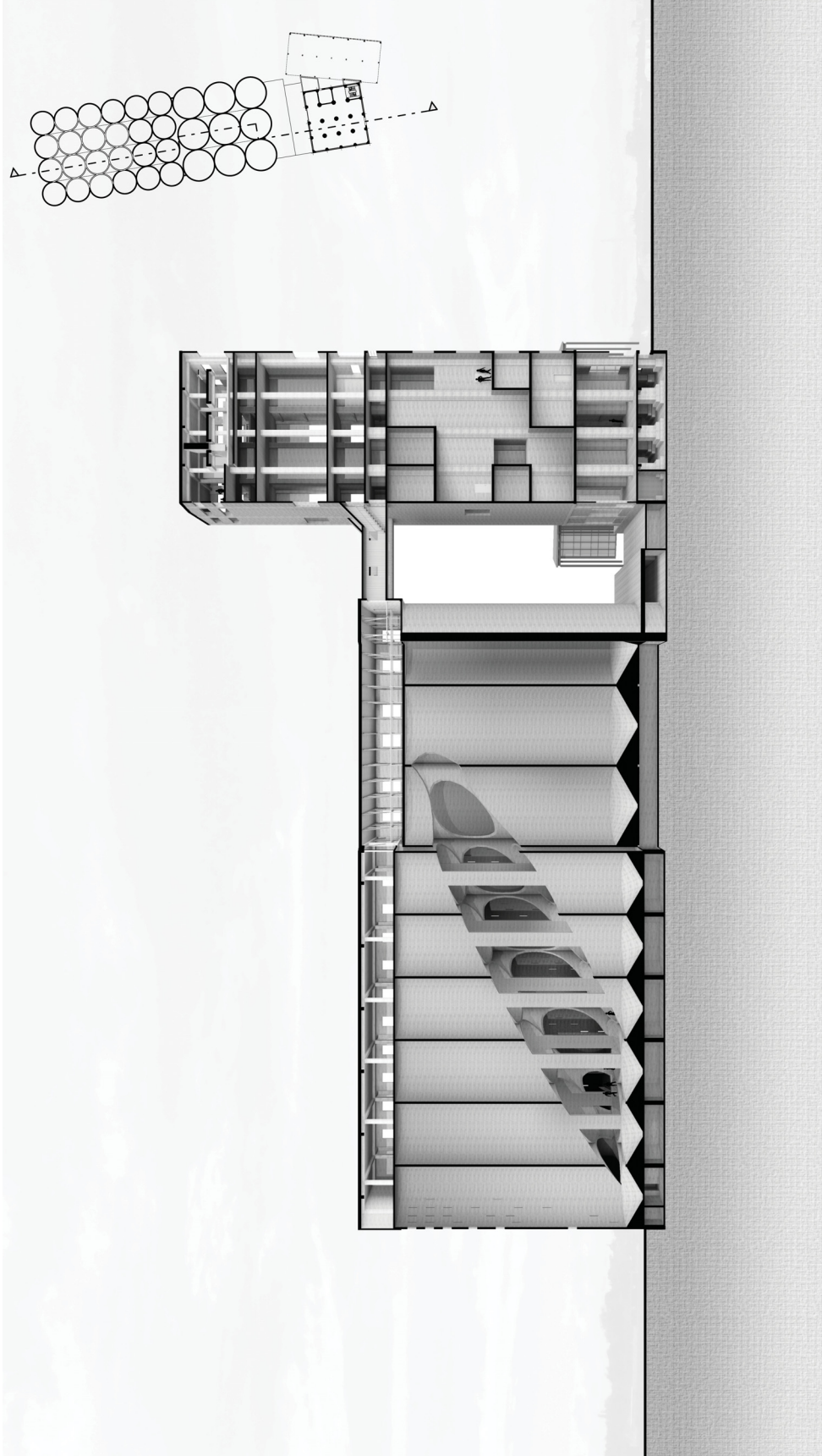


Figure 50: A rendered section-perspective cut north-south. It shows how the spaces on the following two pages are positioned in the building.

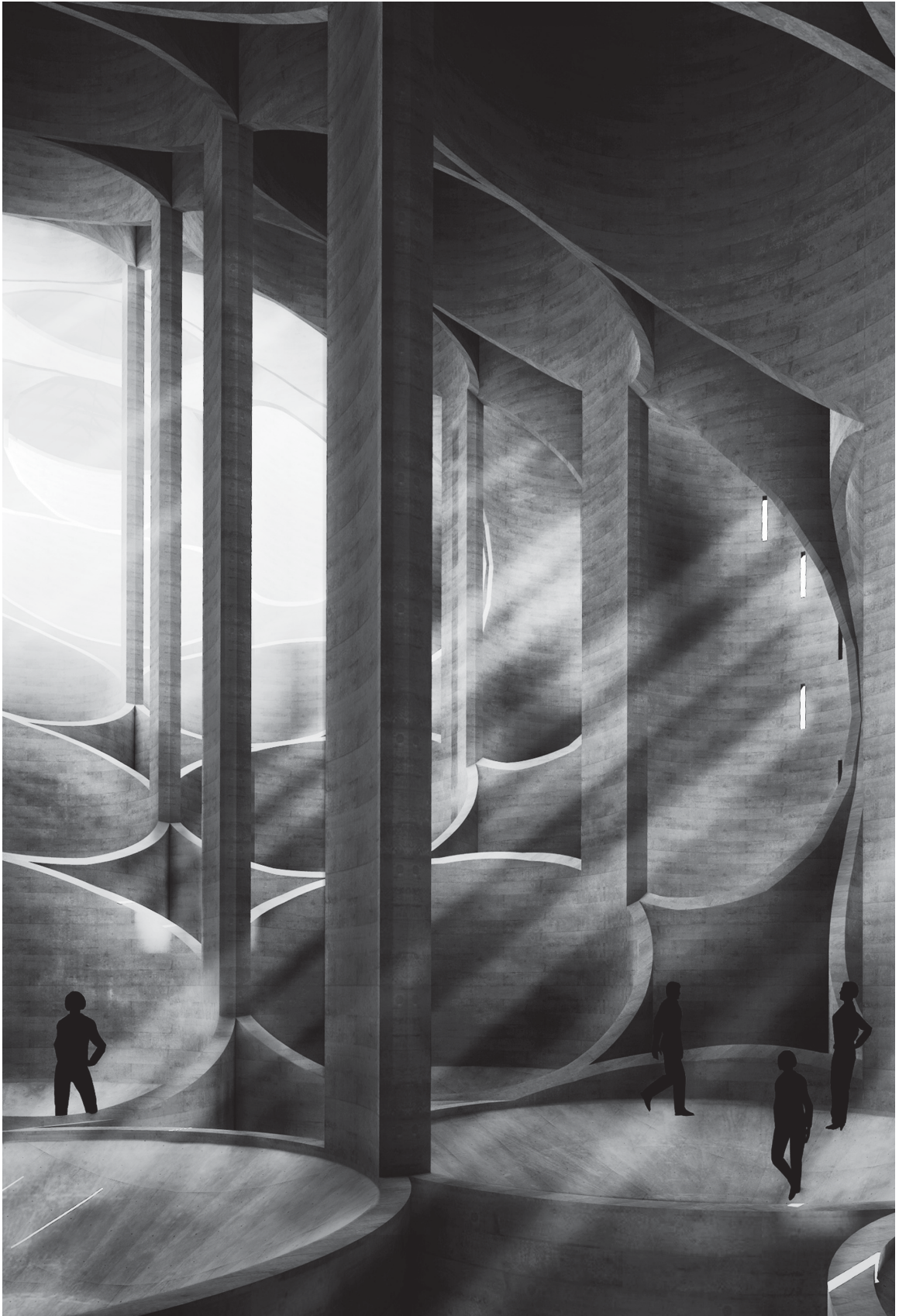


Figure 51: Option C: The tilted ellipse with afternoon light pouring in.

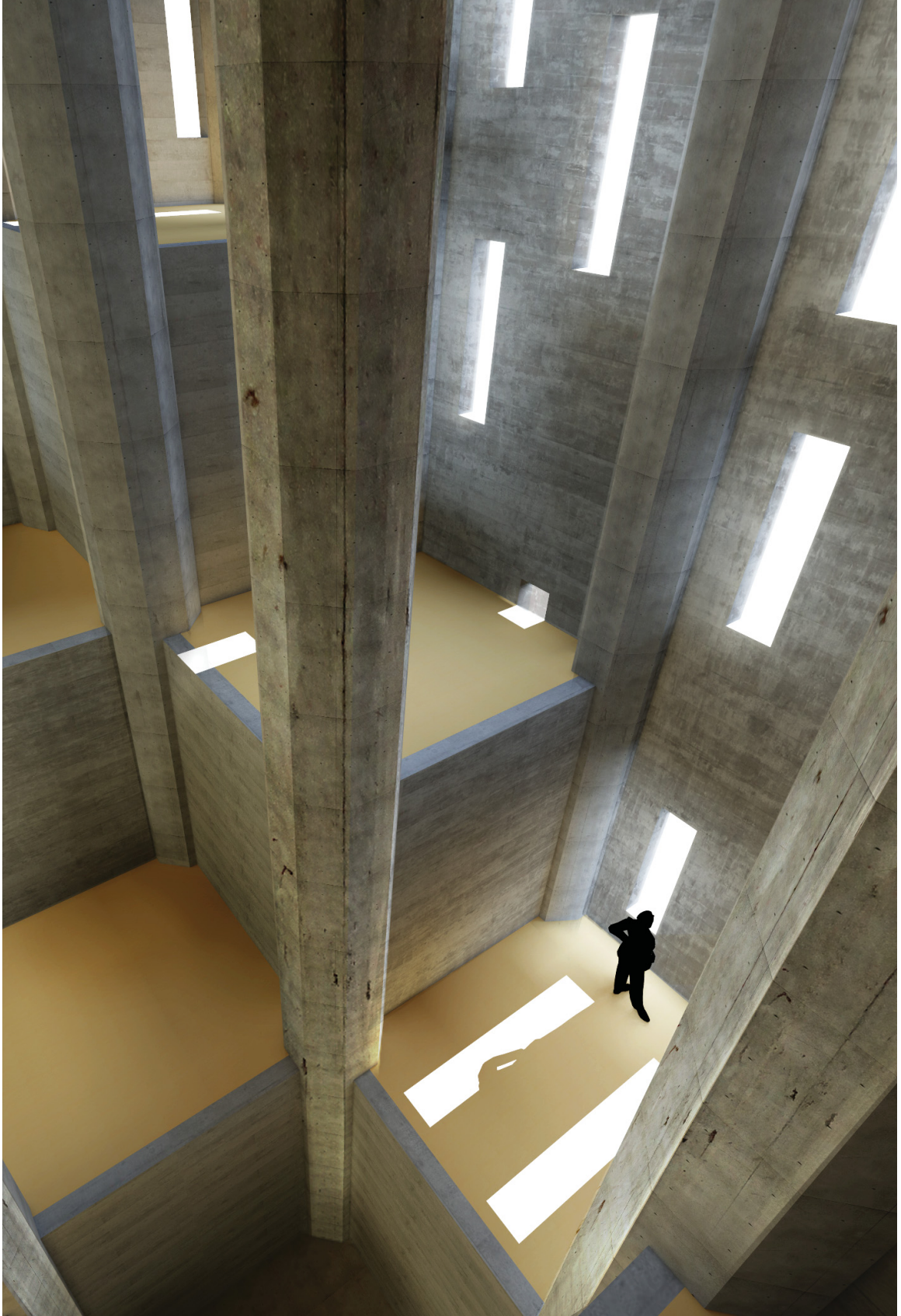


Figure 52: Inside the workhouse bins, with walls removed and floors and windows added.

Addition

The carved spaces in the renderings on the previous pages are not yet habitable. Even considering the spaces as a public terrain, there is no way for people to move through them, or to be protected from falling. This third and final design stage selects one of the three spaces and develops architectural moves that enable people to inhabit the whole structure. It incorporates a system of platforms, floors, and walkways, paired with a system for vertical circulation.

The inclined ellipse (Option C, figure 51) is selected for further architectural development over Options A and B (figures 48 and 49) because of its more diverse spatial potential. Options A and B are basically a linear organization of cylindrical room spaces off a hall space. In Option C, the silos are intersected at different points along their height and there is a large open area where the ellipse meets the base of the silos.

Any inserted constructions should act to further emphasize the scale and mass of the space carved from concrete. In developing building tectonics for this powerful space, the idea of suspended platforms emerged as a suitable contrast to the gravity bound concrete matrix. Perhaps some of these would be temporary. The strategy of vertical circulation might include a route that is not immediately obvious. In this regard a grand stair stretching down through the center of the ellipse would reduce the space to a stairwell, and make the access too simple. Any stair should read as a secondary object added after the creation of this space. Removing reinforced concrete would be an immense task, and this effort should be reflected in the navigation.

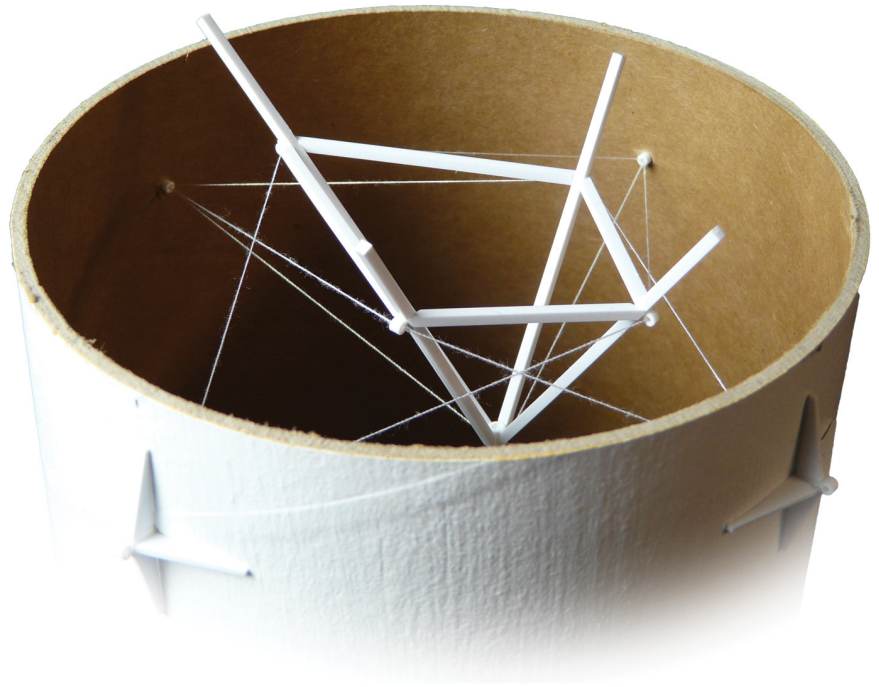


Figure 53: A study of a light tensile construction within a silo.

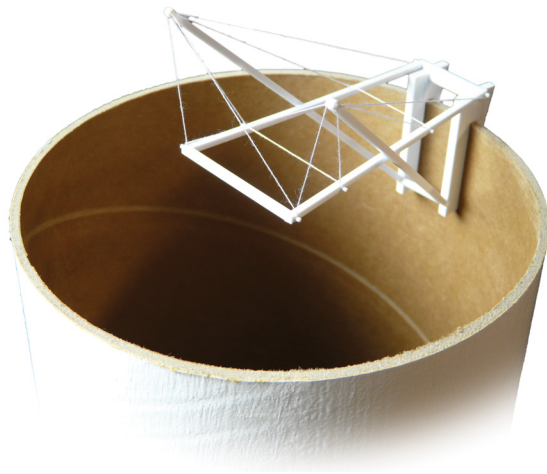


Figure 54: A cantilevered tensile platform.

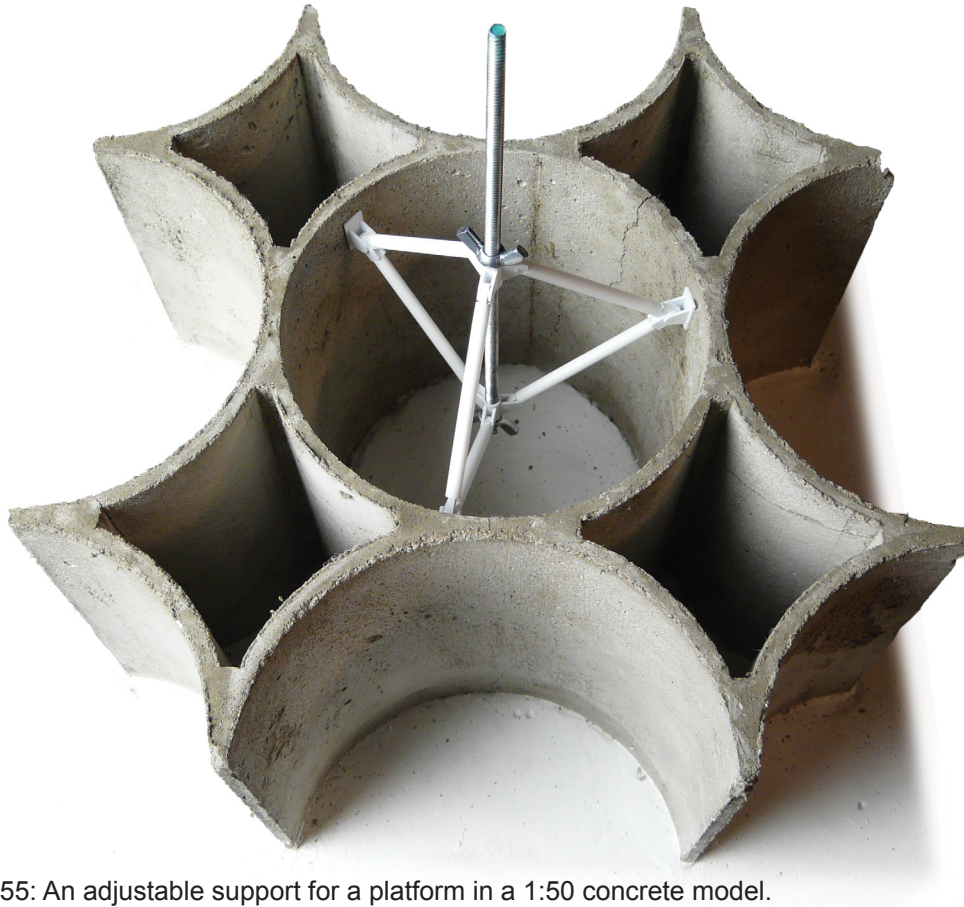


Figure 55: An adjustable support for a platform in a 1:50 concrete model.



Figure 56: A web of cables could stretch through the silos and suspend various walkways/platforms.

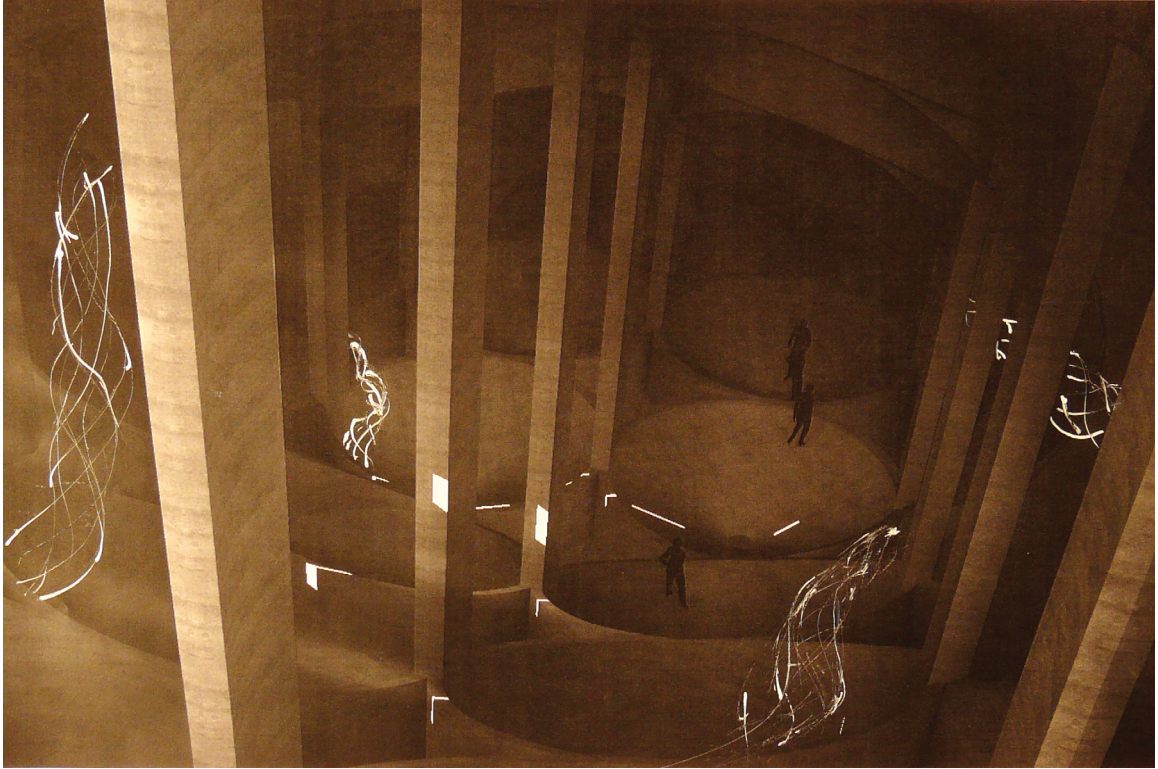


Figure 57: A network of woven paths.



Figure 58: Filling the space with a network of cables to define the volume.



Figure 59: A study of angled solids intersecting the volume.

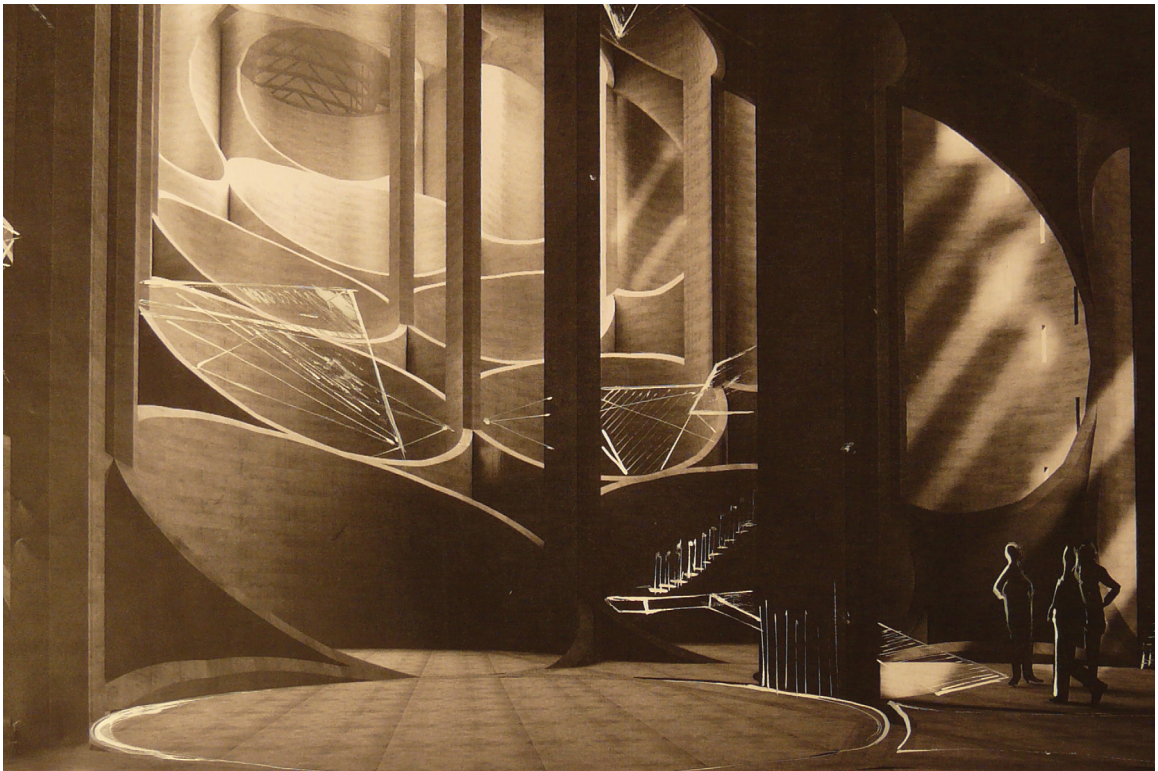


Figure 60: The solids begin to be linked with paths and stairs.

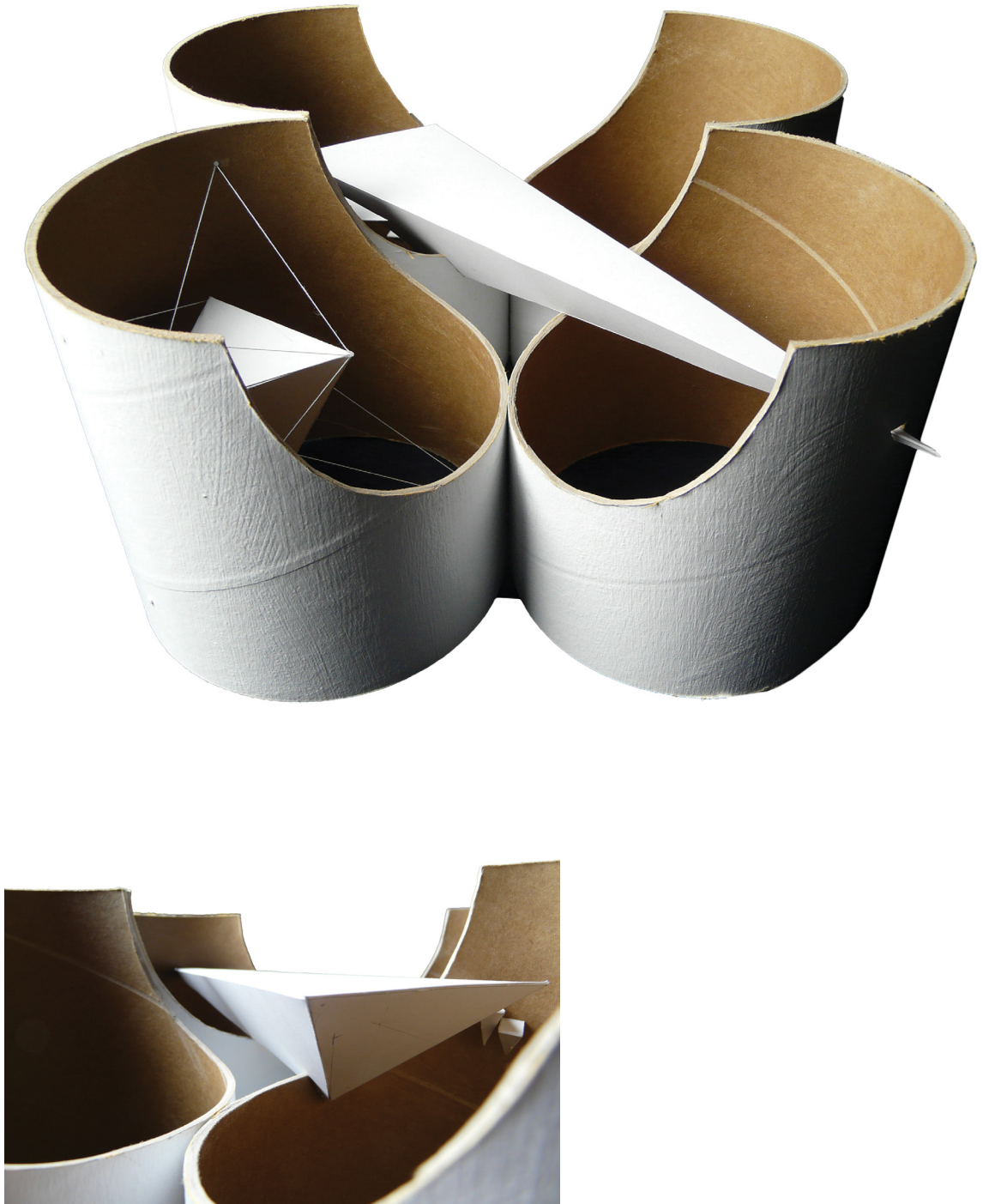


Figure 61: By cladding the frames of the tension structures there is a greater sense that platforms are being suspended. This study model builds on the themes in the sketches and introduces angular geometries that oppose the curves of the silos.

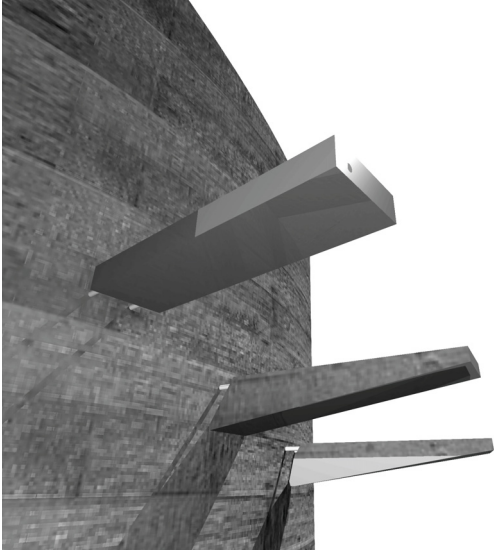


Figure 62: Three experimental steps using monolithic cantilevered treads.

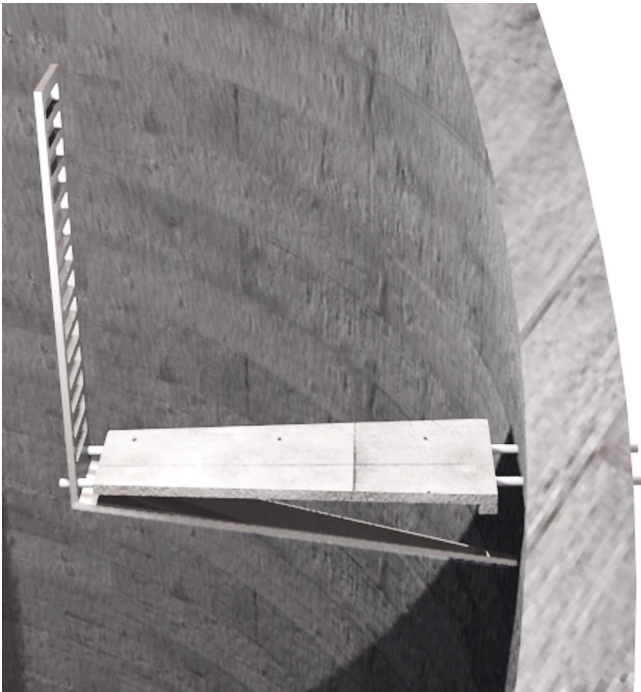


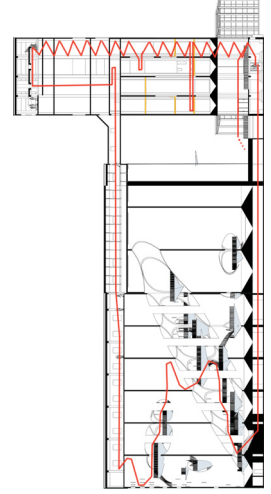
Figure 63: A stair system for the silos. The above design uses a much slimmer tread tied to a steel support. In the final design the guard rail is simplified further.

Walkthrough

A digital model serves as the design conclusion to this thesis. The design combines the selected subtractive move, the ellipse, with the sharply angled platforms suspended in space. A walkthrough of renderings on the following pages describes one sequence of spaces that offers varied experiences. The route reflects the original path of the grain, although in this case it is traced in reverse. The walkthrough also shows some of the moves outside the silo areas. This design is an example of how the spaces created in the previous studies might be incorporated into a whole structure and inhabited in a basic way.



Figure 64: Site photo facing southeast.



V
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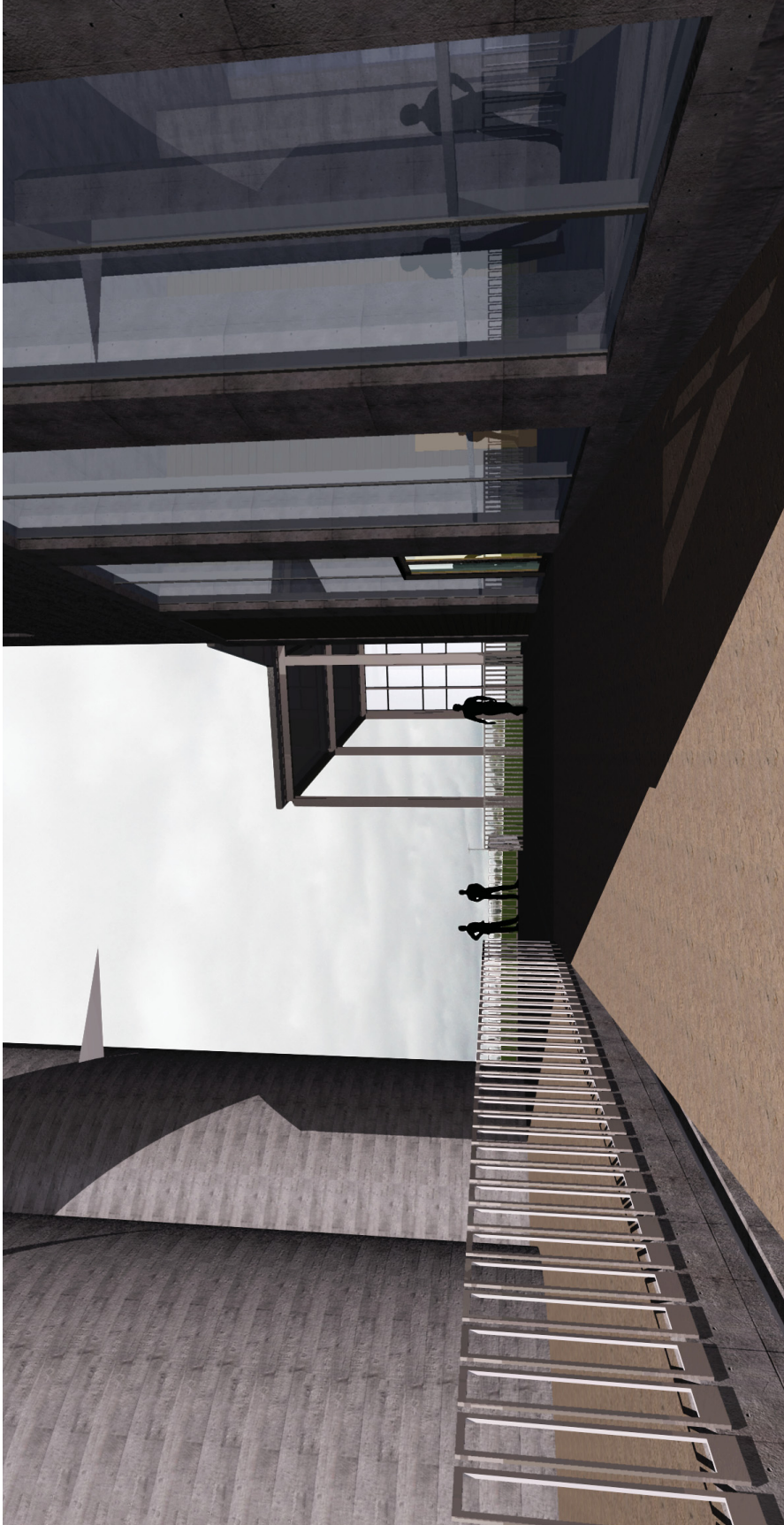


Figure 65: Ascending the ramp to the entrance.

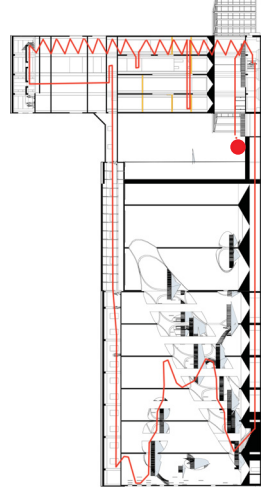




Figure 66: Inside the main foyer.

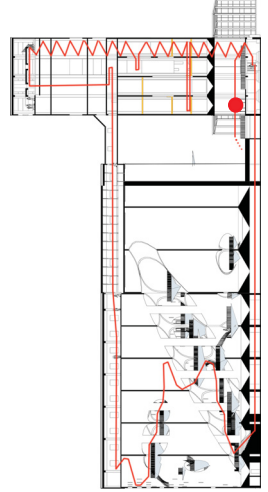




Figure 67: Moving through the ground floor.

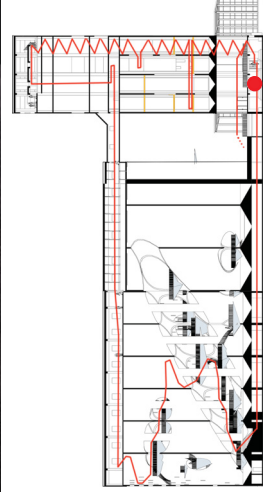




Figure 68: Approaching the tunnel to the silos.

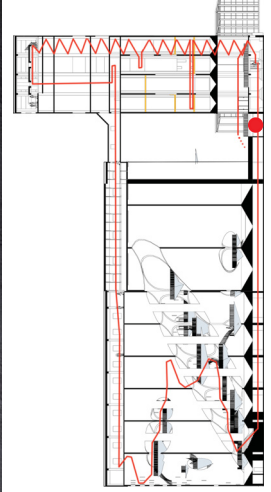
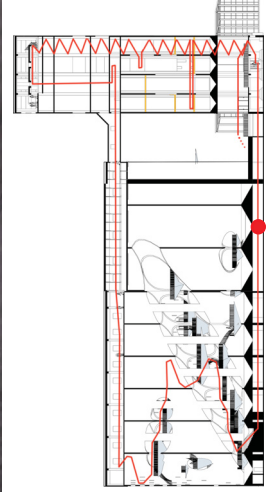




Figure 69: The first entrance to the silo space.



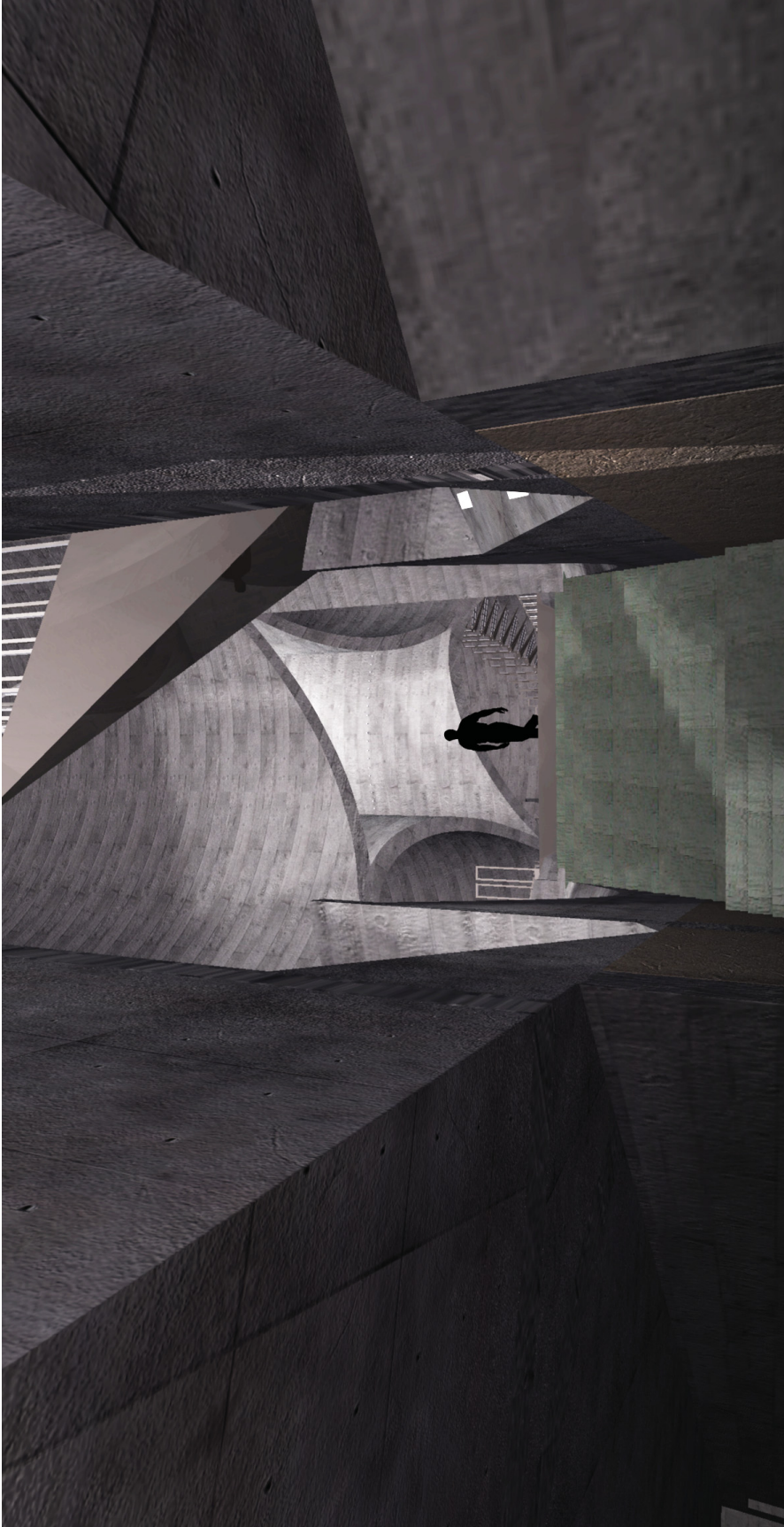
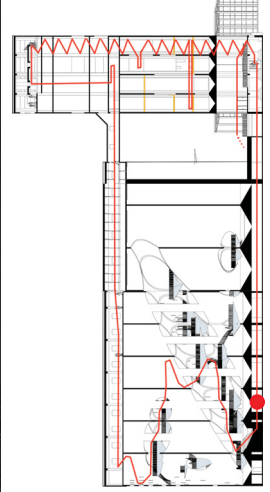


Figure 70: The second entrance to the silo space.



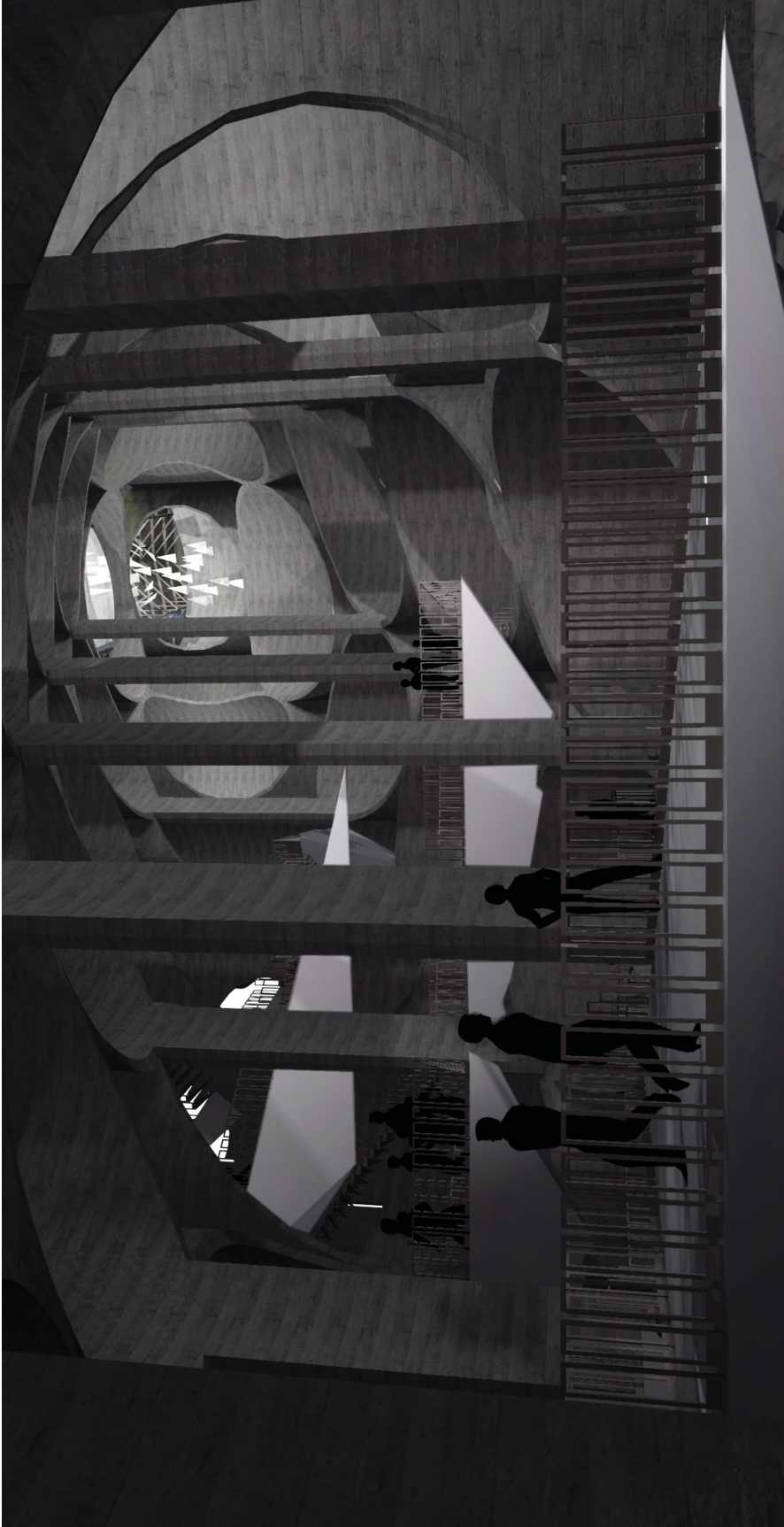
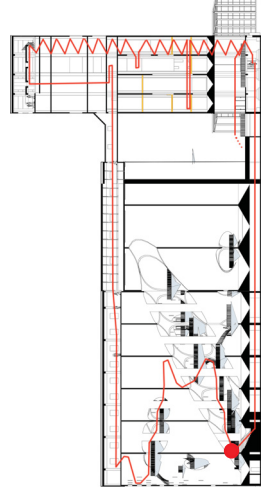


Figure 71: Emerging into the elliptical space.



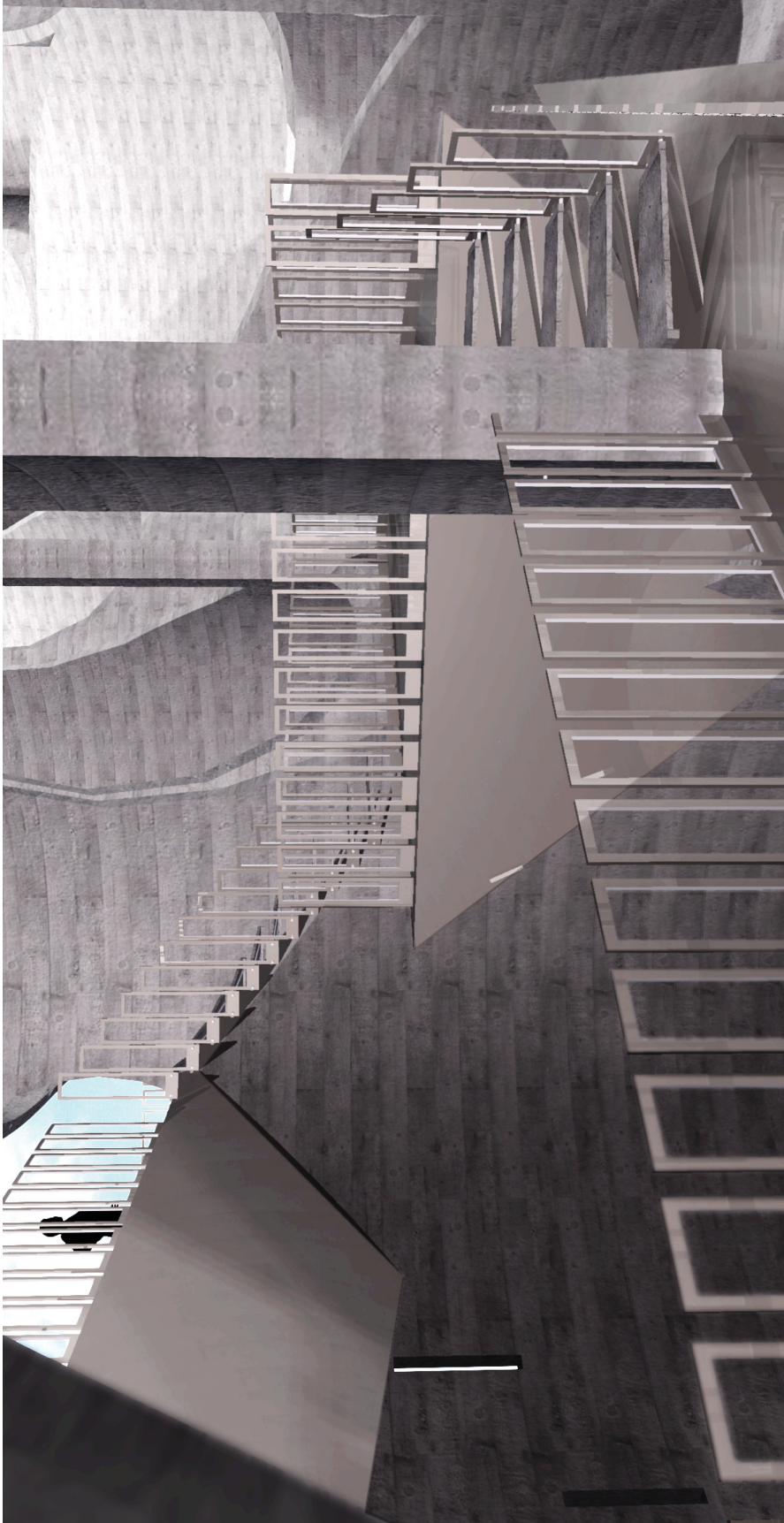


Figure 72: Midway up the silos.

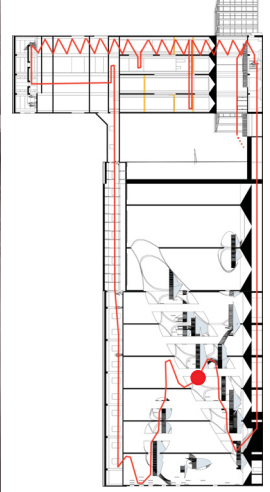
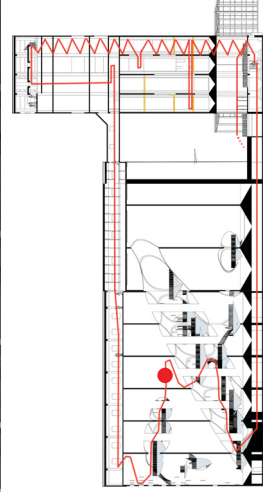




Figure 73: The upper ellipse.



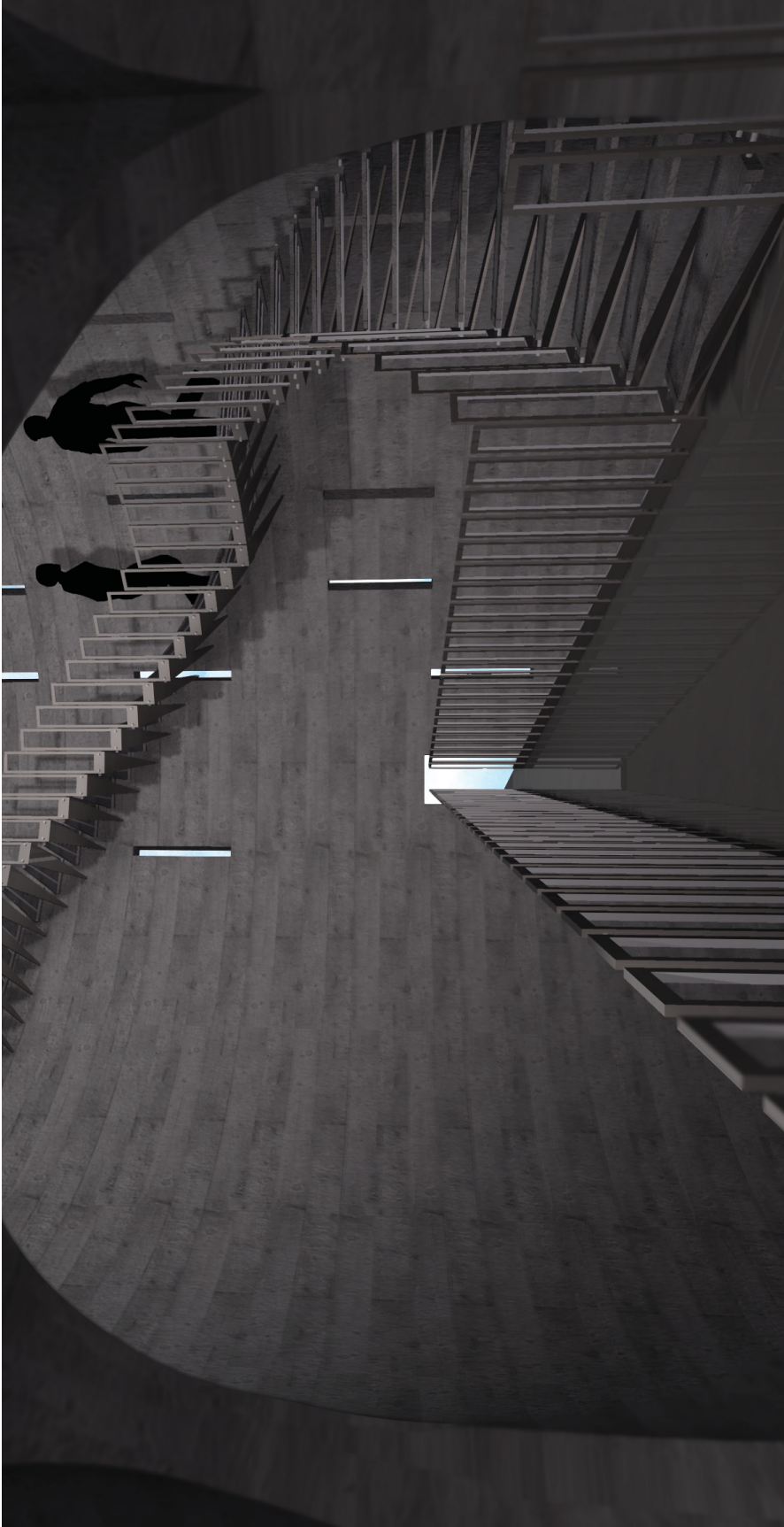


Figure 74: The final stair leading up to the gallery.

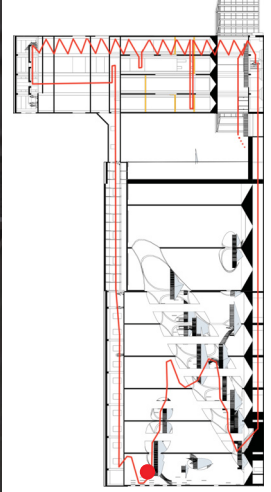




Figure 75: Entering the gallery.

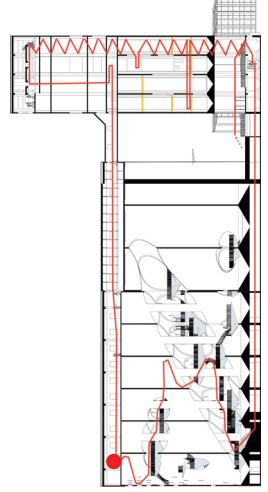




Figure 76: Leaving the gallery.

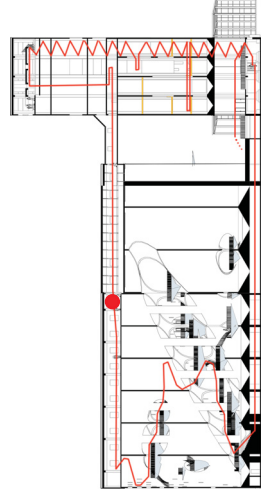
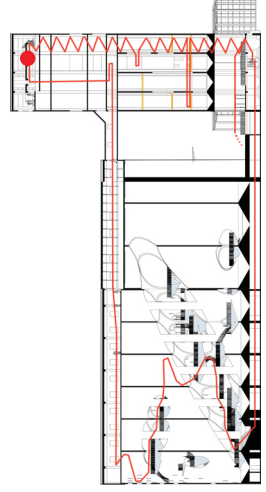




Figure 77: The top floor of the workspace.



Figure 78: The view from the top floor of the workhouse, back towards Thunder Bay.



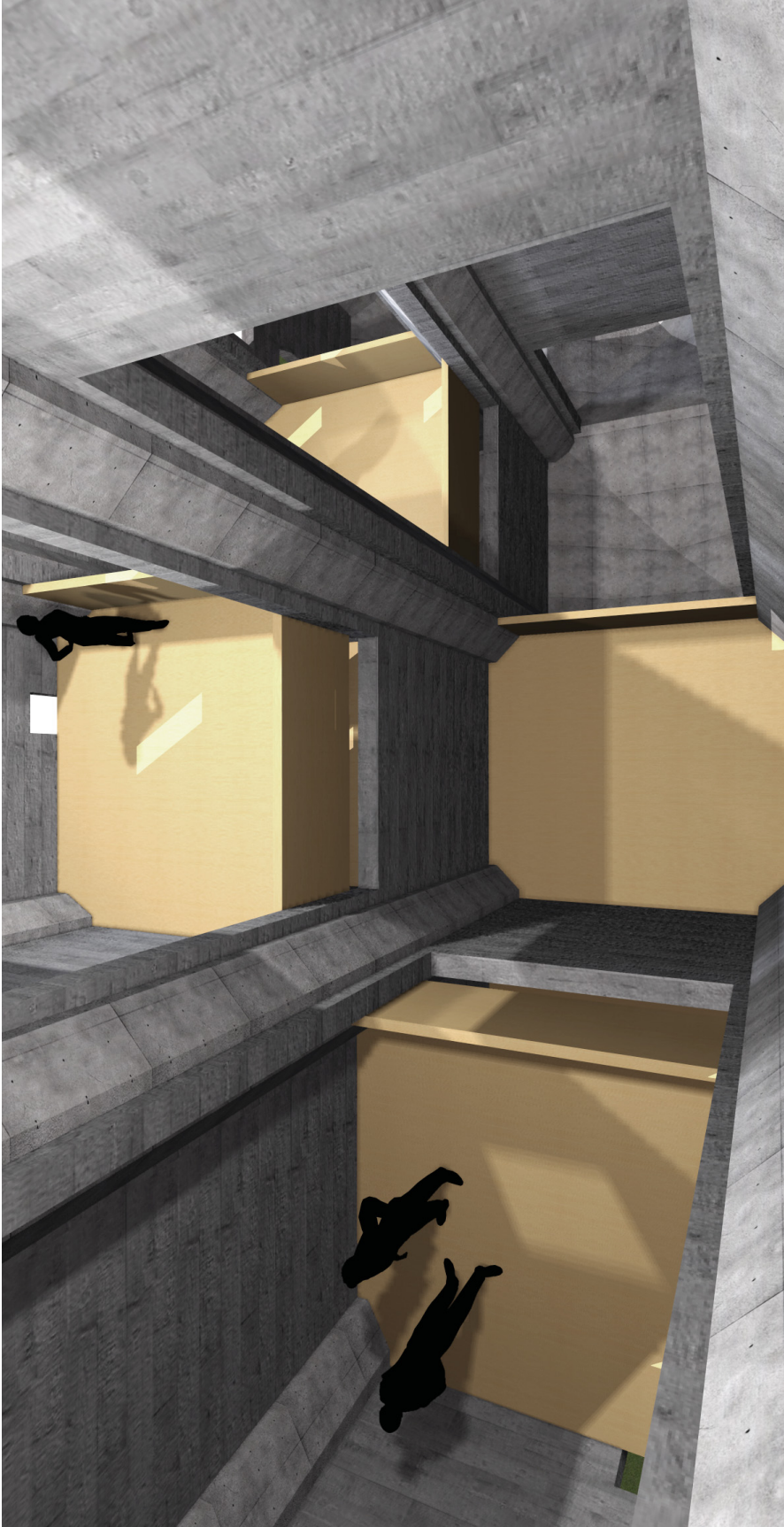
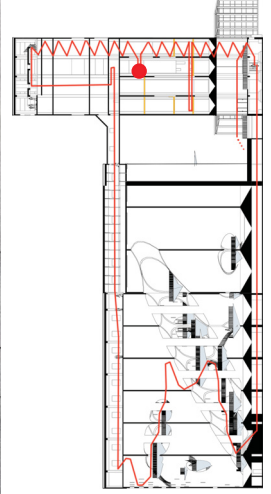


Figure 79: The workhouse storage bins.



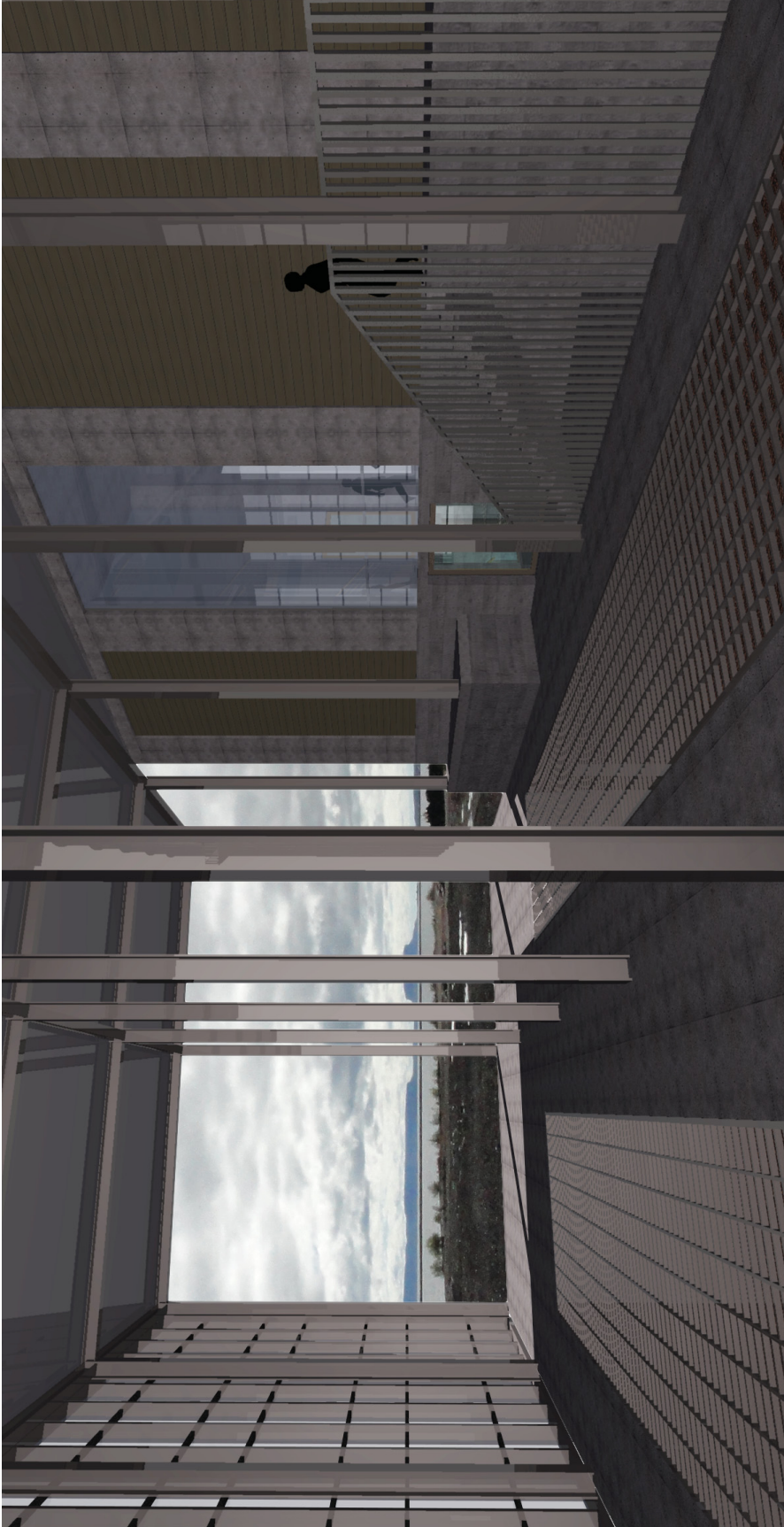
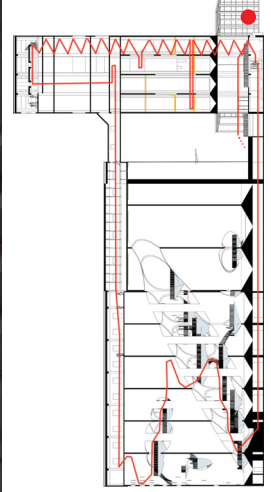


Figure 80: Exiting the building, looking back at the ground floor entrance.



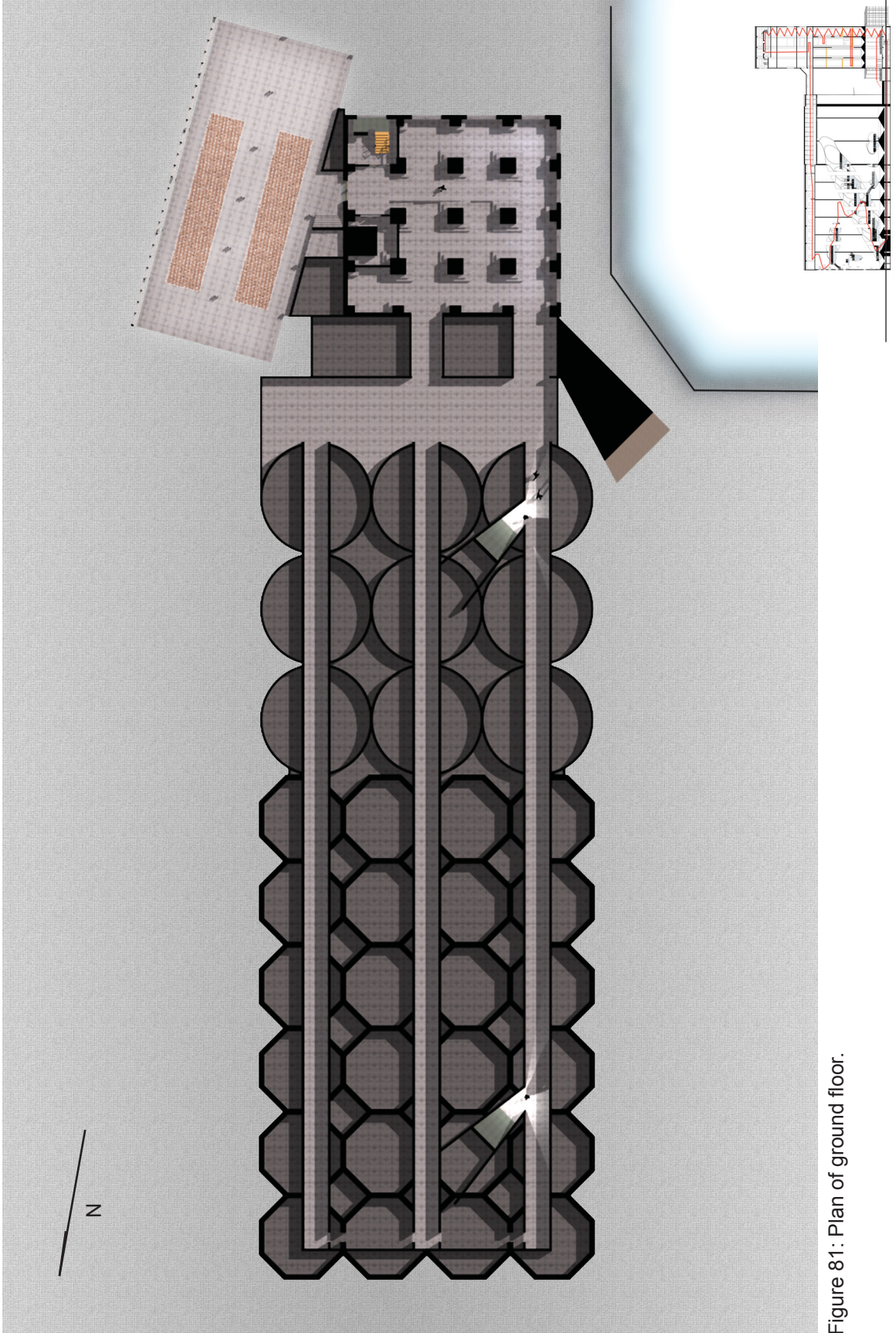


Figure 81: Plan of ground floor.

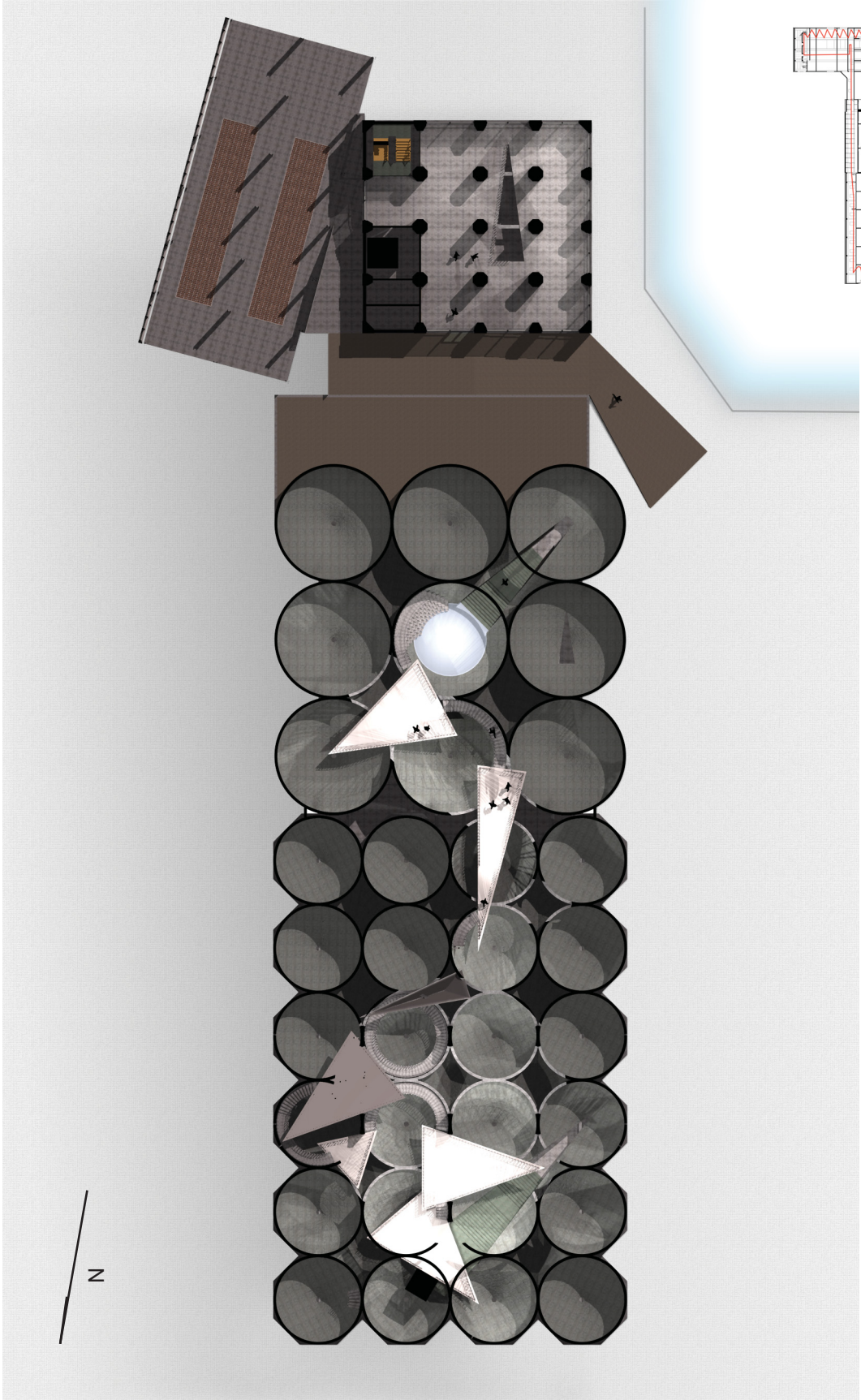


Figure 82: Plan at level of foyer.

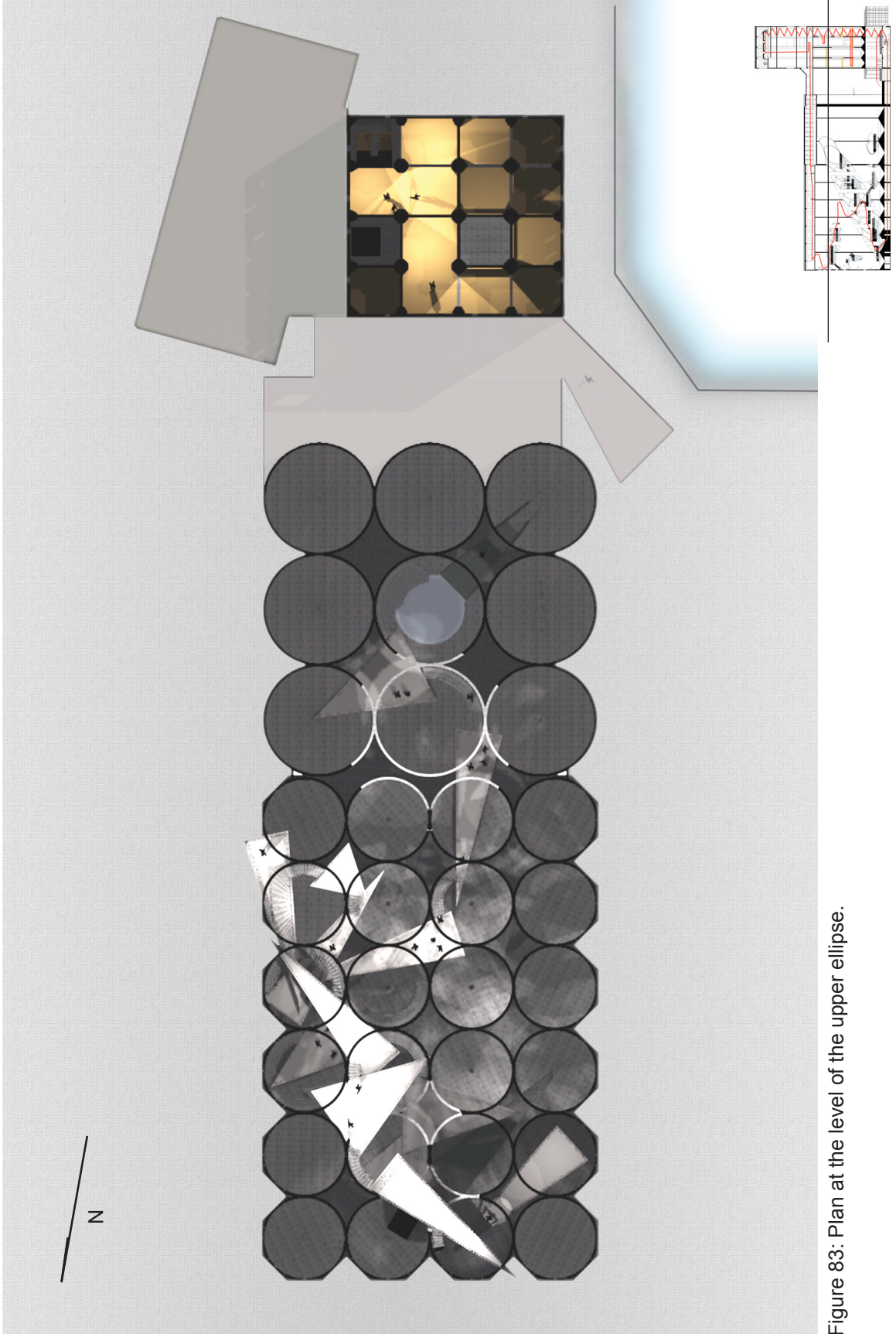


Figure 83: Plan at the level of the upper ellipse.

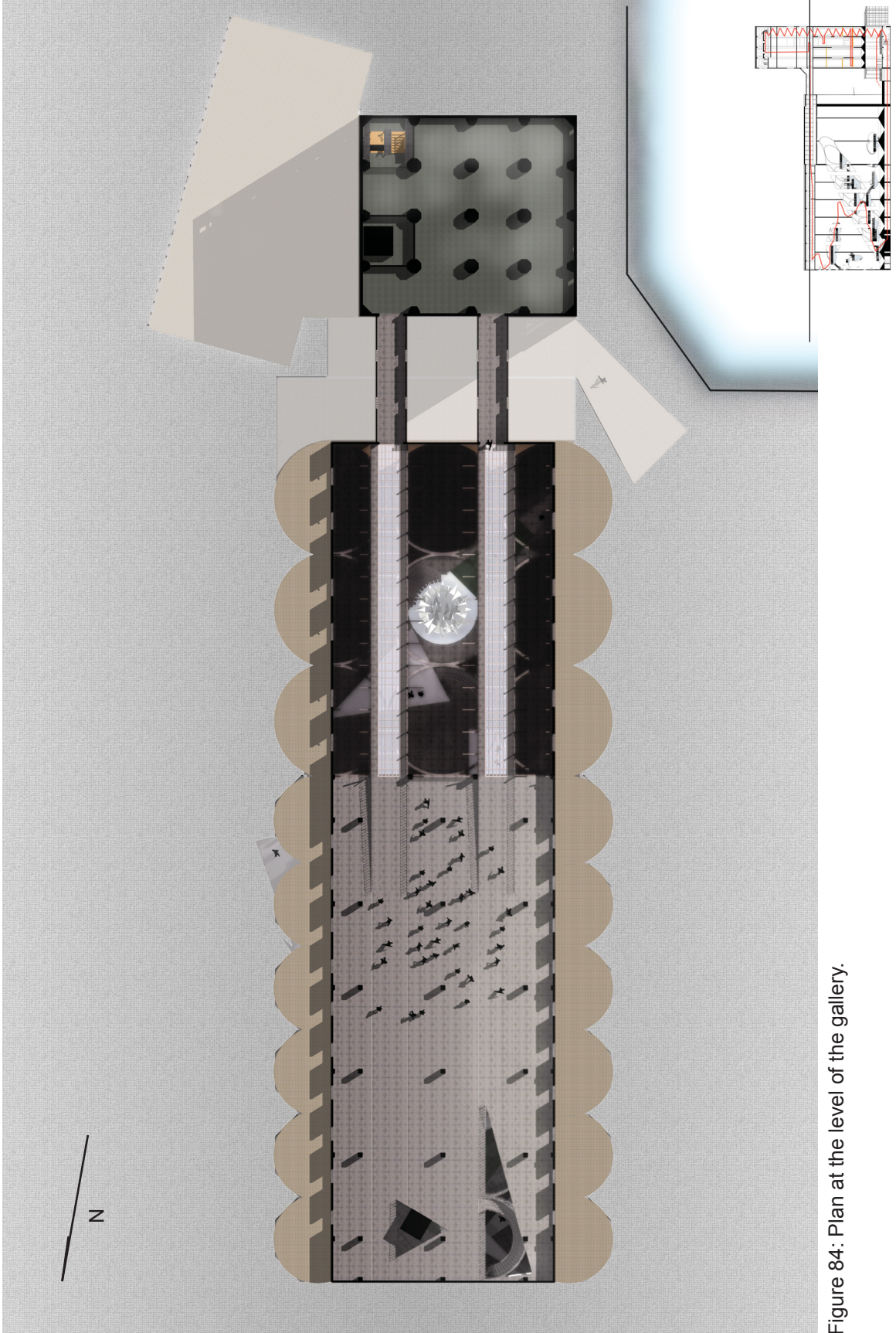


Figure 84: Plan at the level of the gallery.

CHAPTER 3: CONCLUSION

I have argued through illustrations that it is possible to adapt and inhabit an abandoned grain elevator in ways that preserve its monumental and mysterious qualities, and to create new spaces that augment these qualities. Through a process of first subtraction (demolition) and then addition (construction), I have modified the existing concrete structure to include new interior spaces that enhance the sense of scale and add qualities of light. I should acknowledge that the subtractive moves involve unrealistically ambitious demolition schemes that would require overcoming technical issues of cutting and structural unknowns of the old concrete (one option is a custom frame with a CNC waterjet cutter). The goal of this thesis not to present this final design as a practical adaptation proposal. Although the final walkthrough presents an example of a more complete presentation than the earlier geometric studies, it is in those studies that the variety of spatial possibilities is expressed. This thesis took an unconventional approach to the design process by emphasizing the qualities of space, introducing minimal program, then exploring and representing adaptations that augment the monumental and mysterious. Hopefully this thesis has revealed new spatial experiences that inspire further program options for abandoned grain elevators beyond the usual condominiums and hotels.

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