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**Out of Reach:**  
Digital Architecture and the Crisis of Scale.

by

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A thesis submitted to  
The Faculty of Graduate Studies  
in partial fulfillment of  
the requirements for the degree of

**Masters of Architecture**  
M.Arch  
(Professional)

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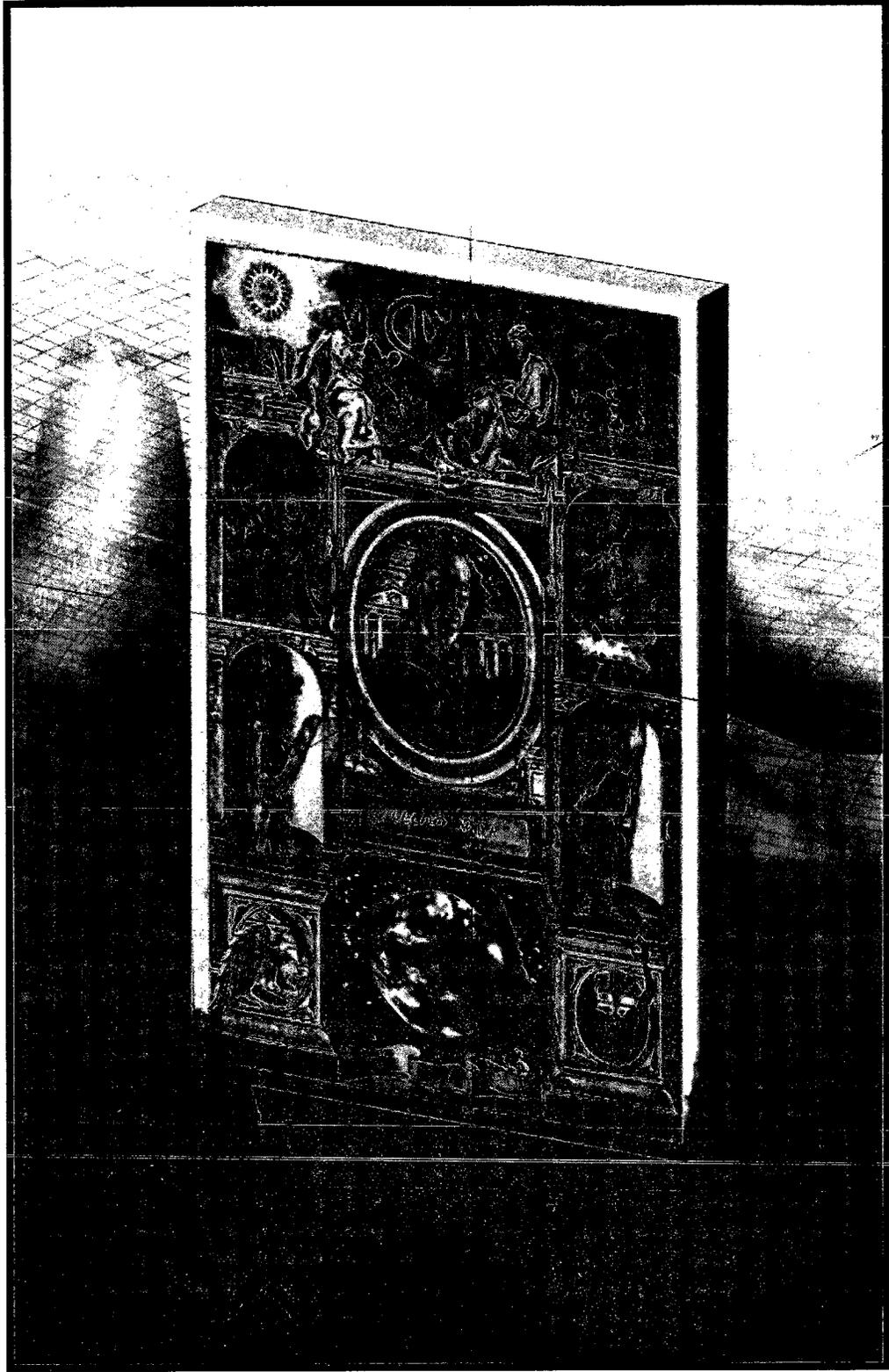


Figure 1. Frontispiece.

## abstract

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The discourse surrounding digital media and architecture is clouded in doubt, but crowded in use. This paper is intended to interrogate the often-misguided use of digital media in the practice of architecture by focusing on the question of scale. Beginning with a chapter entitled *Small* and ending with a chapter entitled *Big*, it is structured around a 'word ladder' – a game conceived by Lewis Carroll in which you navigate your way from one word to another in the fewest possible steps. Following the path of Gulliver, the author navigates the space(s) in between the very small and very big. *Out of Reach* builds on a theoretical foundation laid down by Antoine Picon, in which the "crisis of scale" in digital media, a trauma affecting both medicine and architecture, results from an ambiguity between the small and the big in computer applications. In reaction to this condition, the author looks to the prospective spaces of digital design. Set in the shifting sands of digital architecture, the thesis proposes the inaugural use of human figures in computer-aided design, as well as an attempt to reveal the hidden and ghosted layers lost in between the 'fitting' scales of the digital project.

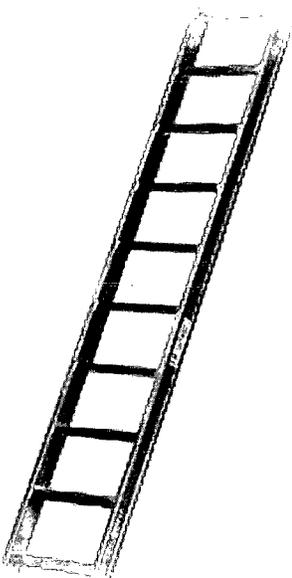
Lastly, the thesis looks to the *practice* of digital architecture explored in conjunction with the theoretical investigation of this thesis. An abandoned hydroelectric power station set on the banks of the Niagara River is transformed into a medical research center by conjuring and embodying the ghosted layers of the digital process.

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# acknowledgements

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To my thesis advisor, Dr. Stephen Fai,

And to my wife.

*Thank you.*

*'Would you tell me, please, which way I ought to go from here?'*  
*'That depends a good deal on where you want to get to,' said the Cat.*  
*'I don't much care where --' said Alice.*  
*'Then it doesn't matter which way you go,' said the Cat.*  
*'--so long as I get somewhere,' Alice added as an explanation.*

Lewis Carroll, *Alice's Adventures in Wonderland*

# smallshallhellheldheadhadhidbidbig

*In this chapter the author outlines the structure of his thesis through the organization of a word game. Each chapter is based on a single rung of a 'word ladder', beginning with small and ending with the big. As such, the thesis looks to occupy the space in between. Additionally, the hypothesis is addressed as the call for critical thought on the digital practice of architecture and the crisis of scale.*

This paper is composed of 10 parts. It is to be read as both a collection of individual chapters and as a singular note. Beginning with the chapter entitled *Small* and ending with the chapter entitled *Big*, it is structured around a 'word ladder' – a game conceived by Lewis Carroll in which one must navigate their way from one word to another in the fewest possible steps.<sup>1</sup> The purpose of this paper is to question the unusual notion of scale in digital media, with a specific focus on the questions facing digital architecture. The questions raised are intended to evaluate the current *crisis of scale*<sup>2</sup> in digital architecture and in turn, suggest measures to address these issues. The first five chapters (small, shall, hall, hell and held) are intended to build a theoretical foundation on which the hypothesis can rest. The crisis of scale and its prevalence in architectural

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<sup>1</sup> Gardner, Martin. "Word Ladders: Lewis Carroll's Doublets." *The Mathematical Gazette*. 80 (1996) 195-198.

<sup>2</sup> The "crisis in scale" is a term used by architectural critic Antoine Picon, describing a condition in which the distinction between the very big and the very small is blurred. A condition most evident in computer-generated images and models. This will be discussed at greater length in the chapter entitled *Hall*.<sup>2</sup> Picon, Antoine, "Architecture, Science, Technology and the Virtual Realm." *Architecture and the Sciences: Exchanging Metaphors*. Princeton Architectural Press: New York. Page 307.

practice is explored as both a product of digital media, and the shifting modes of virtual navigation and as Antoine Picon notes, a “shift of our visual and perceptive categories”.<sup>3</sup>

The first chapter entitled *Small*, is intended to provide a general introduction to the structure of the paper. Next, *Shall* is a brief look into our travels to worlds beyond the reach of our hand/eye. It gestures towards a shifting notion of spatial limits, exploring the seemingly boundless scales which are beyond what we traditionally would understand in connection with the limits of the human body. Following this, the notion of a crisis of scale is explored in *Hall*. Shifting modes of seeing and navigating in digital space have removed the relative intermediacy of the human body, disrupting the distinction between the very small and the very big. The next chapter, *Hell*, addresses the causes of this crisis, specifically looking at the proliferation and the malleability of the digital image, with interest drawn from medical imaging. Next, *Held* looks to the human body and the notion of traditional distance<sup>4</sup> associated with a body bound to its own physicality by gravity.

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<sup>3</sup> Picon, Antoine, “Architecture, Science, Technology and the Virtual Realm.” Architecture and the Sciences: Exchanging Metaphors. Princeton Architectural Press: New York. Page 308.

<sup>4</sup> Traditional distance is a term used by Picon to describe the notion in which the spatial conditions of our environment are understood in relation to the physical limitations of the human body. “We have difficulty dealing with our environment at a traditional distance. On the one hand, with satellites or computer generated global models, we see at a much broader scale than our ancestors did. On the other hand, we are able to look at microstructures as if they were right under our eyes.”

Picon, Antoine, “Architecture, Science, Technology and the Virtual Realm.” Architecture and the Sciences: Exchanging Metaphors. Princeton Architectural Press: New York. Page 308.

Resting on the theoretical foundations described in the previous chapters, the paper changes focus, addressing the latent potential available through the exploration of scale(lessness) in digital architecture. The chapters entitled *Head*, *Had*, and *Hid* navigate the perspective space in digital design as it relates to the shifting sands of digital scale. *Head* looks to the role of architectural figures in digital design suggesting the position of the architectural figure has been misplaced, becoming an afterthought in the generation of architectural ideas. Where it once informed the drawing of idea and proportion, the figure is too often a post-processing 'cut and paste' of faceless figures. The chapter questions the role of the architectural figure in digital design and proposes an inaugural position. *Had* examines the deployment of a hybrid approach to design, engaging both the scaleless space of the digital and inherent scale of traditional modes of imagination in a kind of codified coitus. Drawing the intangibles from both digital and analogical tools of design, the offspring becomes interlaced with transactional ideas. Lastly, the chapter entitled *Hid* looks to the potential hidden in-between the scales of digital architecture, with specific interest in the ghosted, or hidden layers of digital design.

The final two chapters, *Bid* and *Big* outline the *act* of architecture explored in conjunction with the theoretical and practical investigations of this thesis. The subject is a vacant hydroelectric powerhouse set deep in the reclaimed shoreline of the Niagara River. Interlaced in a playful game of the very big and the very

small, I propose a series of interventions, rehabilitating the building as a powerhouse of a different nature – a place of medical research concerned with the pedagogy and technical advancement of medical education aligned with a public entrance to a hidden world tucked behind the curtain of Niagara Falls. The process of architecture looks to the crisis of scale as a place of opportunity, engaging the digital reach with the hand of an architect.

*“If a man will begin with certainties, he shall end in doubts, but if he will be content to begin with doubts, he shall end in certainties.”<sup>5</sup>*

Francis Bacon, *The Advancement of Learning*. 1605

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<sup>5</sup> Francis Bacon. *The Advancement of Learning. Book I.* In *The Works of Francis Bacon: Lord Chancellor of England*. A Hart, 1852. Vol. 1. page 173.

# smallshallhallhellheldheadhadhidbidbig

*In this chapter, the author accounts for the unrelenting human habit of reaching out towards the elusive, albeit attractive limits of our spatial understanding. Briefly touching upon the history of the very small and the very big, the author looks to the scalar journeys in literature, architecture and the digital, capturing the very small with the very big, and the very big with the very small.*

The dream of science, to defrock cosmology, continues to feed a ferocious appetite for technologies that intend to eliminate the unseen and measure the immeasurable. The multi-scalar explorations that drive both science and art reflect a relentless desire to capture and hold fast the limits of inside and outside. However, microscopes have led to electron microscopy and telescopes have lead to space stations, effectively moving the boundary of the knowable further and further away.

To begin his 1665 treatise entitled *Micrographia*, the father of microscopy, Robert Hooke addresses the inter-relationship of the very small, and the very large. “We must first endeavor to make letters, and draw single strokes true, before we venture to write whole sentences, or to draw large pictures.”<sup>6</sup> In order to travel to

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<sup>6</sup> Hooke, Robert. Micrographia: or, Some physiological descriptions of minute bodies made by magnifying glasses. London: J.Martyn and J. Allestry, 1665.

the realm of the very small, Hooke employs the newborn microscope and renders his miniature discoveries through a series of copperplate engravings. Exposed is a rich landscape of textures with alarming complexity, a pattern of untouchable worlds and uncanny landscapes hidden beyond the reach of the un-aided eye and what we might understand as "traditional distance"<sup>7</sup>.

Fifty-seven years earlier, a string of stirring assumptions were confirmed in the lens of Galileo's outstretched telescope.<sup>8</sup> Akin to the inward gaze of Hooke's microscope, Galileo's terrestrial transformation shook the fragile ground of science and religion. In what became a downright defiance of anthropocentric assumptions, the objective lens of Galileo's outstretched reach returned to Earth a previously unseen world outside of the traditional reach of the human scale.

Forty years following the publication of Hooke's *Micrographia*, Jonathon Swift published his own account of the very small and the very large in the acclaimed tale of the miniature and the massive. *Gulliver's Travels* (1726) is a cryptic tale of Captain Lemuel Gulliver's nautical voyages and uncanny encounters with cultures of unusual size.<sup>9</sup> Similarly, Voltaire's *Micromegas* (1738 – 1752) a tale of interplanetary travel, depicts the collision of two societies living within opposing

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<sup>7</sup> Picon, Antoine, "Architecture, Science, Technology and the Virtual Realm." Architecture and the Sciences: Exchanging Metaphors. Princeton Architectural Press: New York. Page 308.

<sup>8</sup> Galilei, Galileo, Dialogues Concerning Two New Sciences,. trans. by Henry Crew and Alphonso De Salvio, Evanston, Northwestern University Press, 1946, pp. 1 - 6, 125 - 128.

<sup>9</sup> Swift, Jonathon. Gulliver's Travels. 2003 ed. London: Penguin Group. 2001

scales.<sup>10</sup> Both stories appear to echo the changing perception of spatial limits in the development and subsequent use of telescopes and microscopes in the 17<sup>th</sup> and 18<sup>th</sup> centuries. Over a century later, Lewis Carroll's *Alice in Wonderland* (1865) demonstrates a contemporary account of the spatial depths of introspective science and literature.<sup>11</sup>

For the architect, movement up and down the scale is commonplace. Through the use of scaled drawings, the architect can focus on the breadth of an entire city, or the fineness of a material. Defining specific scales of representation provides the architect the necessary focus upon a specific task, or a fitting tale, where as the digital scale (or lack there of) exposes the illusion of drawing at multiple scales.<sup>12</sup> Paul Emmons argues the inherent lack of scale in digital tools provides the user with the false notion of drawing at full scale, or 1:1. He suggests that Computer Aided Drawing (CAD) “applies a Cartesian approach to scale in architectural drawings by forgoing the senses to assume scale is solely in the mind. Data is recorded at full scale, but the size of the screen image indefinitely varies as the operator zooms in or out to consider various aspects,

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<sup>10</sup> Voltaire, Francois. (Theo Cull trans.) *Micromegas*. (1995 eds.) New York: Penguin Classics. 1752.

<sup>11</sup> Carroll, Lewis. *Alice's Adventures in Wonderland and Through the Looking-Glass*. New York. The Modern Library. 2002.

<sup>12</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” *Architectural Research Quarterly*. 9 (2005): 227-235.

creating the inability to put them into a perceivable relation to the operators body.”<sup>13</sup>

Reiser + Umemoto argue this "new sense of fineness" allows for the collision of the very small and the very large.<sup>14</sup> By incorporating the extreme yet codependent regimes of scale and organization, advancement in “modeling aerodynamic behavior, and in laser fabrication [has] opened up a whole horizon of possibilities in aeronautical design. Here the very large is synthesized with the very small, the very slow with the very fast.<sup>15</sup> Accordingly, the impact of the very small engaging with the very big “could serve to address the apparent paradox of the global and the local occupying the same space.”<sup>16</sup> As such, an unrelenting rash of digital acquisitions is expanding our diagrams of the known, ultimately rendering a collision of the very small and the very large at our doorstep.

Although the marvels of the very small and the very big may provide us with a sense of wonder, the concept of scale, by its very nature returns us to the eye/hand of the observer. Due to the inherent connection to the human body, the

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<sup>13</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” Architectural Research Quarterly. 9 (2005). Page 232.

<sup>14</sup> Reiser + Umemoto. “The New Fineness.” Assemblages. No. 41 (Apr. 2000). Page 65.

<sup>15</sup> Reiser + Umemoto. “The New Fineness.” Assemblages. No. 41 (Apr. 2000). Page 65.

In defending the claim that we are witnessing a tendency towards a new fineness, they liken the ability to fabricate metal skins of air foils with literally millions of laser cut pores that has radically extended the low speed performance of aircrafts to such a degree that their actions appear completely counterintuitive and unnatural. The capacity to radically extend maneuverability in that strange unstable region at the edge of stall suggests an analogous possibility in architecture, allowing for the incorporation of extreme yet codependent regimes of scale and organization.

<sup>16</sup> Reiser + Umemoto. “The New Fineness.” Assemblages. No. 41 (Apr. 2000). Page 65.

phenomenon of scale rests upon the foundation of association – a tool of reference in which *one* is compared to the *other* in a relative form of measure. For the architect, it allows the city to rest on the width of a drafting table. For the musician, it provides a place to begin and end. For Gulliver, it made a world  $1/10^{\text{th}}$  his size seem familiar. However, one needs to be reminded, the deployment of digital technologies, for both science and art comes with it a prolonged period of adjustment. As the technologies and technologist grapple with the seemingly infinite potential of digital design and research, the reach of the human hand remains the same.

“ευρηκα, ευρηκα.”<sup>17</sup>

(“*Eureka, eureka.*”)

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<sup>17</sup> Upon the discovery of measuring the volume of irregular objects, Archimedes “leapt out of the vessel in joy, and returned home naked, cried out with a loud voice that he had found that of which he was in search ...”

Vitruvius. De Architecture. Book IX. translated by Frank Granger; Cambridge (Mass.): Harvard University Press, 1931.

# smallshalhahhellheldheadhadhidbidbig

*In this chapter, the author looks to the notion of a crisis of scale resulting from the changing modes of representation. Drawing from a traditional human distance to the subsequent collision of the very small and very large, the author suggests the role of digital images and navigation and in particular digital modeling has obscured the way we interpret space. Examples are also drawn from the literature of Lewis Carroll and Jonathon Swift.*

Among the multitude of problems associated with the practice of architecture and its love affair with computer-generated images, the crisis of scale is particularly troubling. Too often, computer-based constructions and their subsequent modes of representation lack a fitting grasp of scale - a quality that is inherently present in hand drawn representation. "As in CAD, [the myth of] full-scale renders the entire notion of scale useless and fails to achieve precision which is necessarily defined by a point of view. Instead, a [hand] drawing is scaled for its destination toward a *fitting* understanding."<sup>18</sup> Emmons suggests a hand drawing is scaled to fit both the sheet of paper on which it sits, and a particular vantage point that it chooses to portray. Conversely, the myth of full-scale drawing in digital, or virtual space is in fact the absence of scale "This absence makes it more likely that the designer looks at the image as an object rather than projecting oneself into the

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<sup>18</sup> Emmons, Paul. "Size Matters: Virtual Scale and bodily imagination in Architectural Drawing." Architectural Research Quarterly. 9 (2005): Page 233.

image through imaginative inhabitation.”<sup>19</sup> Recent trends in digital architecture reveal a tendency toward objects that could rest in the microscopic pores of a miniaturized society, or float among the planets in some awaiting solar system.<sup>20</sup>

Concurrent to this architectural crisis, an ether of scaleless images can be found in the journals of the physical science communities (particularly in the medical sciences). Bound together by a lack of immediate scale, this vast and expanding collection of digital images exhibit the foundations of modern science, weakening the distinction between the very small and the very big.<sup>21</sup> Together, the compilation of digital images and digital models reflect a pattern concurrent to a looming question facing the human condition – the image of the human body and its separation from what can be considered traditional distance.

In a shift away from conventional anatomical representation, medical imaging is often represented at the microscopic scale, completely removing the human body from the image and leaving the audience little, or no association to the immediate scale. When looking at current physiological, or medical images, one might be facing molecules, spaceships, planets, or constellations. A striking resemblance is found in computer-generated architecture. Whereas man was once the measure of architecture, such is no longer the case, at least not on the computer

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<sup>19</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” Architectural Research Quarterly. 9 (2005): Page 232.

<sup>20</sup> Picon, Antoine, “Architecture, Science, Technology and the Virtual Realm.” Architecture and the Sciences: Exchanging Metaphors. Princeton Architectural Press: New York. Page 307.

<sup>21</sup> See Hell

screen.<sup>22</sup> Architectural critic and Harvard professor, Antoine Picon identifies the crisis of scale as "highly problematic" and suggest a recent shift in our visual and perceptual categories as the cause.<sup>23</sup> According to Picon, "scientific notions and representations shape our vision of the world. Among them, information plays a key role. Contrary to the traditional notion of structure, information ignores the distinction between the large, the medium and the small, between the macro and the micro."<sup>24</sup> Picon compares the shift in perceptive categories to the likeness of the loss of ordinary sense of distance upon the advent of the automobile. "In the case of the automobile, the emergence of new pertinent objects is accompanied by the loss of the ordinary sense of distance in favor of the notion of accessibility."<sup>25</sup>

"This blurring of the very large and the very small, and the crisis of scale that is its main consequence, tends also to reflect the fundamental evolution of our society."<sup>26</sup> Picon notes, economic and cultural specialists often equate globalization with the suppression of the intermediaries between the global and the local, between worldwide organizations and individuals.<sup>27</sup> "On the one hand, with satellites or computer generated global models, we see at a much broader

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<sup>22</sup> Picon, Antoine, "Architecture, Science, Technology and the Virtual Realm." Architecture and the Sciences: Exchanging Metaphors. Princeton Architectural Press: New York. Page 307.

<sup>23</sup> Picon, Antoine. "Architecture and the Virtual: Toward a New Materiality." Praxis. 6 (2004). Pages 114-121.

<sup>24</sup> Picon, Antoine, "Architecture, Science, Technology and the Virtual Realm." Architecture and the Sciences: Exchanging Metaphors. Princeton Architectural Press: New York. Page 308.

<sup>25</sup> Picon, Antoine. "Architecture and the Virtual: Toward a New Materiality." Praxis. 6 (2004). Page 117.

<sup>26</sup> Picon, Antoine, "Architecture, Science, Technology and the Virtual Realm." Architecture and the Sciences: Exchanging Metaphors. Princeton Architectural Press: New York. Page 308.

<sup>27</sup> Penn, Mark J. Microtrends: Small Forces Behind Tomorrow's Big Changes. New York, NY: Twelve. 2007.

scale than our immediate ancestors did. On the other hand, we are able to look at microstructures like they were right under our eyes.”<sup>28</sup> Distances have seemingly shortened, and velocities have amplified, as a globalized society looks to make a virtual earth much smaller than that of the real. Digital technology has the capacity to consider distance and scale at near impossible levels of accuracy, while easily ignoring the distinction between the very large and the very small.

By looking at the software that mediates the architect’s idea and the production of architectural drawings, models and construction, we find a curious neglect of standard scale. The notion of traditional (human) scale only becomes apparent when the architect looks to print a physical copy. The separation between what is commonly referred to as ‘paper space’ and ‘model space’ proves to be only a vehicle for altering text and dimensions to accommodate a desired scale while points, lines, planes and textures adjust to the ever-changing size and position of the observer. Emmons infers, “CAD only requires scale when printing in paper space. As Descartes transformed geometrical constructions into mathematical formulas, the CAD scale factor is a multiplier that converts the full-sized measurement into a scale for the plot.”<sup>29</sup> The scaleless model space rests precariously in an immeasurable void, with the illusion of representing an idea at the scale of 1:1. “Only in paper space does the CAD representation take on a

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<sup>28</sup> Picon, Antoine, “Architecture, Science, Technology and the Virtual Realm.” Architecture and the Sciences: Exchanging Metaphors. Princeton Architectural Press: New York. Page 308.

<sup>29</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” Architectural Research Quarterly. 9 (2005): Page 232.

synoptic scale in relation to the observer. It is at this moment that many computer-generated drawings reveal their scalar limitations and fail to allow the imagination to focus on particular sets of issues.”<sup>30</sup>

In a small text entitled *On Exactitude of Science* (1946), author and cultural critic Jorge Luis Borges shares a cautionary tale of a society who falls in love with the precision and exactitude of cartography. The story elaborates on the fictional tale by Lewis Carroll, entitled *Sylvie and Bruno Concluded* written some 20 years prior. Enthralled by the ability to increasingly capture a higher level of accuracy through an escalation in scale, Carroll conveys the story of a country that has become enveloped by their own fascination with mapping.

*Mein Herr looked so thoroughly bewildered that I thought it best to change the subject. "What a useful thing a pocket-map is!" I remarked.*

*"That's another thing we've learned from your Nation," said Mein Herr, "map-making. But we've carried it much further than you. What do you consider the largest map that would be really useful?"*

*"About six inches to the mile." "Only six inches!" exclaimed Mein Herr.*

*"We very soon got to six yards to the mile. Then we tried a hundred yards to the mile. And then came the grandest idea of all! We actually made a map of the country, on the scale of a mile to the mile!"*

*"Have you used it much?" I enquired.*

*"It has never been spread out, yet," said Mein Herr: "the farmers objected: they said it would cover the whole country, and shut out the sunlight! So we now use the country itself, as its own map, and I assure you it does nearly as well."<sup>31</sup>*

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<sup>30</sup> Emmons, Paul. "Size Matters: Virtual Scale and bodily imagination in Architectural Drawing." *Architectural Research Quarterly*, 9 (2005). Page 232.

<sup>31</sup> Carroll, Lewis. *Sylvie and Bruno Concluded*. New York: Forgotten Works. 2001. Page 169.

A similar neurosis with digital exactitude and exaggerated scope lends itself to a growing myth about the precision of digital media and a tendency to 'over do it'.<sup>32</sup> However, within the seemingly translucent walls of virtual space, a digital model appears to avoid the cumbersome nature of Carroll's conundrum.

The titillation from precision and control when representing an idea at full scale, both digitally and physically, is not to be overlooked. The nine concentric rings of Brunelleschi Dome in Florence were traced in the sands along the banks of the Arno River at a scale of 1:1<sup>33</sup>. "[Brunelleschi] had a large area of the Arno's bank leveled, an expanse roughly a mile and a half in every direction, and in the sand he traced a full-scale plan of the dome." Such a concept is echoed in the nostalgic grasps of the frontispiece of Viollet-le-Duc's *Dictionary of French Architecture from the 11<sup>th</sup> to 16<sup>th</sup> Century*, (1868) representing the honored tradition of the architect designing at the site of construction, scribing the geometries directly on the Earth's surface.<sup>34</sup> According to accounts from Richard Neutra, Adolf Loos started a revolt against the practice of indicating dimensions in figures or measured drawings. He felt that such a procedure dehumanizes design stating, "[I]f I want wood paneling to be of a certain height, I stand there, hold my hand at that certain height, and the carpenter makes his pencil mark.

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<sup>32</sup> Wood, Willam R. (Virtual) Myths. *Critical Sociology*, Vol. 30, issue 2. 2004. Koninklijke Brill NV, Leiden. Page 543.

<sup>33</sup> King, Ross. *Brunelleschi's Dome: The Story of the Cathedral of Florence*. New York: Penguin. 2001. Page 85.

<sup>34</sup> Viollet-Le-Duc, Eugene. *Dictionary of French Architecture from the 11th to 16th Century*. 1868. Page 1.

Then I step back and look at it from one point and from another, visualizing the finished result with all my powers. This is the only human way to decide on the height of wainscot, or the width of a window.”<sup>35</sup>

Conversely, the illusion of a full-scale digital space is generated, not by a change of physical position, but by a change in Cartesian co-ordinates and the ability to zoom in and out. Picon questions, “[w]hat is the true scale of forms that appear on the computer screen? The answer is not immediate.”<sup>36</sup> Picon goes on to suggest, “Computer imagery is in profound accord with a world organized by fractal rather than traditional geometry in which information and complexity are found at every level. In such a world, there is no fixed scale at which things must be deciphered.”<sup>37</sup>

The future of digital media and the possible applications to architecture are just beginning to reveal themselves and we must be constantly reminded of the relative infancy of these technologies. Wide spread computer based design does not appear to be a fleeting phenomena in the architect’s office. Although still immature, these tools are reshaping how architects and designers not only (re)present their ideas, but they have become vehicles of material imagination. However, the question of scale remains both a prospect and a crisis.

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<sup>35</sup> Neutra, Richard. *Survival Through Design*. New York: Oxford Press. 1954. Page 300.

<sup>36</sup> Picon, Antoine. "Architecture and the new Virtual Reality: Towards a New Materiality." *Praxis*. Page 117.

<sup>37</sup> Picon, Antoine. "Architecture and the new Virtual Reality: Towards a New Materiality." *Praxis*. Page 117.

*"The terrible thing about hell is that when you're there you can't even tell. As you move through this life you love so, you could be there and not even know."<sup>38</sup>*

Tom Marshall

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<sup>38</sup> Marshall, Tom. *Shafty. Story of the Ghost*. 1998. Track 6.

# smallshalhallhellheldheadhadhidbidbig

*In this chapter, the author looks to the cause of the crisis in scale – the digital image. With specific focus in medical imaging, its indifference to size, and the ability to navigate from very small to the very large is reshaping our understanding of the body as it relates to the physical makeup and representation. The author looks specifically at the digital nature of medical sciences and the implications on digital architecture.*

According to a report in the New York Times, most New Yorkers face approximately five thousand advertisements a day.<sup>39</sup> This saturation of signifiers represents a widespread and tenacious attack of heavily connoted systems of ideal objects in ideal settings, telling us what ‘it’ is that we consume. The study of visual rhetoric dictates that an image contains a highly controlled system of messages where attention is to be paid to the composition of an image as a signifying complex of cultural meaning.<sup>40</sup> In what W.J.T. Mitchell refers to as picture theory, “the realization that spectatorship (the look, the gaze, the glance, the practices of observation, surveillance and visual pleasure) may be as deep a problem as various forms of reading and that ‘visual experience’, or ‘visual

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<sup>39</sup> Story, Louise. “Anywhere the Eye Can See, It’s Likely to See an Add.” The New York Times. New York. Jan 15, 2007.

<sup>40</sup> Barthes, Roland. “Rhetoric of the Image.” Image, Music, Text. Ed. and trans. Stephen Heath. New York: Hill and Wang, 1977. Pages 32-51.

literacy' might not be fully explicable in the model of *textuality*.”<sup>41</sup> The *impact* of visual media in forming our understanding of the world and its effect on the crisis of scale is not to be underestimated.

According to Antoine Picon, the crisis of scale in architecture is fundamentally tied to a shifting perspective in how we see/model our world. Picon states, “We live in a world in which scale has become highly problematic because of “the shift of our visual and perceptive categories.”<sup>42</sup> He suggests “science and the often computer-generated images that illustrate it play a key role in this crisis of scale.” For example, the digital models and abstracted images found in the journals of medical sciences are redefining the way we value the human body, while images of uncanny likeness are scattered in the journals of particle-physics and nano-science. The seemingly scaleless representations of scientific and medical information reside in a virtual realm both unfamiliar and eerily uncanny.

According to Picon, current scientific notions and their representations that shape our vision of the world play a key role in the crisis of scale. “In our global world we see things either from very close or from an extremely distant point of view. It is certainly no coincidence that the computer has been instrumental in the process of globalization.”<sup>43</sup>

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<sup>41</sup> Mitchell, W.J. T. Picture Theory. Chicago: University of Chicago. 1994. Page 16.

<sup>42</sup> Picon, Antoine. Architecture, Science, Technology and the Virtual Realm. Architecture and the Sciences: Exchanging Metaphors. New York: Princeton Architectural Press. 2003. Page 308.

<sup>43</sup> Picon, Antoine. Architecture, Science, Technology and the Virtual Realm. Architecture and the Sciences: Exchanging Metaphors. New York: Princeton Architectural Press. 2003. Page 308.

The computer-generated diagrams, images and models in the realm of medical sciences, reveal a trend to visualize that, which is not in themselves visual from a traditional distance.<sup>44</sup> This myopic rendering of the visual experience while simultaneously avoiding the other senses puts an unworthy premium on the visual experience. Heidegger reasons, “a world picture ... does not mean a picture of the world but the world conceived and grasped as a picture.”<sup>45</sup>

According to Jose Van Dijck, the myth of peering inside the hidden world of the human body comes with two popular misunderstandings – that seeing is healing, and that the act of seeing is an innocent activity with no consequences.<sup>46</sup> In connection to the latter, the mechanical-clinical gaze directed and mediated by imaging technologies detaches a body from a person, a process that Foucault refers to as externalizing the internal. “It is precisely its dissemination outside of medicine that has popularized the mechanical-clinical gaze.”<sup>47</sup>

Thankfully, our ability to resolve distances beyond the scale of the human eye is nothing short of wonderful. Images return from the tips of microscopes, and

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<sup>44</sup> A process that contrasts sharply to the opaque body over a century ago, the production of a complete virtual body involves a range of complicated, state-of-the-art techniques. First, the body needs to be digitized by means of magnetic resonance imaging and computer tomography. Then the cadaver is immersed in a special fluid and deep frozen to minus seventy degrees Celsius. Next, lab workers use a precision planning device, a cryogenic macrotome, to shave off millimeter thin slices of the body. After each slice, the cross-sectioned profile is photographed digitally and scanned into a compute. The resulting data set constitutes the basis for an unlimited series of three-dimensional simulations. Van Dijck, José. *The transparent body: A Cultural Analysis of Medical Imaging*. Seattle: University of Washington Press, 2005, Page 119-120.

<sup>45</sup> Heidegger, Martin., "The Age of the World Picture." *The Question Concerning Technology and Other Essays*. trans. William Lovitt. New York. Garland. 1977. Page 130.

<sup>46</sup> Van Dijck, José. *The transparent body: A Cultural Analysis of Medical Imaging*. Seattle: University of Washington Press, 2005, Pages 6-8

<sup>47</sup> Van Dijck, José. *The transparent body: A Cultural Analysis of Medical Imaging*. Seattle: University of Washington Press, 2005. Pages 11-12 Also ... Michael Foucault, *The Birth of the Clinic: An Archeology of Medical Perception*. London: Travistock, 1973, xiv.

telescopes revealing two worlds of comparable textures and landscapes.<sup>48</sup>

Among the many domains that digital technology has affected, the practice of medical sciences is paramount. The assembly of medical imaging has reconfigured the way we understand the human body. From the dissections recorded in *De Humani Corporis fabrica* of Vesalius to the current state of nanotechnology, medical interests have shifted from the balancing act of Galenian diagnostics, to the molecular magnification of modern medicine.<sup>49</sup> Likewise, the digital diagrams, drawings and models of architects are also finding similar obscurity in the scale(lessness) of the digital environment.

The microscopic morphology of human anatomy is built on the shoulders of silicon chips and graphene strips, hidden beyond the meandering path of cable trays and wireless connections. Digital modes of scientific, medical and architectural representation sit precariously outside the traditional distance of the human scale. A digital body is beyond the reach of the human hand. The impact of externalizing the internal and the Gulliver-like travels to interminable scales not only redefine the way we see the human body, but also distorts the way in which we navigate the Body. Virtual navigation behooves a world in which one can travel to the far reaches of the Universe, or zoom deep into an underworld of

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<sup>48</sup> Picon describes the contemporary condition in which landscapes have collided with textures. The similarities of landscape and texture – existing at drastically different scales within the traditional human distance – reveal an emerging material reality that distorts, or rather reshapes our current perception. Here, a landscape covering counties, communities and countless ecosystems can be (mis)understood as a object of smaller origins, closer the molecular texture of a crystalline protein.

Picon, Antoine. Architecture and the new Virtual Reality: Towards a New Materiality. *Praxis*. Page 117.

<sup>49</sup> Van Dijck, José. *The transparent body: A Cultural Analysis of Medical Imaging*. Seattle: University of Washington Press, 2005.

fractal geometry, all with a simple digital gesture.<sup>50</sup> The way in which we travel within the digital environment begins to shift our perception of the built environment. “We perceive our ordinary three-dimensional world as if ordinary reality were the result of a provisional compromise, or rather a middle range lens accommodation, between the very small and the extremely large, between the atoms, or rather pixels, and galaxies.”<sup>51</sup>

In his discussions concerning the simulacrum — the blurring of the real and its representation — Jean Baudrillard warns of a contemporary culture asphyxiated in a hyper real postmodern apocalypse.<sup>52</sup> This cultural diagnosis, emerging from a glut of digital images and a redefined conception of reality, describes a world where the copy supersedes the original; the map precedes the territory. “Meaning is out of reach and out of sight, but not because it has receded into the distance. It is because the code has been miniaturized. Objects are images, images are signs, signs are information, and information fits on a chip.”<sup>53</sup> The inadequacy of the digital image undermines the distinction between the copy and the model, while the blind acceptance of digital constructions appears to be a widespread epidemic that threatens the significance of architectural representation.

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<sup>50</sup> Digital in the traditional sense, referring to one of the more distal parts of the limb.

<sup>51</sup> Picon, Antoine. “Architecture and the Virtual: Toward a New Materiality.” *Praxis*, 6, 2004. Page 119.

<sup>52</sup> Baudrillard, Jean. *Simulations*, trans. Paul Fross, Paul Patton, Philip Beitchman. New York: Semiotext(e), 1983. Page 4.

<sup>53</sup> Massumi, Brian. “Realer than Real: The Simulacrum according to Deleuze and Guattari.” *Copyright*. No. 1, 1987. Page 91.

According to Kenneth Frampton<sup>54</sup>, among other detractors, software too often appears to neglect the material dimension of architecture such as its intimate relation with properties like weight, thrust and resistance. The concrete realities of construction and building technologies are often overlooked in the scaleless domain of digital distractions and architectural rendering. "There is something deeply unsettling in this apparent freedom that seems to question our most fundamental assumptions regarding the nature of architectural discipline."<sup>55</sup> However, Picon continues, suggesting we must be cautionary in our discrimination as computer based processes remains in their infancy and not to draw conclusions about its temporary features. However, the toxic tract of hyperreal renderings (re)presents architecture without virtue.<sup>56</sup>

A world picture shaped by the very small and the very big must be bound by the in-between. The connection between two seemingly distant worlds is found in the association of the known — the human body. The adolescence of digital design, while continuing to shape our ever-changing world picture, must remain in touch with the concrete foundations of architecture as the product of design ultimately leads us to the construction of built realities. Outside of the scaleless state of the digital sphere lies a world bound by the materials and governing forces of nature. Unbounded by the freedom of the virtual, the architect must keep one foot bound

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<sup>54</sup> Frampton, Kenneth. *Studies in Tectonic Culture*. Cambridge, Massachusetts: The MIT Press. 1995.

<sup>55</sup> Picon, Antoine. "Architecture and the Virtual: Towards a New Materiality." *Praxis*. vol. 6. Page 114.

<sup>56</sup> Frascari, Marco. *The VIRTUE of Architecture: A 2009 Stenna*. Lexington. 2009.

by a world governed by gravity and the other foot aloft in the world of Dionysian dreams and nomadic voyages. The architect is the go-between, within reach of two distant, yet neighboring worlds.

*"We stand in the middle of infinity to outer and inner space  
and there is no limit to either."<sup>57</sup>*

Mr. Grant, *Fantastic Voyage*

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<sup>57</sup> *Fantastic Voyage*, Richard Fleischer, dir. Columbia Pictures, 1966.  
*Mr. Grant, one of three miniaturized bionauts, marvels at the wonders of the corporal space during a special mission inside the threatened patient.*

# smallshalhalhellheldheadhadhidbidbig

*In this chapter, the author looks towards the notion of scale as it relates to the human body as its frame of reference. Upon reflection of the aforementioned crisis in scale, the built environment exists entirely in full scale, where as the digital environment has no specific scale. The inertia of digital media compounds the problem of scale by existing outside of the governing forces that define our built environment. The author looks to the theories of Galileo, Haldane, and Reiser and Umemoto as they relate to the transpositional equations of size and material, suggesting the need to expose the notion of scale as it relates to the forces and materials of the built environment.*

Amid the expanse of the cosmos as we know it, the human body resides at a rather auspicious place. It is handily nested in-between the immeasurable riches of the sub-atomic and the astronomical. Our bodies act as a go-between, situated within an (artificial) arms-length of the neighboring worlds. Such is the hypothesis reflected in the film *Powers of Ten (1977)*, by Charles and Ray Eames. The film illustrates this favorable position by travelling (by powers of 10) from the traditional distance of the human body outward to the scale of the solar system, and returning inward to the cellular level of the human skin. The film reveals a harmonious rhythm of density and systemic organization, drawing upon uncanny similarities between the macro and the micro, while using scale to reveal our

relative proximity to these neighboring worlds. It also casts light on a trend in which the traditional distance of the human body is affected by the unrelenting sprawl of technology. As we reach deeper and deeper into the abyss of scale(lessness), we remove ourselves from the haptic forces that govern our spatial existence. As Emmons states, “scaled sight is not an abstraction; it is achieved through judging the size of things in relation to ourselves”<sup>58</sup> With digital exploration “we do not operate at any particular scale because the image is severed from our frame of reference.”<sup>59</sup>

Unlike the constructions within the digital environment, a building must serve to accommodate the movements and desires of the human body. For example, the rise and run of a staircase is to be measured to the size, position and movement of the human step. Likewise, a door handle conforms to the size, position and movement of the human hand. In this sense, the traditional distance of the human body reflects our full-scale inhabitation of the built environment. As such, the rules of architecture are embedded in the proportions of the human body. However, the association between building and body resides well beyond the *dimension of stairs and door handles*. The theoretical and practical engagement of anthropomorphism, in which the *imitation* of the body is used as a model for the organization of spaces, or the transformation of materials looks to scribe

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<sup>58</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” Architectural Research Quarterly. 9 (2005): Page 232.

<sup>59</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” Architectural Research Quarterly. 9 (2005): Page 232.

human characteristics onto otherwise inanimate objects, yielding a traditional distance outside of the reach of the human hand.<sup>60</sup>

The scales of architecture, the role of material, the human body and the collision of the governing perturbations provide the architect with a cadence of critical values. Assuming some elasticity, the rules, or measures of scale, present the opportunity for a playful association of size and its relation to the human body while maintaining compliance to the governing forces<sup>61</sup>. “Since nature only exists in full scale, imagination is required to project a change of scale and it occurs through relation to a stable entity, our own body.”<sup>62</sup> Architectural gestures drawing attention to the rules of proportion, such as an unusually small stair, or a playfully large door, must remain within the margins of human measure in order to be a part of our built environment. Once we journey beyond these limits, we

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<sup>60</sup> In tracing the origins of anthropomorphism, we begin at Vitruvius who founded his theory on the architecture of antiquity and its proportional relationships to the human body – *Eurythmy*. A theory used to describe a building that encompasses the harmonic balance of proportional relationships based on the human body. Leon Battista Alberti, in his treatise *Ten Books on Architecture* (1452) links the process of building construction to the body. In what he coins as ‘concinntas’, Alberti understands the body as a composition of parts and their relation to each other and to the whole in contributing to the beauty of the building / body. During the same historical period, Antonio Averlino linked the body and building using human characteristics – animating otherwise inanimate objects. A building could become sick, and an architect could become impregnated with an architectural idea. Francesco di Giorgio extends the relationship to the design of an entire city. “He observes that just as the eyes, ears, nose, mouth, large intestine, and other interior and exterior parts of the body are organized according to their needs and wants, so too should the city be arranged in a similar fashion.”<sup>60</sup> These developments must be seen in parallel with the advancements in medicine and human anatomy. Andreas Versalius developed what is considered the first anatomically correct human atlas. Revealing the anatomy of the human body affected not only the cosmological foundation in the 16<sup>th</sup> century .

Frascari, Marco. "Drafting Knife and Pen" *Implementing Architecture*. Atlanta: Nexus Press, 1988.

<sup>61</sup> Besides that of gravity, life contends with a diversity of forces—for instance that inertial force from the unwillingness of mass to accelerate; the force of surface tension from the cohesion of liquids in gases or in other, immiscible, liquids; and viscous force from the resistance of both liquids and gases to shearing motion.

Vogel, Stephen. Living in a Physical World. VI. Gravity and Life in the Air. *Biosci*. 31(1), March 2006, Pages 101–113.

<sup>62</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” *Architectural Research Quarterly*. 9 (2005): Page 232.

fall into a realm outside the *traditional distance* of the human body. A microscopic door, or planetary chair both exists well beyond the physical and spatial limitations of material and physical science. Of course, such limitations on size are not applied to the prospect of ones architectural imagination. As Emmons suggests, “the tool of scale is not simply a technical issue, but a question of the nature of architectural conception.”<sup>63</sup> Because the act of drawing is not the recording of preconceived ideas, but a “source of information”, the making of ideas that fall outside the rules of our built environment resist the perturbations that make them possible or impossible. The digital environment, much like the environment of our imagination, provides a unique space free from the rules that (in)form the full scale built environment. The fundamental difference between the built environment and digital, and between the possible and the impossible is the stresses and forces found in the text books of physical science, and the material limitations based on these impeding perturbations.

In-between the possible and the impossible rests the potential of the obscure, a theory explored by Reiser + Umemoto in a series of diagrammatic deployments. “These territorial infringements on scale are among the most difficult to operate well within, but they can be the most rewarding when successfully negotiated.”<sup>64</sup> However, Reiser + Umemoto note the practice of diagrammatic explorations of

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<sup>63</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” *Architectural Research Quarterly*. 9 (2005): Page 232.

<sup>64</sup> Reiser + Umemoto. *Atlas of Novel Tectonics*. Princeton Architectural Press, New York: 2006. Pages 118-121.

the obscure too often remove the qualities of matter, reducing it to its “most basic reading”. “This type of error becomes even more egregious as a result of software inertia, where the governing algorithm becomes so insistent that it forces the same expression at all levels of the project, independent of the architect’s will for or against it.”<sup>65</sup> For Reiser and Umemoto, the interest in scale must engage not with a simple exchange of representation, but with the “transposition of the real relationships between matter and force at one scale into another.”<sup>66</sup> The forces that define the nature of material are not immediate in the digital transposition of scale. The diagrammatic efforts that place the very large and the very small together too often reside without the influence of their defining force – gravity. For Reiser + Umemoto, the potential of the obscure is relevant if the real relationships between matter and force can be transposed from the scales of the diagram to the scale of the designers body. In essence, the scalar transformation of an object cannot take place without the consideration of the forces and material ingredients that are defining its form.

On the subject of scalability, Galileo claims “the impossibility of increasing the size of structures to vast dimensions either in art or nature.”<sup>67</sup> Galileo’s diagnostics of physical and material limitations in his controversial work,

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<sup>65</sup> Reiser, Jesse and Nanako Umemoto. Atlas of Novel Tectonics. New York: Princeton Architectural Press. 2006. Page 123

<sup>66</sup> Reiser, Jesse and Nanako Umemoto. Atlas of Novel Tectonics. New York: Princeton Architectural Press. 2006. Page 123.

<sup>67</sup> Galilei, Galileo, "Dialogues Concerning Two New Sciences," trans. by Henry Crew and Alphonso De Salvio, Evanston, Northwestern University Press, 1946, Pages 1 - 6, 125 - 128.

*Dialogues* (1632) opened a path towards scientific design and an architecture betrothed with the practice of engineering. The empirical nature of material and the calculations for predicting physical forces would gradually redefine the practices of design.<sup>68</sup> Those indebted to an intuitive understanding of proportional geometry and the divine truths of human body were challenged by a new science of building. Central to Galileo's text is the square cubed rule.<sup>69</sup> According to Galileo, the scalability of a material is limited.<sup>70</sup> As the size of an object increases, its mass exceeds its ability to support itself. A hypothesis further illustrated by the improbability of a giant human, claiming its oversized bones would fail under the weight of itself.

Another account of the limitations of scale is found in the text *On Being the Right Size* (1928), by J. B. S. Haldane in which he also reflects on improbability of a giant human roaming the Earth's surface. Recalling the sixty foot high Giant Pope and Giant Pagan recoiled in their cave at the end of the valley in the "Pilgrim's Progress" by John Bunyan, Haldane echoes the nature of physics, founded in Galileo's square cubed law. "Unfortunately the cross section of their bones were

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<sup>68</sup> Salvadori, Mario, Saralinda Hooker and Christopher Ragus. *Why Buildings Stand Up: The Strength of Architecture*. New York: Norton. 1980. Page 21. And, Salvadori, Mario, Saralinda and Matthys Levy. *Why Buildings Fall Down: How Structures Fail*. New York: Norton. 1987. Pages 270-271.

<sup>69</sup> Galilei, Galileo, "Dialogues Concerning Two New Sciences," trans. by Henry Crew and Alphonso De Salvio, Evanston, Northwestern University Press, 1946, Pages 1 - 6, 125 - 128.

<sup>70</sup> Santiago suggest that "although Galileo was right about the form of the equation: for a given material and a certain cross section, the bending strength is proportional to the product of its area by its depth", *the error in Galileo's hypothesis is with reference to the design and structural stability of masonry arches, inferring that Galileo's law applies only to the strength problems and not to the issue of stability, as the masonry arch is governed by geometry*, Huerta, Santiago. "Galileo was Wrong: The Geometrical Design of Masonry Arches." *Nexus Network Journal*. 8 (2006) Pages 25-52.

only a hundred times those of Christian, so that every square inch of the giant's bone had to support ten times the weight borne by a square inch of the human bone. As the human thigh-bone breaks under about ten times the human weight, Pope and Pagan would have broken their thighs every time they took a step.”<sup>71</sup>

The limitation of material and its scalability reflects an inverse relationship between scale and articulation. The articulation of a body is a function of its size and relative resistance to gravity. It is for this reason we do not see the complexity of an ant on the frame of an elephant. Likewise, “an insect is not afraid of gravity; it can fall without danger and can cling to the ceiling with remarkable little trouble.”<sup>72</sup>

Quatremere de Quincy's essay *On Imitation* (1823) states “Imitating does not necessarily mean making the likeness of a thing, because one cannot imitated the work and imitate the worker. One therefore imitates nature by doing not what she does, but as she does:”<sup>73</sup> A commonality in the diverse voices of J. B. S. Haldane, Galileo and Reiser + Umemoto is the issue of material scalability and form. With some exceptions, the forces that prevent such things as giant humans ten times our size from roaming the earth found in the digital environment.<sup>74</sup> The simplicity involved in transforming the size of an object in digital space lends itself

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<sup>71</sup> Haldane, J.B.S. *On Being the Right Size and Other Essays*. Oxford: Oxford University Press. 1985.

<sup>72</sup> Haldane, J.B.S. *On Being the Right Size and Other Essays*. Oxford: Oxford University Press. 1985.

<sup>73</sup> Quatremere De Quincy, “An Essay on the Nature, the End, and the Means of Imitation in the Fine Arts, in: *AD*, v. 28, no. 9-10 (1988) Pages 8-9.

<sup>74</sup> Although some software applications can inherit forces such as gravity and wind etc. through the use of parametric modeling, I am speaking of directly to the most common digital applications and their uses.

to both reward, and failure. However, it appears the architect should look to engage in an act of translation, in which the digital environment and its apparent lack of scale can yield such things as the obscure while navigating the rules that govern the built environment.

*"[If] the sky, the stars, the seas, the mountains and living creatures, together with all other objects, were, the gods willing, reduced to half their size, everything that we see would in no respect appear to be diminished from what it is now [...] all these are such as to be known only by comparison. Comparison is made with things most immediately known."<sup>75</sup>*

*On Painting, Alberti*

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<sup>75</sup> Alberti, Leon Battista. Cecil Grayson (trans) On Painting. New York: Penguin Books. 1991. Page 53.

# smallshallhellheld**head**hadhidbidbig

*In this chapter, the author looks at the historical use of the architectural figure as an allegorical muse' in the process of design, while noting its absence in most contemporary digital architectural practices. The use of the digital human figures is often disregarded up until the conclusion of the design process rather than part of its augmentation. The author also looks forward to the benefits of hybrid design as a facilitator towards the inclusion of architectural figures in the process of digital design.*

Assuming Galileo's and Haldane's hypothesis' on the limitations of size are correct, the probability of Earthly beings at the scale of those from either Lilliput or Brobdingnag are unlikely. Rather, we can rely on the wonderful ways of our imagination such as hypothetical narratives and allegories to propel us towards far-reaching levels of creativity and scale. Physically, the human body is constrained by a strict proportional relationship founded on material limitations, articulation and gravity. However, the practice of architectural imagination can navigate beyond these limitations in a speculative journey toward hypothetical dimensions. The naissance of an idea can be nurtured in the imaginary domain, free of the physical limitations on which the theories of Galileo and Haldane rest. Similar to the weightlessness of digital modeling, it is within the freedom of ones imagination that the corporal body can shed its numerical restrictions and inhabit a world of multiple scales.

Accordingly, Jonathon Swift's accounts of Gulliver's travels from the tiny to the tall reflect upon the allegorical richness embodied in the overall tale. The story reveals the author's unease with the equivocal values of society through the impossible worlds of the very big and the very small. The very small Lilliputians, and the very big Brobdingnagians provide a soulful comparison of the human condition through the use of allegorical structure and difference.<sup>76</sup> By using these techniques, the author extracts compassion, and empathy from the reader, rendering the journey both a tale of epic travel, and a soulful gaze into the ontology of a modern society. The use of character placement and development within Swift's morphological myth is analogous to a technique discussed in Marco Frascari's work entitled "A Tradition of Architectural Figures: A Search for *Vita Beata*." (2002). The thesis recalls a traditional Venetian practice – something that is disturbingly absent in the contemporary practice of digital architectural.

On the surface, the use of human figures in architectural drawing provides a sense of scale while lending itself to the illusion of physical embodiment. However, the traditions of architectural figures reach much deeper than the superficial layering of the human body. Regrettably, the fashionable practices of many contemporary architects produce architectural bodies without qualities.<sup>77</sup>

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<sup>76</sup> Fitzgerald, Robert P. "The Structure of Gulliver's Travels." *Studies in Philology*. Vol. 71, No. 2 (April 1974). Page 249.

<sup>77</sup> Frascari, Marco. "A Tradition of Architectural Figures: A Search for *Vita Beata*" *Body and Building: Essays on the Changing Relation of Body and Architecture*. Cambridge. MIT Press 2002. Page 259.

Layered within a digital assemblage, clusters of human profiles are often nothing more than an architectural afterthought; part of a post-processing procedure that attempts to make the rendering look less like an apocalyptic apparition and more appealing to the paying customer or magazine editor. Lost in translation, “the employment of these malicious practices takes the place of the traditional use of the corporeal figures as inaugural mechanisms of sound analogical design”.<sup>78</sup> Therefore, to engage in the virtues of architectural happiness, the architect must look to show empathetic bodily projections upon imagining a future edifice. “Not a human measuring stick, but a way to imagine measure through the human body like miniature humans as traditional representations of the soul.”<sup>79</sup> As Frascari suggests, [c]onstruing architecture through body-image ensures that the imaginal forces of human bodies is impressed, received and vividly transmitted into the built environment.”<sup>80</sup>

Certainly, one of many growing pains in the development of digital design derives from the misguided use of the human figure. Aside from a generic avatar adopted by the rudimentary *Google Sketchup*®, architectural bodies are commonly added to an image at the end of the design process, rather than acting as an integral part. The post-processing procedure of ‘cutting and pasting’ provides the image

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<sup>78</sup> Frascari, Marco. “A Tradition of Architectural Figures: A Search for Vita Beata” *Body and Building: Essays on the Changing Relation of Body and Architecture*. Cambridge. MIT Press 2002. Page 259.

<sup>79</sup> Osmond, Rosalie. *Imagining the Soul: A History*. Stroud: Sutton Publishing, 2003. Page 112.

Also, Dalibor Vesely notes of the Aristotelian tradition that the identification of the soul with the axis of the body or with the body’s center of gravity. Vesely, Dalibor. “The Architectonics of Embodiment.” *Body and Building: Essays on the Changing Relation of Body and Architecture*. Cambridge. MIT Press 2002. Page 35.

<sup>80</sup> Frascari, Marco. “A Tradition of Architectural Figures: A Search for Vita Beata” *Body and Building: Essays on the Changing Relation of Body and Architecture*. Cambridge. MIT Press 2002. Page 259.

with scale and inhabitation but neglects the potential of Inaugural analogical design and the soulful use of body-image.<sup>81</sup> Unlike the insemination of analogical design, in which the insertion of human figures informs the drawing of its earthly fate, the digital model is barren of any life. In fact, by its very nature, the starting point of digital projects is the Cartesian collapse of a gridded flatland, void of any gesture towards the human elements in architecture.

Beginning at the origin of a concocted Cartesian coordinate system (0,0,0), the architect is seemingly enclosed in a grid of dumbfounded certainly, their destiny bound by the snaps of a virtual cage. The inability to colour outside of these digital lines epitomizes the rigid nature of architectural software and the discouragement of analogical techniques.<sup>82</sup> This apparent lack of freedom and immediacy is easy to juxtapose to the propinquity that a pen and paper provide. However, the opportunity to engage in hybrid representation presents itself through the coming together of the digital and the analogue. By digitizing and subsequently importing sketches, images, and models, the origin of digital design does not have to begin within the captivity of the Cartesian cage, but can flourish in concert with the immediacy and freedom of analogical techniques. The concept of hybrid architectural drawing will be presented in the following chapter,

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<sup>81</sup> "By body-image. Frascari (2002) refers to the schema of the "imaginal body" as theorized by Paul Schindler ... [it] consists of a meaningful body image that is formed in the mind. This image is not merely the product of sensation, representation, or perception; it results from the coalescing of the three, generating an understanding of ones body that is fairly different from one's literal anatomical condition.

<sup>82</sup> Ironically, the origin of many digital tools in Computer Assisted Drafting and Modeling programs derive from analogical techniques. Examples include; French curves, hatching techniques, etc.

entitled *HAD*. Secondly, removing, or ghosting the Cartesian coordinate system, and its virtual walls transforms the computer screen from a striated space of grids and snaps to a smooth space not unlike the oceans navigated by Captain Lemuel Gulliver. The concept of digital navigation will be further explored in the chapter entitled *HID*.

The human figure as an inaugural part of a digital excursion can not only provide the architect with a soulful analogical character, but it can also provide scale to the digital project. Without the presence of a human figure, the chosen scale of a digital project is irrelevant, as it can be rescaled to meet any prescribed dimension. As such, a house can be modeled to the size of a coin, or a country. As Emmons suggests, “CAD only requires scale when printing in paper space. [...] This odd relation to scale is revealed by the necessity to put text into scale rather than the drawing so that the lettering is printed in an appropriate size.”<sup>83</sup> Along with the appropriate steps to plotting a digital model, scale can be given to model space by the inclusion of a proportional relationship to ones body. The scale of the digital project is relative to the presence of a human body. Akin to the discoveries of Gulliver, “there is no such thing as true extent, only relative size proportional to ourselves.”<sup>84</sup> Therefore, by using bodies of proportional size, the digital project is given immediate scale in association with user and provides a

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<sup>83</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” Architectural Research Quarterly. 9 (2005). Page 232.

<sup>84</sup> Emmons, Paul. “Size Matters: Virtual Scale and bodily imagination in Architectural Drawing.” Architectural Research Quarterly. 9 (2005). Page 232.

fitting guide beyond the tensions of the Cartesian coordinates and bounding grids.

On the other hand, the inclusion of the human body should not only look to inform the working scale of the project, but should engage in telling a 'fitting' tale. The body, like that of Gulliver, can traverse the imaginary lines of a ladder and reach the hovering heights of monsters or meander in the microscopic pores of the miniature. It is here that one can harness the power of the digital by manipulating the scale of the figure to engage the project in multiple dimensions. For example, the regulating lines used in the proportional balance of the human body can reflect the rhythms on a façade or in the detail of a threshold. The very big can inform the very small and conversely, the very small can inform the very big.

*“We of the modern age are provided with two types of bodies. The real body which is linked with the real world by means of fluids running inside, and the virtual body linked with the world by the flow of electrons.”<sup>85</sup>*

*Toyo Ito*

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<sup>85</sup> Ito, Toyo. “Image of Architecture in Electronic Age. University of Tokyo Web Page. ([http://www.um.u-tokyo.ac.jp/publish\\_db/1997VA/english/virtual/01.html](http://www.um.u-tokyo.ac.jp/publish_db/1997VA/english/virtual/01.html)), Accessed Dec., 2009).

# smallshalhalhellheldheadhadhidbidbig

*In this chapter the author looks to the troubling condition of digital representation and suggests a path in which the multiple scales of digital design engage in the traditional modes of analogical representation. Hybrid Architectural Drawing (HAD) presents a technique that engages in the genetics of a drawing while simultaneously harnessing the prowess of digital techniques through multiple factures of both digital and virtual material while engaging in the opportunity provided by the shifting scales of digital media.*

The meandering path of literature, much like the path of architecture, reflects the many tinctures of bitterness and brilliance facing the human condition. For example, Jonathon Swift's long tales of Lemuel Gulliver echoes a growing concern for the role of government and the societal stumbles of a modernizing Britain. Likewise, the cautionary tale by Edgar Allen Poe entitled "The Man Who Was Used Up", imparts of a man rebuilding himself from the mechanical pieces of the industrial wasteland.<sup>86</sup> Poe's tale unfolds to convey a common theme of the industrial age - the pairing of man and machine; flesh and steel. Conversely, today's information and digital technology appears to be replacing the mechanical gears and steel limbs of the cyborg with a virtual body encompassed

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<sup>86</sup> Poe, Edgar Allen. "The Man That Was Used Up: A Tale of the Late Bugaboo and Kickapoo Campaign." The Collected Works of Edgar Allen Poe: Tales and Sketches, 1831 – 1824. Cambridge Mass.: Harvard University Press. 1978. Page 378.

in a blurred alterity. A modern day hybrid body suggests the chiasmic marriage of the human body with the scale(lessness) of the digital—a theme explored in the film *The Matrix* (1999).<sup>87</sup>

The current state of architectural representation is locked in a prison of false efficiency and photorealistic digital renderings. However, the shifting scales of digital design offer a unique opportunity to engage in architectural design in a hybrid manner. The following, examines two facets of hybridity that look to (re)present architectural representation. Firstly, the ability to digitize sketches, drawings, images and models and transforms them to a fitting scale, and secondly, the inclusion of genetic information often left behind in the sprawling digital ocean.

In his *Strenna* directed at the resurrection of righteous architectural representation, Marco Frascari looks for a new approach to digital power by using the virtue embedded in hybrid architectural drawings. Suggesting it “might help architects to get out of the shifting sands of graphic digitization,”<sup>88</sup> Frascari points to the material sapience and imbedded qualities lost in the production of computer aided drafting techniques and other modeling software. He suggests, architectural drawings should not be understood as visualizations, but as hybrid

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<sup>87</sup> The film looks toward a future in which a society exists, unbeknown to them, in a virtual dreamscape composed of a digital matrix of complex data sets while their physical bodies are prisoners in an energy farm hidden in the underbelly of an apocalyptic earthscape. The films suggests to the overlapping universes as a battleground for good and evil – raw human emotion and technological indifferences.

<sup>88</sup> Frascari, Marco. The VIRTUE of Architecture. A 2009 Strenna. 2009. Page 9.

factures. A facture as “that which is marked, inked, penciled, brushed, chalked and printed comes into being.”<sup>89</sup> Frascari infers, “Architectural drawing is wholly based on the sapience of materialization, in which the materiality of the lines becomes the carrier of fluid and invisible, lines becomes thoughts.”<sup>90</sup> The potential of hybrid representation rests in the engagement of both the scaleless vectors of digital drawings and the material sapience of traditional architectural drawing techniques. However, Picon argues that the lack of material sapience that Frascari longs for is latent in the maturity of digital architecture.

In his essay *Architecture and the Virtual: Towards a New Materiality* (2004) Picon addresses the concern of the immaterial and digital design and suggests “materiality, like almost every feature of our environment is, to a large extent a cultural construct.”<sup>91</sup> Accepting both the novelty of digital technology in architecture and recognizing that perception is affected by media, the tendency to remove traditional methods from architectural representation seems heavy handed or premature. However, Picon does point to the indisputable strengths of digital design, comparing the difference between hand and computer-mediated design to the contrasts between a walk and a car ride.<sup>92</sup>

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<sup>89</sup> Frascari, Marco. *The VIRTUE of Architecture*: A 2009 Strenna. 2009. Page 55.

<sup>90</sup> Frascari, Marco. *The VIRTUE of Architecture*: A 2009 Strenna. 2009. Page 55.

<sup>91</sup> Picon, Antoine.. “Architecture and the Virtual: Towards a New Materiality.” *Praxis* Page 115.

<sup>92</sup> Picon, Antoine and Alessandra Ponte., eds. *Architecture and the Sciences: Exchanging Metaphors*. New York: Princeton Architectural Press. 2003. Page 116.

The question as to how the slippery scale of digital software can be re-appropriated for hybrid architectural drawing is, for now, open to speculation. First, the default functions of software that hide the processes of digital design must be subverted. The craft embodied in digital design is more often lost in a tangled web of ghosted layers and deleted images. Secondly, the demand for photorealistic renderings provides little incentive for a representation that reveals its origin(s). The genetics of a drawing are more than a means to an end, they inform the drawing of its beginning, and its future. By layering digital media with sketches, images, and doodles, the materiality of an idea becomes visible. The weight of a line is not simply a function of the digital tool, but reflects its importance as an individual movement; an architectural thought, or idea. Frascari argues that the digital lines, planes, and points of architectural drawings are the same, no matter who draws them.<sup>93</sup> As such, digital software does not easily allow you to draw outside the lines, or doodle in the margins, but the imprecision of the human hand does. The layering of these two distinct processes provides a glimpse into the origin and direction of an idea.

The inclusion of the digital process within a drawing remains difficult in part due to the collision of multiple scales residing within one drawing. A symptom to what Frascari refers to as "...an architecture laying bare, melted into a senseless

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<sup>93</sup> This is not entirely true. Assuming the user can look beyond the baseline, the malleability of design software allows for nomadic disruption of the standard uses. However, this type of behavior is not common and requires an exceptional level of tool manipulation and interface dexterity and is not nearly as intuitive as a hand drawn sketch, or doodle.

commercial presence by visual exploitation.”<sup>94</sup> “Hybrid drawing compels the architect to articulate the invisible and inner relationships existing between the parts composing a construction by not leaving them hidden within the electronic back boxes of the digital program used to elaborate them.”<sup>95</sup> As a guided tale toward the inauguration of building, the role of the architect is to make/draw together bodies and world making.<sup>96</sup>

As the changing categories of physical and virtual constructs continue to unfold, literature, film, architecture and art must engage in these shifting modes of understanding. As Toyo Ito suggests, “this virtual body of electron flow is drastically changing the mode of communication in family and community, while the primitive body in which water and air flow still craves for beautiful light and wind. To achieve this, architecture today must be a media suit – an extension of our skin to facilitate the relationship between both nature and information.”<sup>97</sup>

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<sup>94</sup> Frascari, Marco. The VIRTUE of Architecture. A 2009 Strenna. 2009. Page 15.

<sup>95</sup> Frascari, Marco. The VIRTUE of Architecture. A 2009 Strenna. 2009. Page 63.

<sup>96</sup> Frascari, Marco. The VIRTUE of Architecture. A 2009 Strenna. 2009. Page 10.

<sup>97</sup> Ito, Toyo. “Image of Architecture in Electronic Age. University of Tokyo Web Page. ([http://www.um.u-tokyo.ac.jp/publish\\_db/1997VA/english/virtual/01.html](http://www.um.u-tokyo.ac.jp/publish_db/1997VA/english/virtual/01.html)) Accessed Dec, 2009).

*"For there can be no middle, [since the Universe] is infinite.  
Nor. Indeed, if middle there really were, could anything at all  
stand still there [on account rather]?"<sup>98</sup>*

*Lucretius, De Rerum Natura*

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<sup>98</sup> Lucretius De Rerum Natura. (M.F. Smith trans). (1924 eds). New York. Loeb Classical Library.  
Line 1070.

# smallishallhellheldheadhad**hid**bidbig

*In this chapter, the author looks to the hallucinatory nature of changing scales and the nomadic reaches of the ocean as a metaphor for the duality of digital design and navigation. Drawing upon the experiences of Gulliver, Alice, and Walter Benjamin, the nature of digital navigation is likened to the coitus of Apollo and Dionysus. The fluidity, and improvisation of digital navigation is brought together with the gridded nature of Cartesian coordinates and orthographic snaps.*

Akin to the prowess of Captain Lemuel Gulliver's pelagic intuition, the art *and* science of digital navigation allows one to move thorough the illusion of infinite space, demarcating decisions in time while surrendering to the rhythmic tale of the sun, wind and everything in-between. The art of nautical navigation requires one to relinquish the quantitative tools such as the out-reached arms of the compass and surgical lines of nautical charts, to the inertia of ones intuitive perception. For Gulliver, the ocean is both mathematical – a course of precise measurements – and a horizon of discovery – a smooth space capable of nomadic embodiment. Analogues to the inseparable modes of pelagic navigation, the nomadic exploration and striated certainty of the digital environment also combine to induce innovation and precision. Navigating the digital spaces of architectural software, the computer screen, much like the

ocean, appears to be a space of seemingly infinitesimal mathematical precision and boundless emptiness, awaiting discovery.

The gridded guides and subtle snaps of digital modeling hold the architect imprisoned in a kind of Cartesian captivity. Contemporaneously and within the same virtual space lies a boundless ocean, capable of collapsing the caged domain of digital design. Akin to Walter Benjamin's description of film and its ability to break free from the delineations of life,<sup>99</sup> digital space can similarly supply a sense of freedom to go travelling beyond. Appropriately, the tools of *navigation* provide the architect the ability to wander in any direction, zooming in and out of a virtual space, with complete disregard for the canon of scaled drawings. At one moment, the architect can embody the perspective of a common housefly, the next, upon the wings of a soaring eagle. It is this freedom and immediacy of movement that contrasts so sharply with the rigidity of measured certainty found in the nano-scopic precision of digital information. However, the two seemingly polar opposites work together towards the discovery of new worlds. In concert with the Nietzsche's interpretation of antiquity, the Dionysian dream can dance with the hard edges of the Apollonian rule. "Where Apollo, the god of sculpture, represented structure, marked boundaries, plastic forms, images, conscience, thought and concepts, all that would contribute to

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<sup>99</sup> *Our taverns and our metropolitan streets, our offices and our furnished rooms, our railroad stations and our factories appear to have us locked up hopelessly. Then came the film and burst this prison-world asunder by the dynamite of the tenth of a second, so that now, in the midst of its far-flung ruins and debris, we calmly and adventurously go travelling.* Benjamin, Walter. *On Hashish*. Cambridge: Belknap Press. 2006. Page 236.

what we today with one word call “individuation”, Dionysus, the god of wine, represented the unbound, timeless, the lack of image and reflection, music, and intoxication.”<sup>100</sup>

To achieve the necessary disorientation, or to rest in the unbound timeless space of the Dionysian dream, one must surrender to its intoxication. Dionysian intoxication can appear in the form of narcotics, or simply in the form of spatial exploration.<sup>101</sup> For Benjamin, it came in both the form of hallucinogens and spatial experimentation.<sup>102</sup> Benjamin’s posthumous publication *On Hashish (1927-1934)* provides a peculiar glimpse into his provocative adventures of ‘profane illumination’ – a state of mind induced by self prescribed doses of hashish and other intoxicants. In a stream-of-consciousness account of his travels, he draws a parallel to being a spindle in Nietzsche’s banister,<sup>103</sup> acknowledging the struggles of two powerful, but separate worlds – the plastic and the fluid. For Benjamin, the quest of travelling to and from the two worlds is triggered by varying methods of intoxication.

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<sup>100</sup> Nietzsche, Friedrich. *The Birth of Tragedy from the Spirit of Music* (1872)

<sup>101</sup> *This essay explores the Dionysian experience of virtual navigation using the software Google Earth.© Kingsbury and Jones illustrate the Dionysian experimentation as a defining force in how Google Earth© is used, drawing reference to the spatial and hallucinogenic experiences of Walter Benjamin.* Kingsbury, P., Jones, J.P. *Walter Benjamin’s Dionysian Adventures on Google Earth*, [Geoforum](#) (2008). Pages 3-4.

<sup>102</sup> Kingsbury, P., Jones, J.P. *Walter Benjamin’s Dionysian Adventures on Google Earth*, [Geoforum](#) (2008). Pages 3-4.

<sup>103</sup> *“The Forster House: (she has turned the Nietzsche Archive into the Forster House) the Forster House is of red stone. I am a spindle in its banister: an obdurate, hardened post. But that is no longer the totem pole – only a wretched copy. Chamois’ foot or horse hoof of the devil: a vagina symbol.”* Benjamin, Walter. *On Hashish*. Cambridge: Belknap Press. 2006.

According to Kingsbury and Jones, Benjamin's fascinations with spatial disorientation lead to his "study of the phantasmagoria machine – a projector popularized in the late 18<sup>th</sup> century and early 19<sup>th</sup> century. It consisted of candle illumination, concave and convex lenses to focus light, and projected images painted on small glass slides. A tracking system enabled it to increase and decrease the projected apparition, and "the looming and zooming figures were said to have shaken the audience out of their seats, some of them running toward rather than away from the projections." <sup>104</sup>

Reaching the unbound domain of Dionysian dreams, whether it be through narcotics, or spatial disorientation appears to induce the ability to transcend our figurative bodies. Passing through a threshold of intoxication is not unique to the experiments of Benjamin, but can be found in the tales of both Alice and Gulliver. In the case of Alice, upon reaching the end of a 'tail race' she is given the gift of intoxication, leaving her body physically fit to pass. Likewise, Gulliver, who is driven by a violent storm to the north-west of Van Diemen's Land is set adrift from his vessel. His accounts upon arrival at Lilliput suggests a convergence of exhaustion and intoxication. "I was extremely tired, and with that, and the heat of the weather, and about half a pint of brandy that I drank as I left the ship, I found myself much inclined to sleep." <sup>105</sup>

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<sup>104</sup> Kingsbury, P., Jones, J.P. Walter Benjamin's Dionysian Adventures on Google Earth, Geoforum (2008). Pages 3-4.

<sup>105</sup> Swift, Jonathon. Gulliver's Travels. 2003 ed. London: Penguin Group. 2001. Page 23.

Much like meandering path of the urban wanderer, or the Parisian flâneur, digital navigation behooves a certain necessity to meander between to the multitude of scales.<sup>106</sup> To lose oneself in their work is to effectively escape the confines of the computer desk and engage in a scaled exploration of design. Not just to think in scale, but imagine ones self inside the virtual space.

Specific scales are chosen to fulfill a prescribed orthographic or perspective, deliberating on a specific setting, or telling tale. Conversely, digital models are born under the guise of full-scale representation, ultimately providing the production of plotted outputs and particular projections. The act of dissecting parts from the whole results in a staggering amount of process work *hidden* in-between scales. Digital processes seem to suffer the fate of most hallucinations —they are ephemeral moments left to description. The act of digital creation is a dizzying journey from the miniature the massive. From the very small to the very big – a poetic tale of invention and inversion, stirring the liquid with the plastic, the smooth and striated. In order to return the act of drawing to “a source of imagination rather than a recording of prior ideas,” the shifting scales and intoxicating affects of digital navigation should reveal both the fluid and fixed.

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<sup>106</sup> Kingsbury, P., Jones, J.P. Walter Benjamin’s Dionysian Adventures on Google Earth, Geoforum (2008). Pages 3-4.

The digital vehicles of architecture descend into the depths of the miniature and retreats to the outer reaches of the universe with little respect to the traditional notion of distance. The collision of this special intoxication with the rigidity and plastic fate of the architectural project echoes the radical relationships of Apollo and Dionysus. The performance of design lies in-between, hidden from the prescribed scale, or rendered image. Too often the digital doodles, and lines of lucid hallucination are left hidden, ghosted or deleted to produce images of precision. The tale of the drawing must present itself as an intoxicating path of intoxication and precision to engage in an architecture that reveals its origins as an inseparable marriage of Dionysian dreams and Apollonian regulation.

*The verb 'to scale' suggests to attack with ladders.*<sup>107</sup>

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<sup>107</sup> "to scale." Def. 5b. *The Oxford English Dictionary*. 2nd ed. 1989. Print.

# smallshalhallhellheldheadhadhid**bidbig**

*This marks the beginning of the architectural project. The chapter introduces the site of the project and the nature of the procedures, both programmatic and tectonic. The author looks to re-imagine an abandoned powerhouse at the edge of Niagara Falls as a medical research center and tourist attraction.*

Precariously perched between a promenade and the raging Niagara River rests the forgotten corpse of the Toronto Electric Powerhouse. Discarded in the winter of 1973, the Powerhouse was once a peculiar place of multi-scalar symphony — transforming the molecules of moving water into a continental grid of hydro-electricity.<sup>108</sup> Born in the dawn of winter, 1906, the brainchild of Toronto financier Henry Pellatt, and architect Edward J. Lennox, this temple to electricity was the largest of its kind, producing over 98,000 kilowatts of energy. Water was drawn into the building by a wing dam, which reached 735 feet into the river. Passing through the arched bays of the outer forebay, water dropped down a row of 10 ½ foot diameter steel penstocks to the turbines nested below. From here, the water was returned to the river through a subterranean brick lined tailrace, eventually discharging the water behind the curtain of the falls.

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<sup>108</sup> Nearly 10,000 cubic feet of water rush over Niagara Falls every second; that works out to 2,832 tonnes per second. <http://www.niagaraparks.com/media/geology-facts-figures.html> (Visited on 01.12.10)

Conceived as conjoined twins, two half buildings are bound by a center wall, one half provides a decorative gaze toward the Niagara Promenade and the less expressive (expensive) rear façade faces the inhabitable waters above the falls. The front, or West façade draws upon the Italian Renaissance style seen in many of Lennox's buildings throughout Toronto.<sup>109</sup> It echoes the structural logic of steel columns and trusses, responding to the proportional rhythms of geometry and scale. On the other side, the East façade reveals a grid of structural logic akin to the industrial economy of function rising above form.

Upon a site visit, extensive analysis, and a review of the structural report and gap analysis prepared by *The Ventin Group* (2008)<sup>110</sup>, I found the building to be comatose, neither dead nor alive. It is the intention of this thesis to revive the building through a series of reconstructions and translations. The project operates in two parallel procedures; to reinvent the programmatic identity of the Powerhouse, and to rehabilitate and reinvent the ailing structural and material integrity while conserving its outstanding values.

Firstly, the programmatic identity of the building will resurface as a medical education research centre with a secondary program of tourism. Its primary occupants will be a research studio sharing interdisciplinary methods and

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<sup>109</sup> Common architectural typologies are seen in Lennox's building in Toronto including the Old City Hall (1899) and the Bank of Toronto (1906)

Litvak, Marilyn M. *Edward James Lennox: Builder of Toronto*. Dundurn: Toronto. 1995.

<sup>110</sup> Ventin Group. *GSA Report*. Structural Analysis performed per request from the Niagara Parks Commission. 2009.

procedures to the betterment of the medical pedagogy and practice with specific interest in digital technologies and imaging. Digital laboratories will fill the subterranean void left behind by the removal of the hydro-electrical generators and subsequent equipment, as well the void of the inner forebay. Studio and office space will make up the remainder of the building on the eastern side of the center wall with a library embodying the cranial rotunda at the north. The secondary program will occupy the main entrance, the central penstock as well as a section of the tailrace and will cater to the abundant tourism of the area. Providing the public a glimpse at what once was, the formal entrance adjacent to the promenade will welcome visitors to a small visitor center and an elevator. Conversely, the laboratory and office space will be accessed through a secure entrance off the South façade, adjacent to the small landscaped parking area. Lastly, a small perch above the library will provide a space for an intern writer.

The physical reconstruction looks to the material and structural beauty of the building through a balanced (re)creation and restoration. Today's architect is often left with the task of settlement, treading a sustainable path between conservation and reconstruction. The question arises as to why we protect something? Because it has "outstanding universal value"?<sup>111</sup> The decisions based on conservation, and preservation of built heritage must overlap with a

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<sup>111</sup> Outstanding Universal Value is a key term written in UNESCO's Convention concerning the Protection of World Culture and Natural Heritage. While the scope is global, the concept is structured around a system of exceptional value. Source: <http://whc.unesco.org/en/conservationtext/> (Sept. 2009)

wide spread evaluation of all aspects of the building including the immeasurable. In this case, the tangible and the intangible heritage of the Toronto Electric Powerhouse provide a sustainable foundation on which to revive the old, with the injection the new. The importance of maintaining the overall character of the building must be achieved while investing in the translation and recreation of a new body image.

According to the gap analysis, the major issues facing the rehabilitation of the building are found in the roof, and the south façade. Patchwork repairs have left the roof in a state of disrepair and the combination of inconsistent mixing of roman stone<sup>112</sup> and the exposure to the savage conditions of the Niagara River has left the east façade in need of total reconstruction. The redesigned east façade provides skin like protection from the wind, rain and sun, while harnessing the natural energy it provides. Microscopic etching on the exterior of a double-glazed system will provide the necessary light refraction, diffusing natural light while eliminating direct light, which is unsuited for work environments. Passive solar heating and cooling will be controlled through a three-foot air space between the double glazed façade. Lastly, air vents on the upper reaches of the wall, capturing prevailing wind currents providing the circulation needed to exercise the buildings ventilation system.

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<sup>112</sup> Part of the rear (east) wall facing the river is constructed in 'Roman Stone' (concrete units used for cladding), which show significant degradation. Short term remediation would include the current approach -- shotcrete or similar parging material. The long term solution, and most recommended, is replacement of Roman Stone with stone masonry construction.

Currently, the roof is a compromised patchwork of aluminum panels. The proposed design will see the roof and truss system replaced with an undulating mat of sod and moss composite crates. The individual crates will connect to an insulated subflooring system, conforming to the existing structural rhythm of lightweight steel trusses. Penetrating through the roof are a series of light wells, drawing natural light down to the subterranean lab space while providing a vertical stack for natural ventilation and heat recovery through colder seasons. The main interior of the western hall will retain its original grandeur, with no prescribed program aside from vertical circulation of light, energy and inhabitants. The southern most turbine, and penstock will remain operational serving to power the buildings energy requirements. The eastern hall will house offices, administration, bathrooms, and studio space as well as vertical circulation to the inner forebay.

# smallshallhallhellheldheadhadhidbidbig

*This brings us to the end of our journey. The following is a collection of images from the architectural intervention of a abandon hydro electric power station. Acting as a conclusion, the collection of images records the author's travels from site analysis, to the design development of a medical research center and tourism deposit.*



Figure 2. Conceptual Drawing

By Author

site analysis

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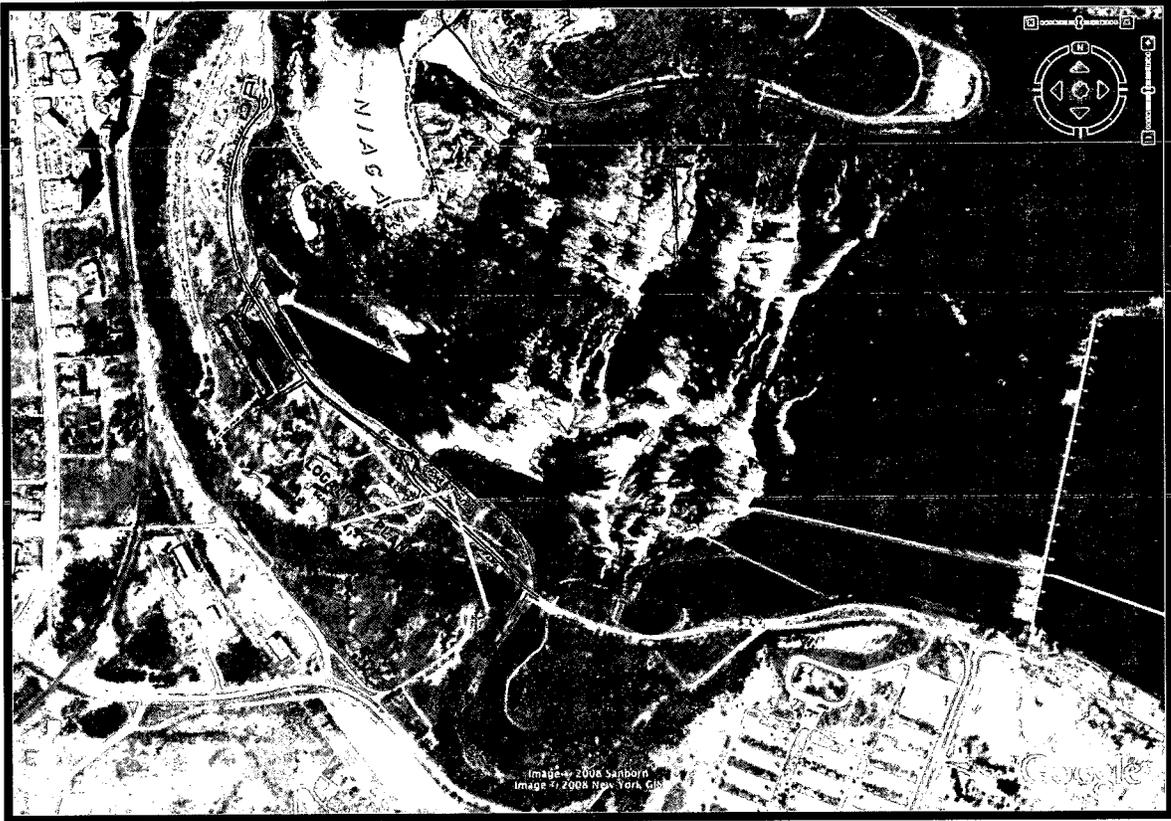


Figure 3. Site Plan

By Author

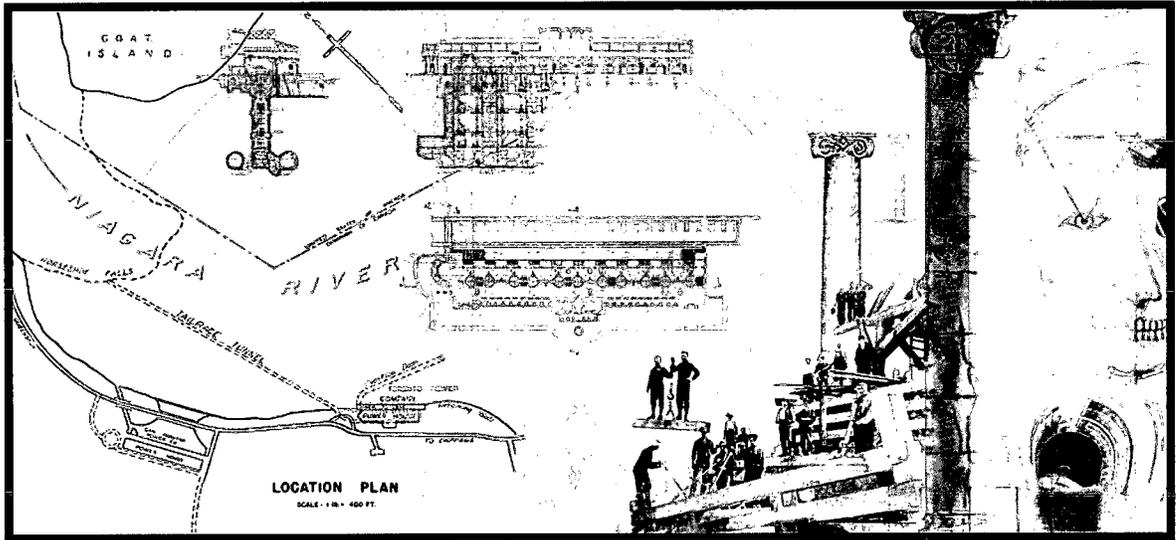


Figure 4. Site Panel

By Author

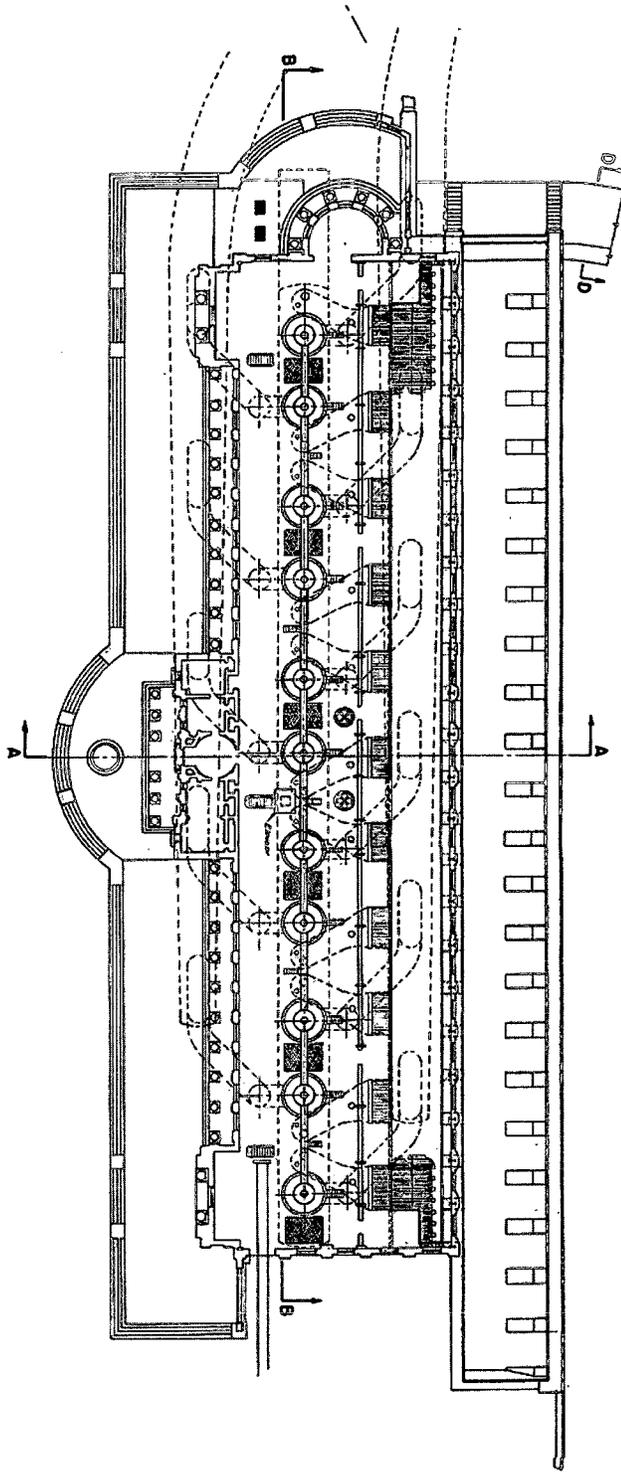


Figure 5. As Built Plan

Source: Niagara Parks Commission

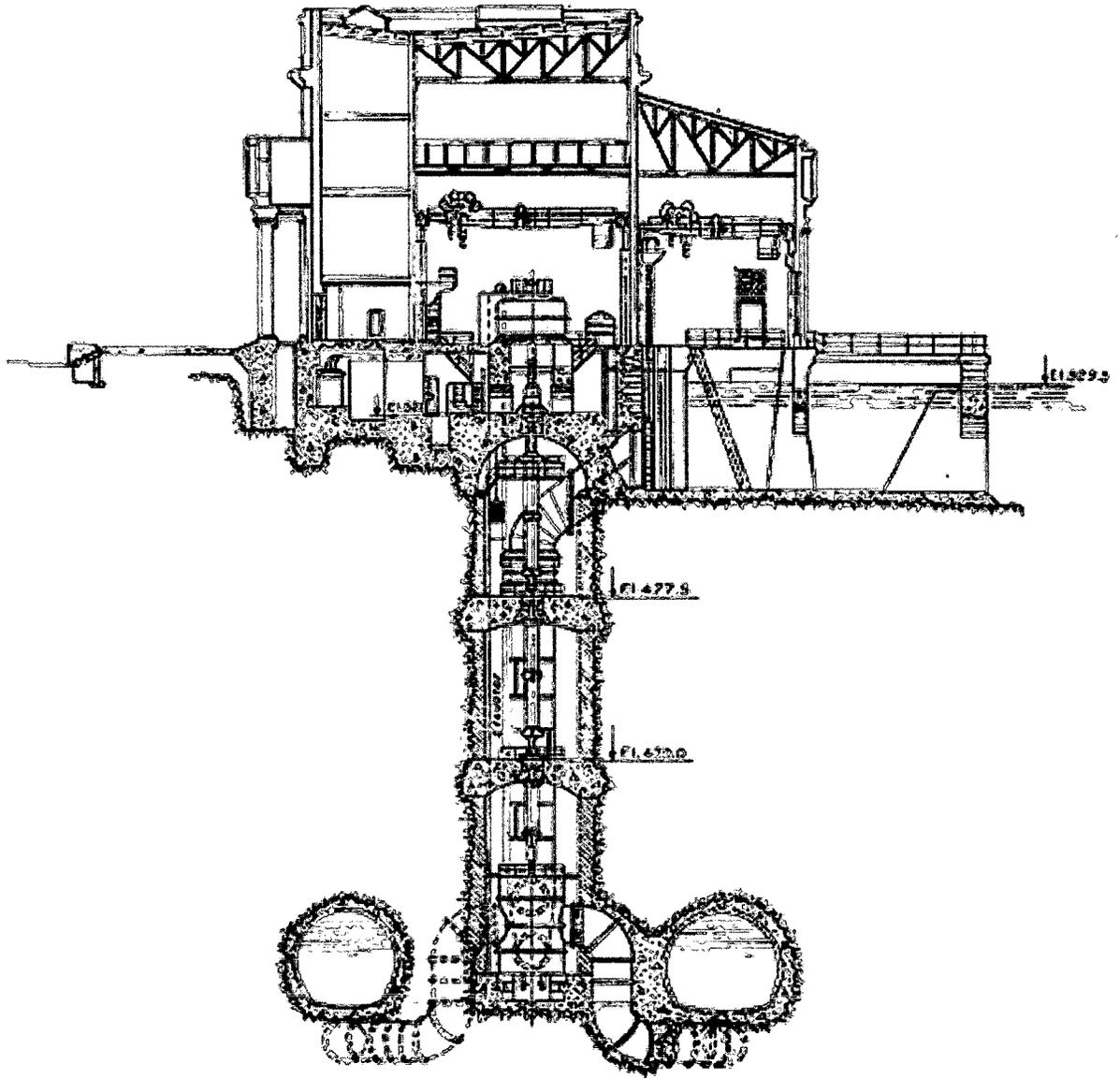


Figure 6. As Built Cross Section

Source: Niagara Parks Commission

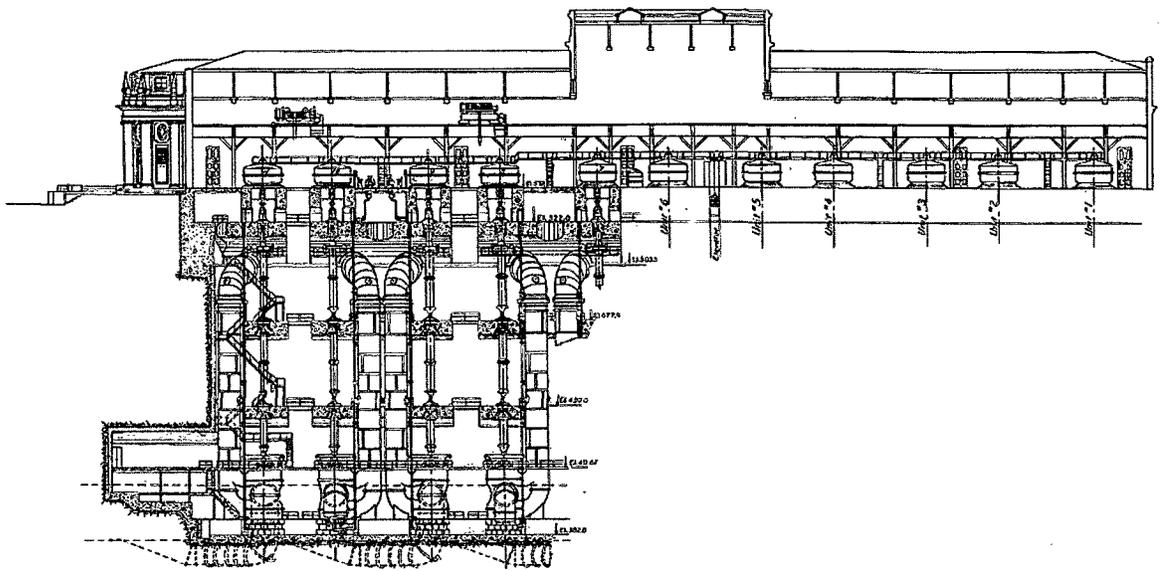
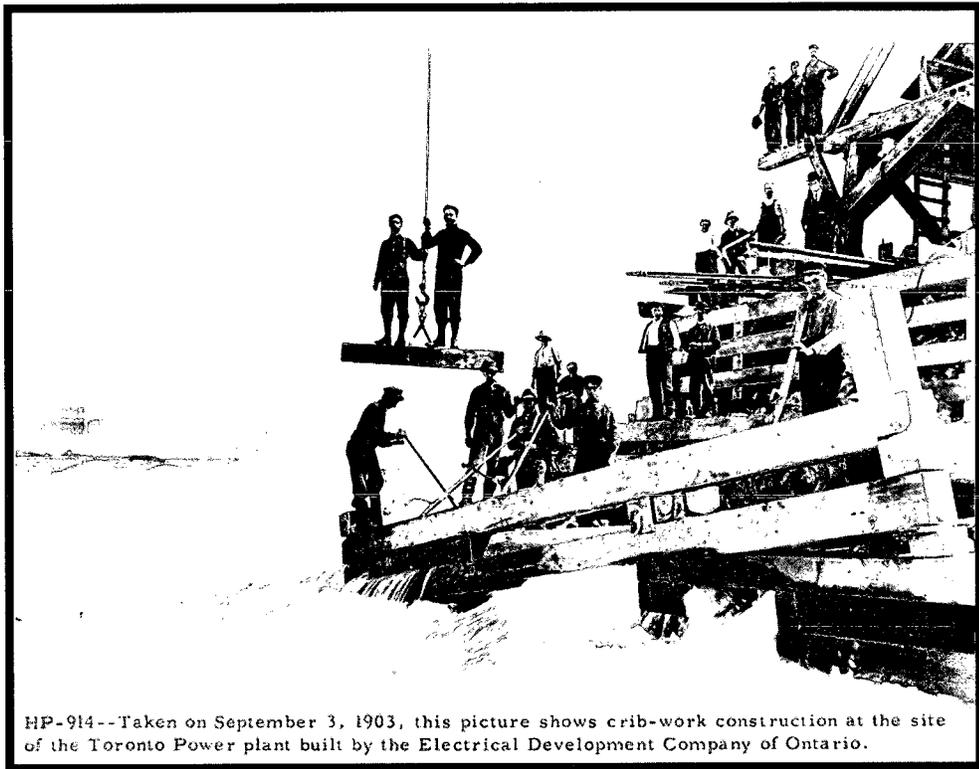


Figure 7. As Built Section

Source: Niagara Parks Commission



HP-914--Taken on September 3, 1903, this picture shows crib-work construction at the site of the Toronto Power plant built by the Electrical Development Company of Ontario.

Figure 8. Construction of crib foundation.

Source: Niagara Parks Commission

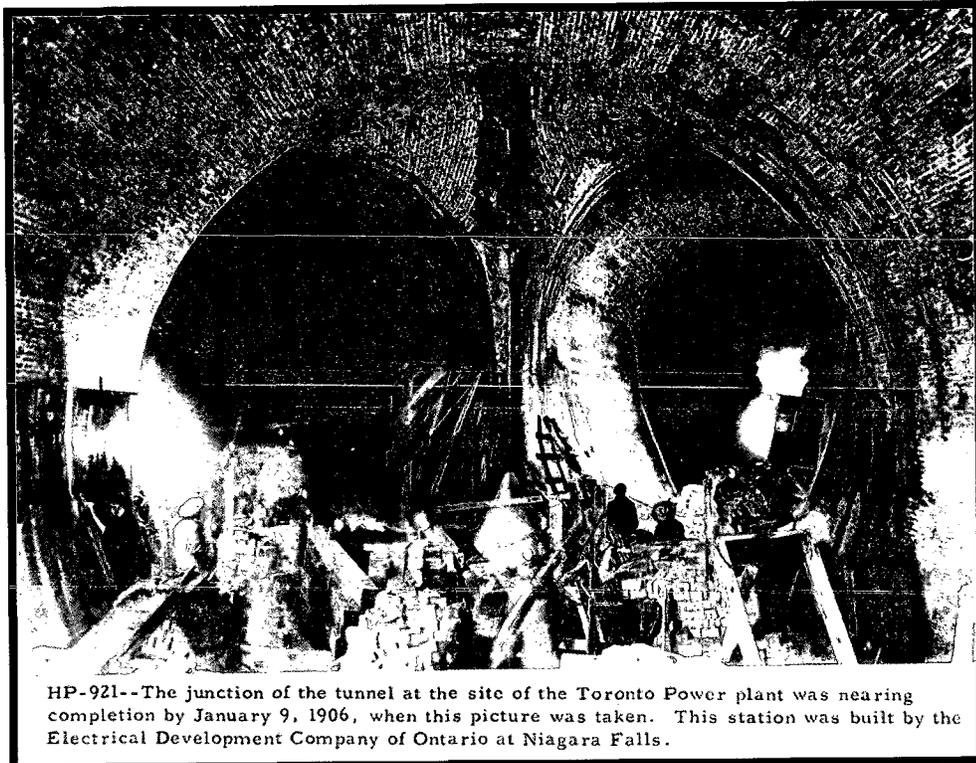


Figure 9. Construction of tailrace

Source: Niagara Parks Commission

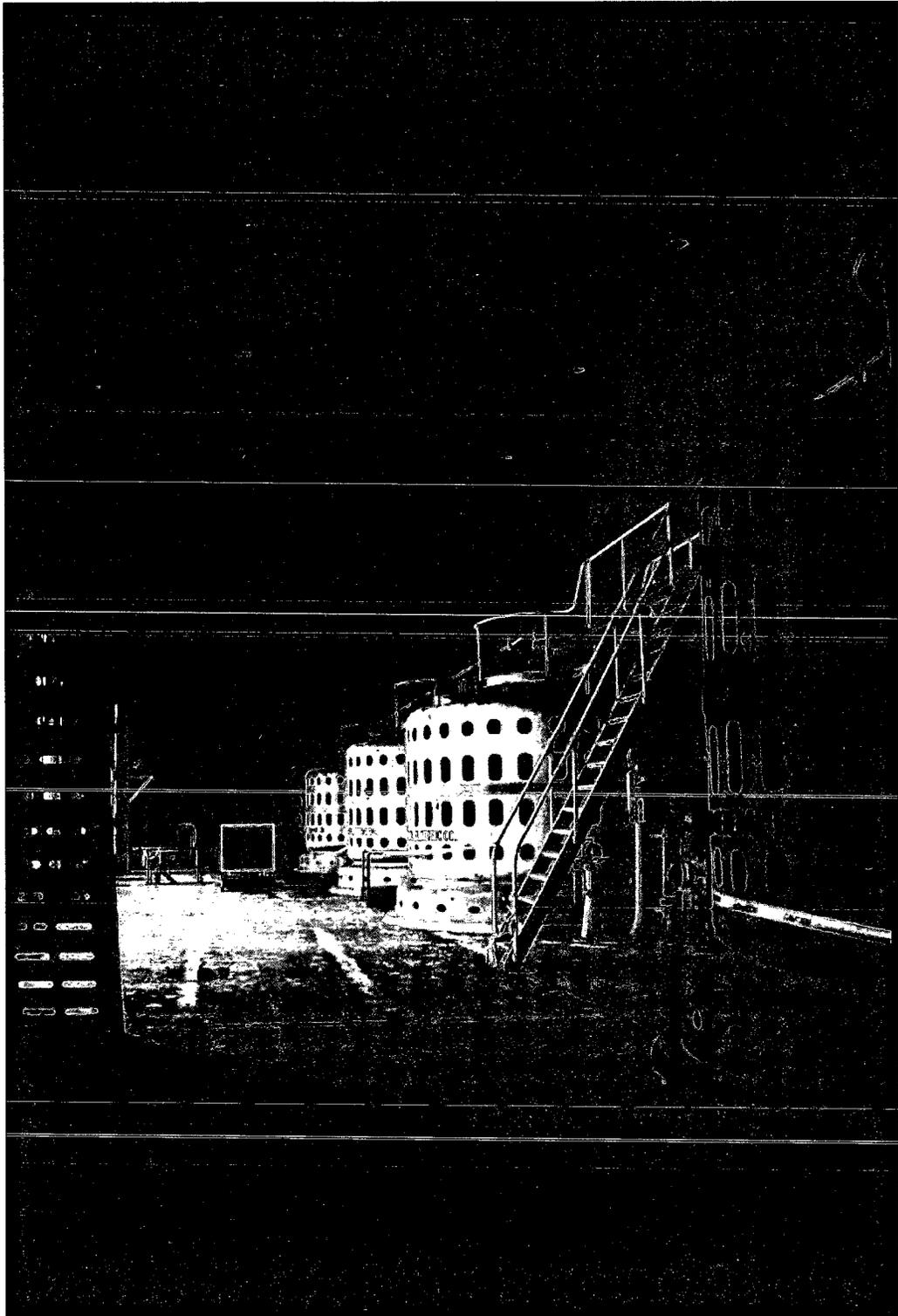


Figure 10. Inner Forebay Generators

Source: Niagara Parks Commission

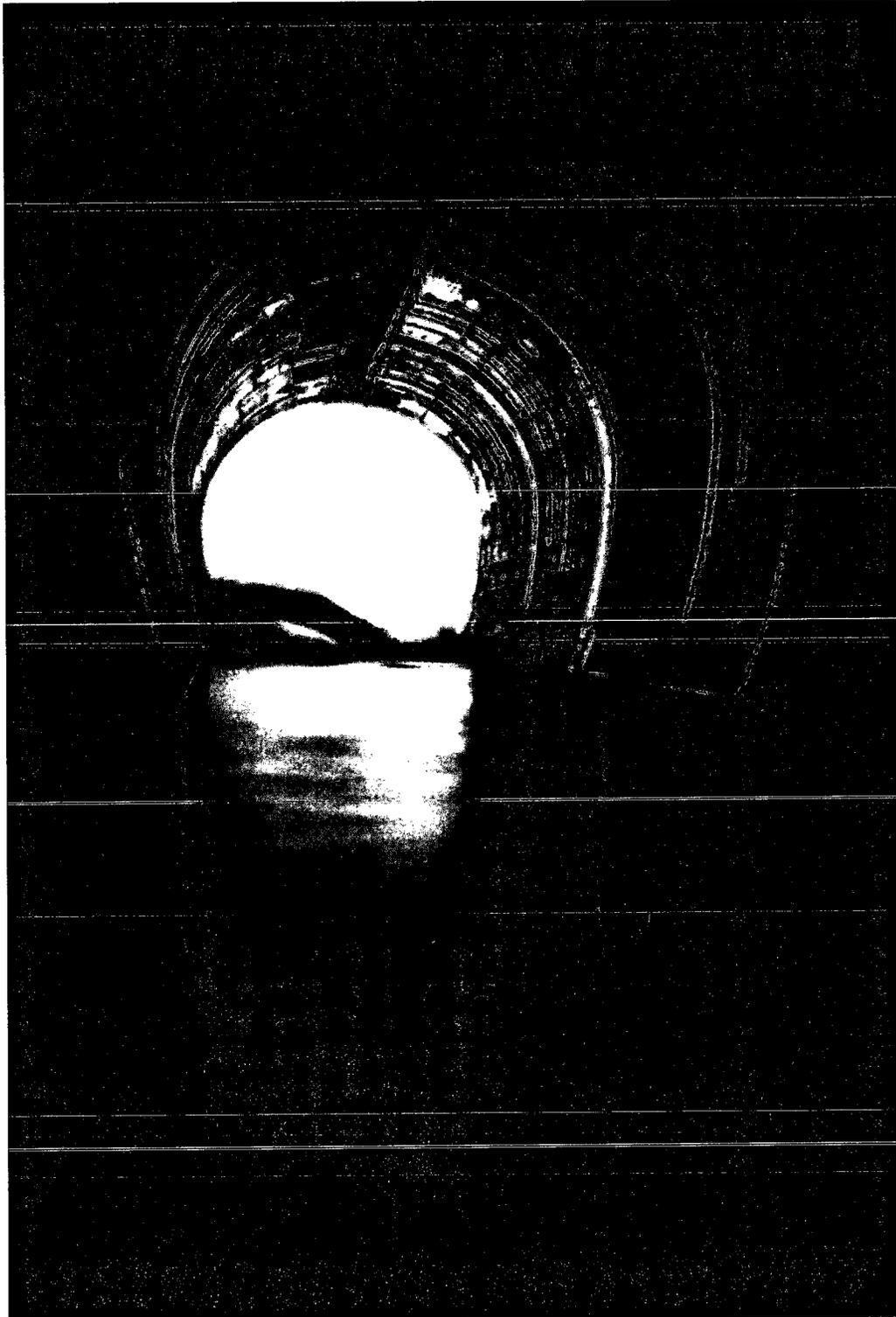


Figure 11. Tailrace discharge at curtain of falls

Source: Niagara Parks Commission

process work

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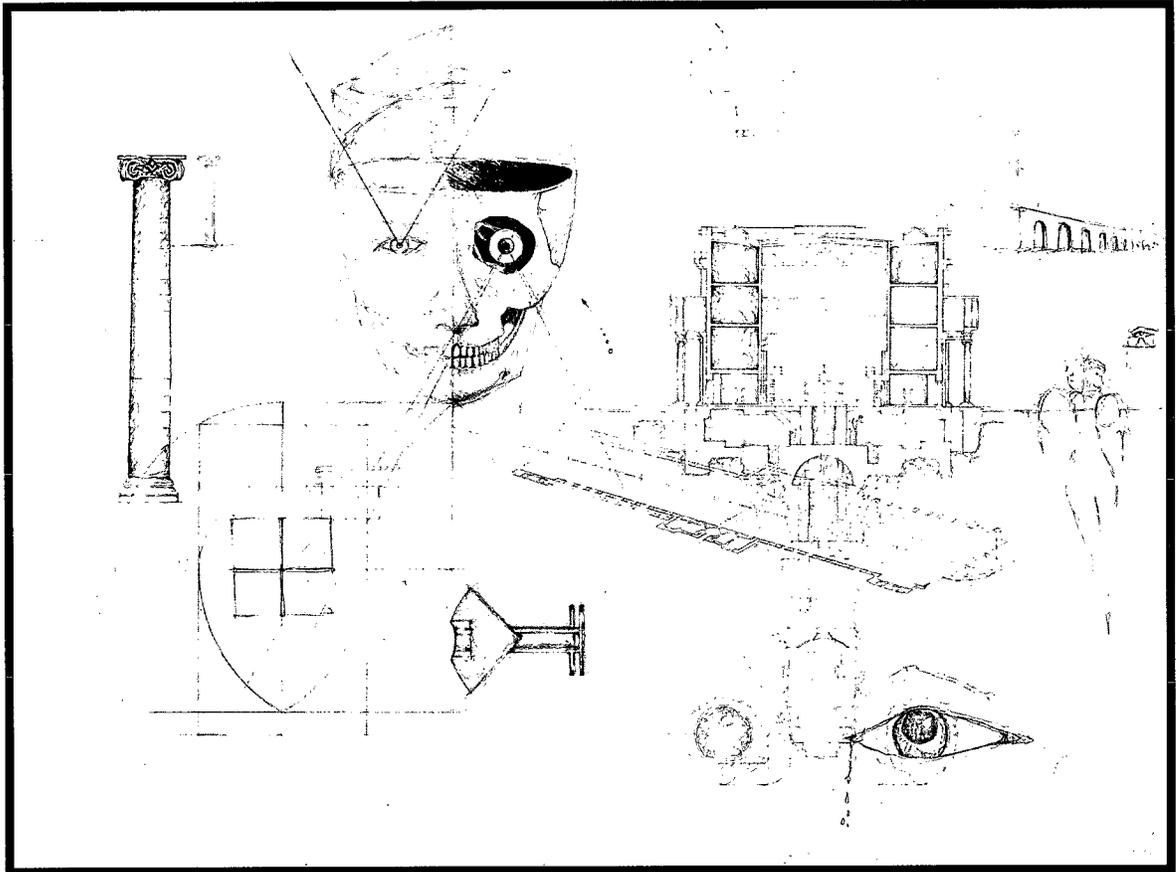


Figure 12. Study Drawing

By Author

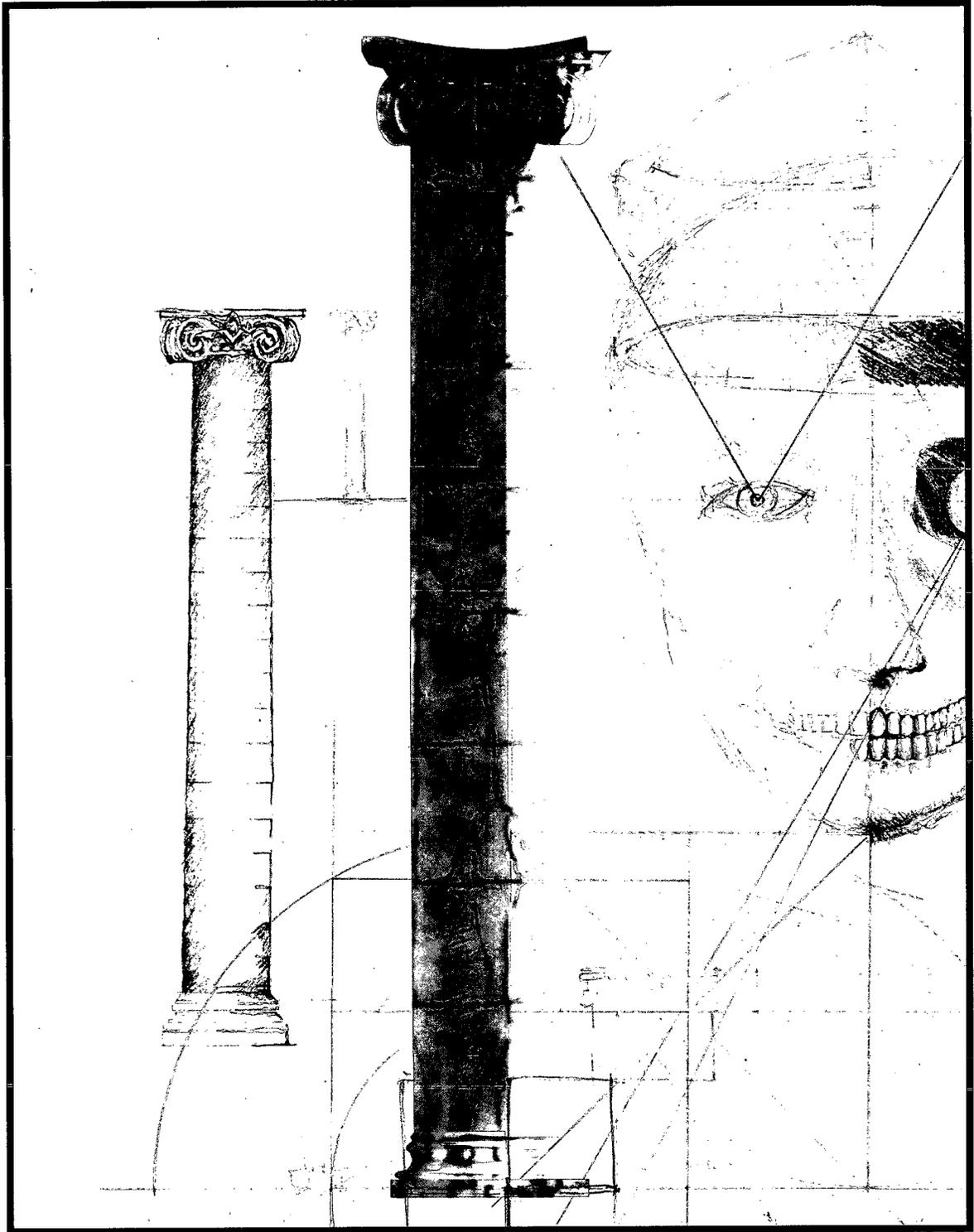


Figure 13. Study Drawing

By Author

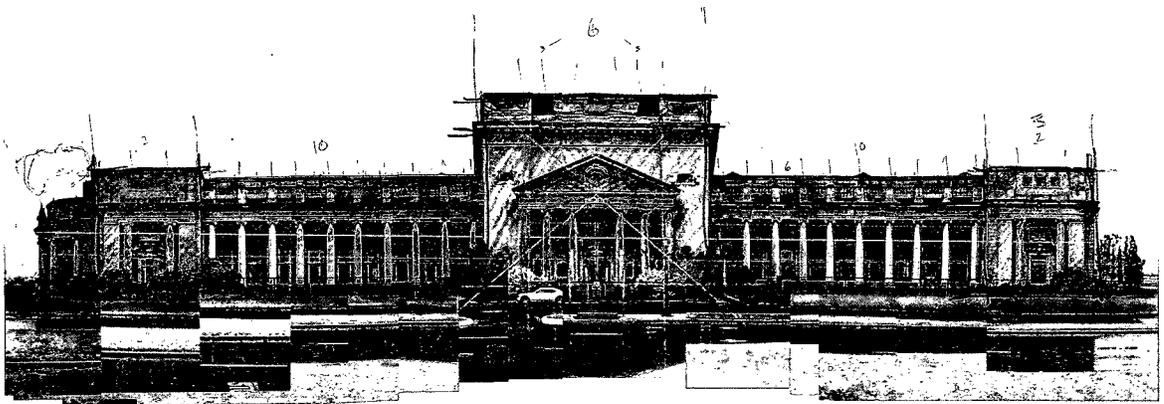


Figure 14. Hybrid Elevation Drawing

By Author

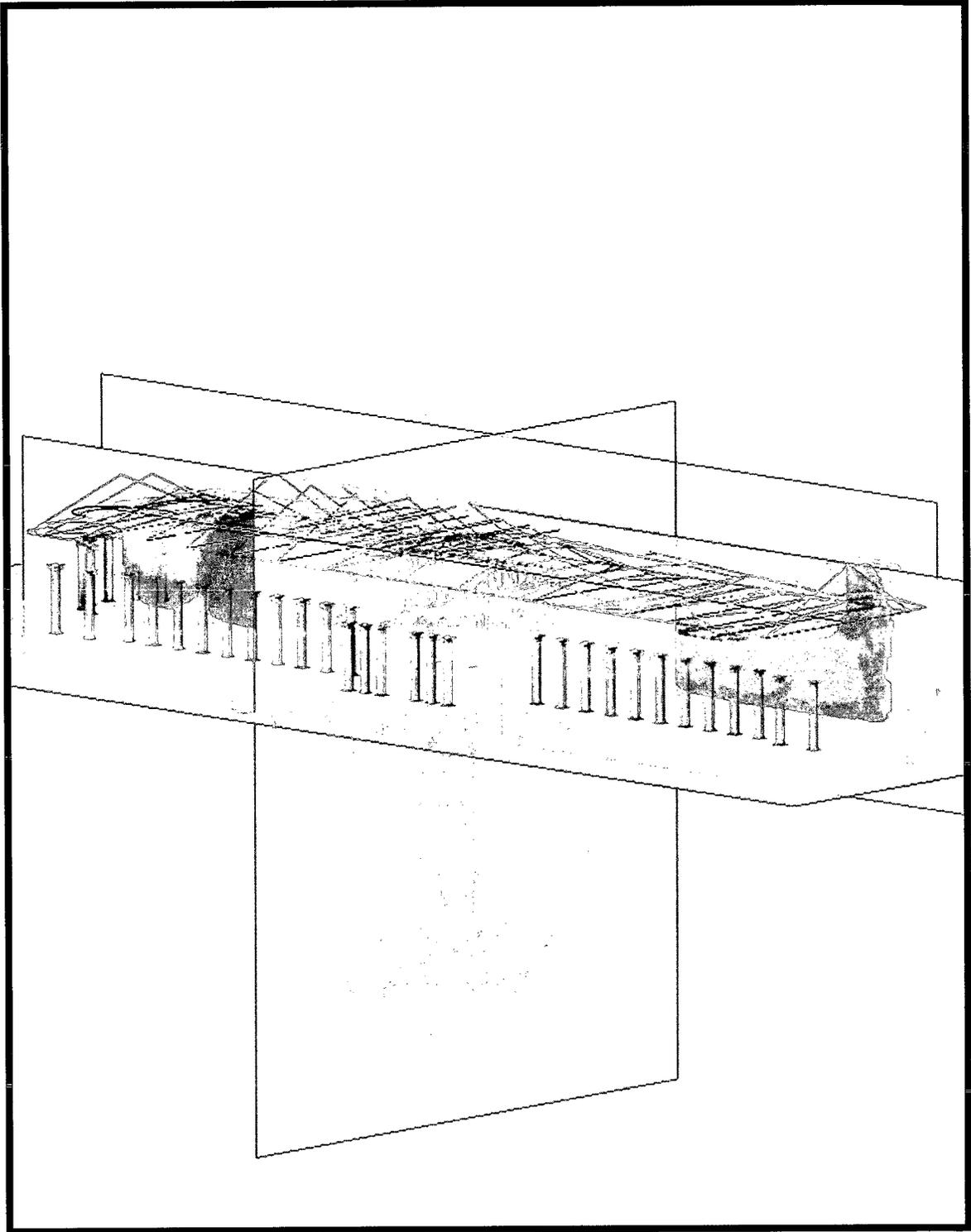


Figure 15. Roof Construction

By Author

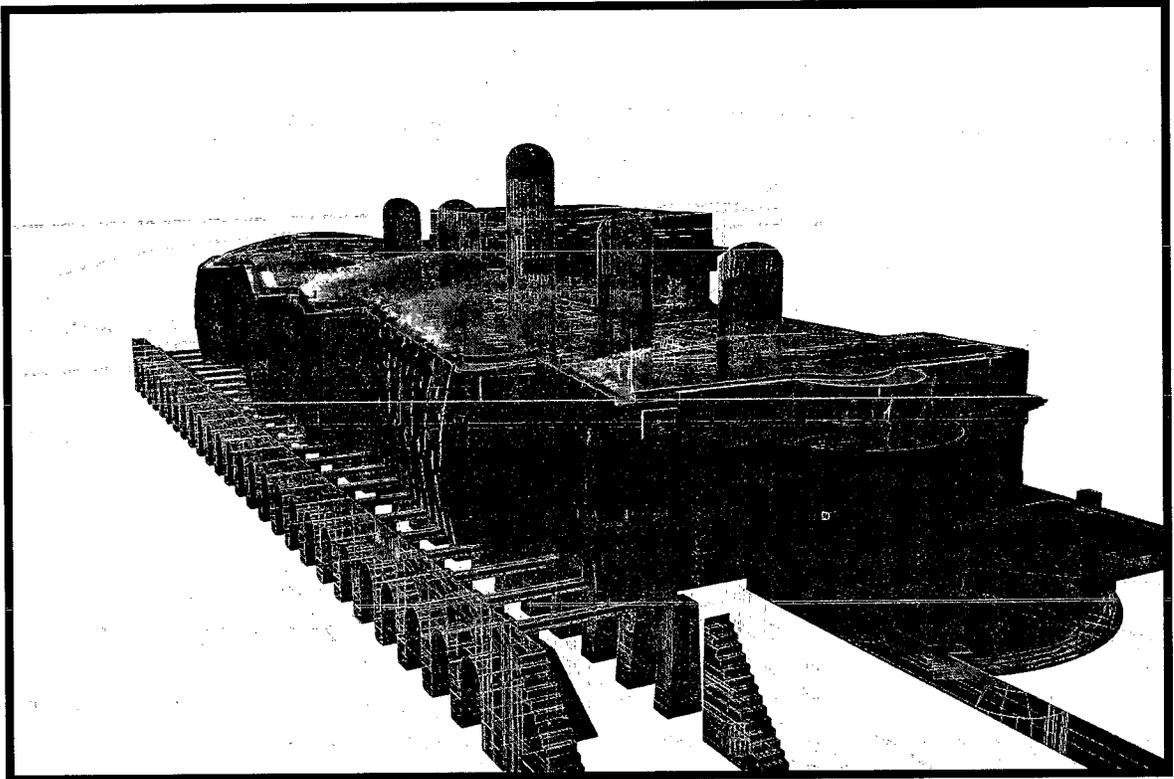


Figure 16. Digital Perspective

By Author

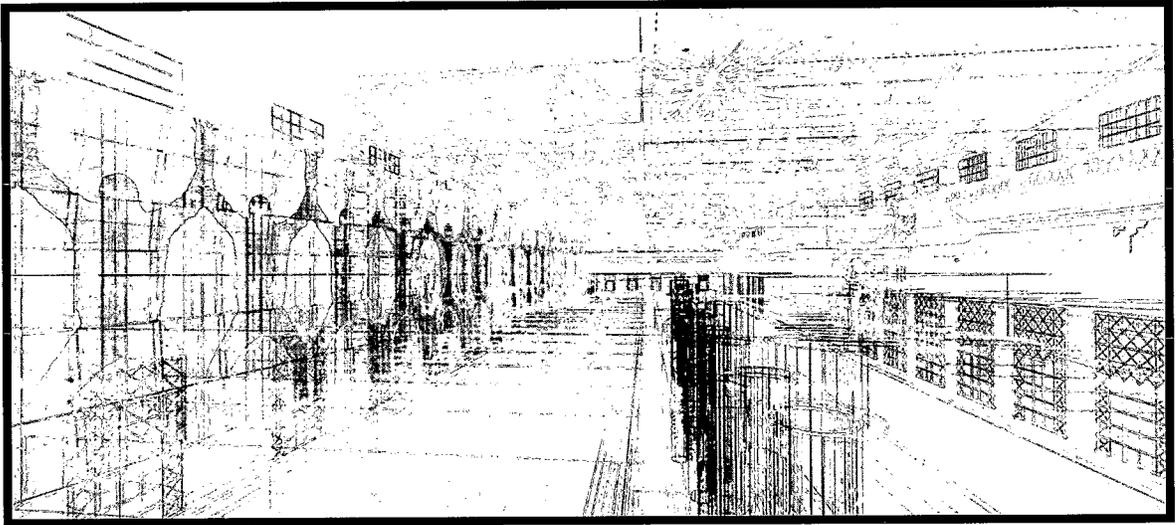


Figure 17. Digital Perspective

By Author

design development

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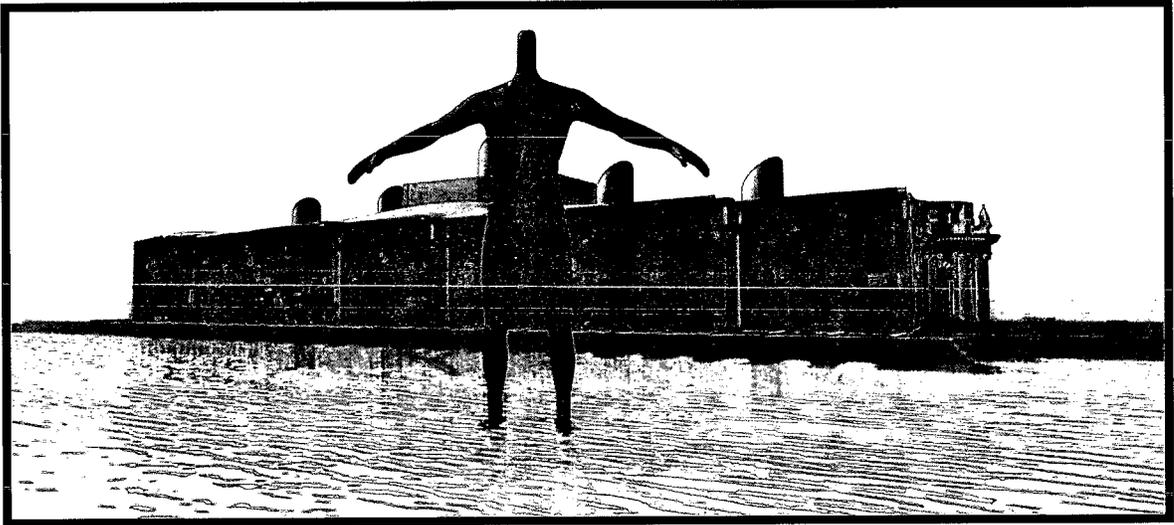


Figure 18. Perspective

By Author

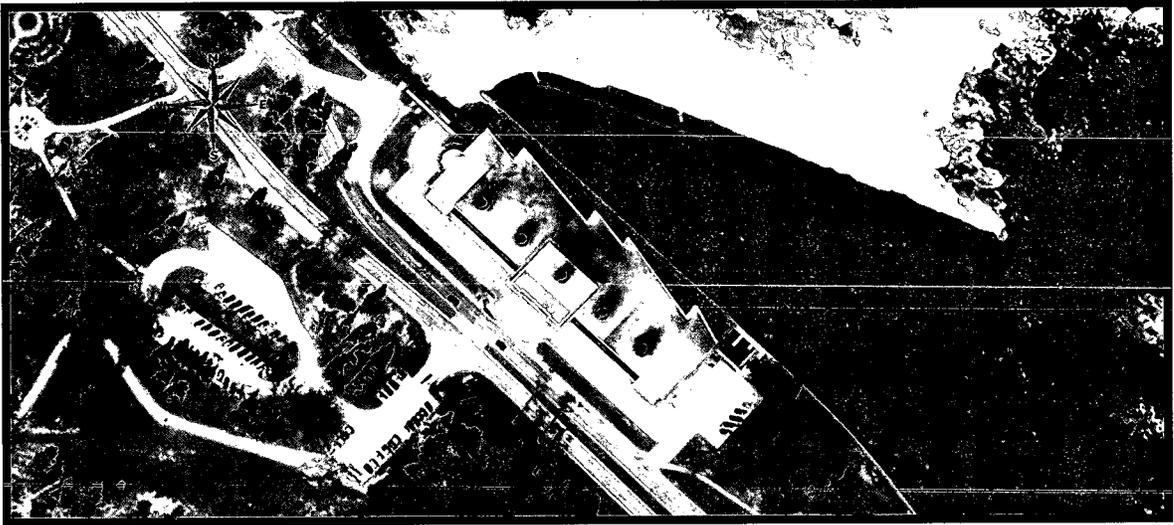


Figure 19. Site Plan

By Author

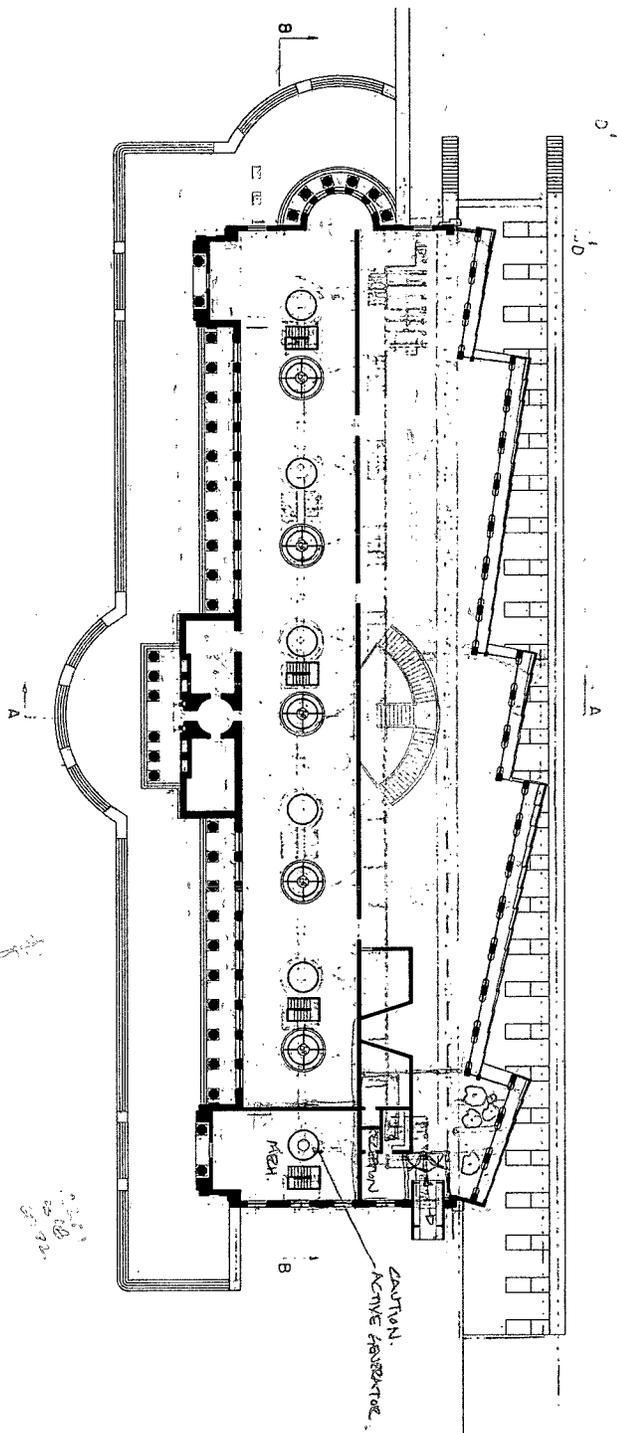


Figure 20. Plan

By Author

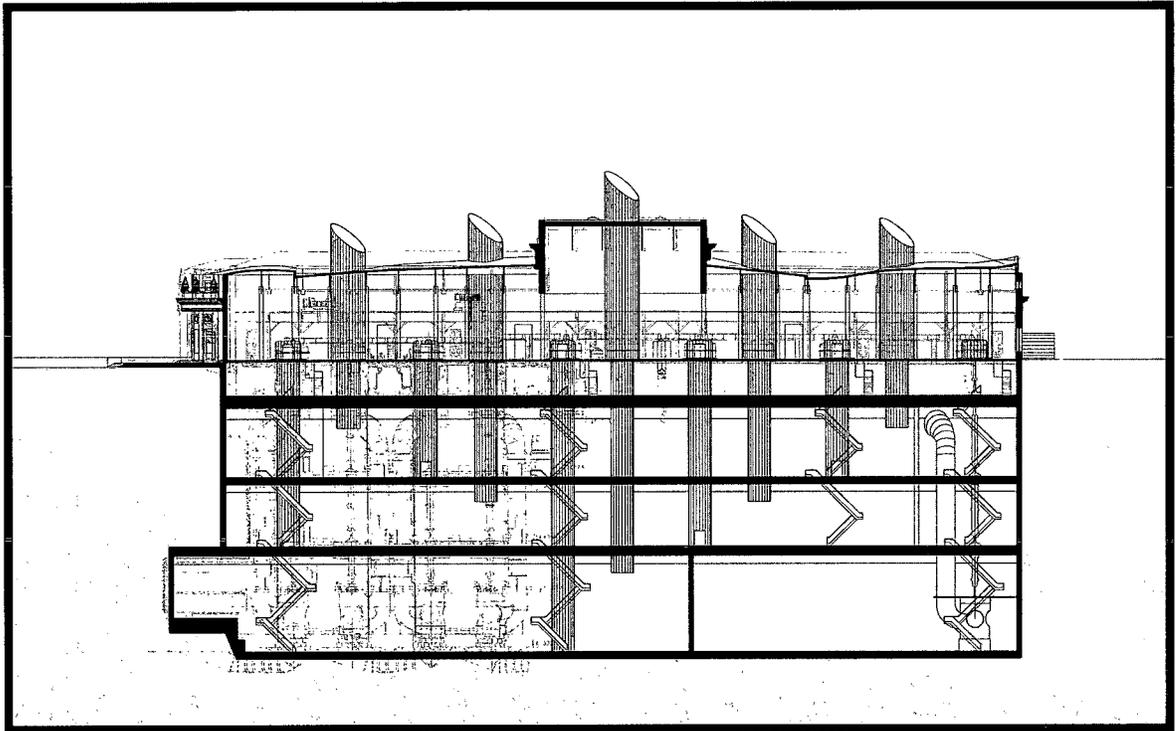


Figure 21. Section

By Author

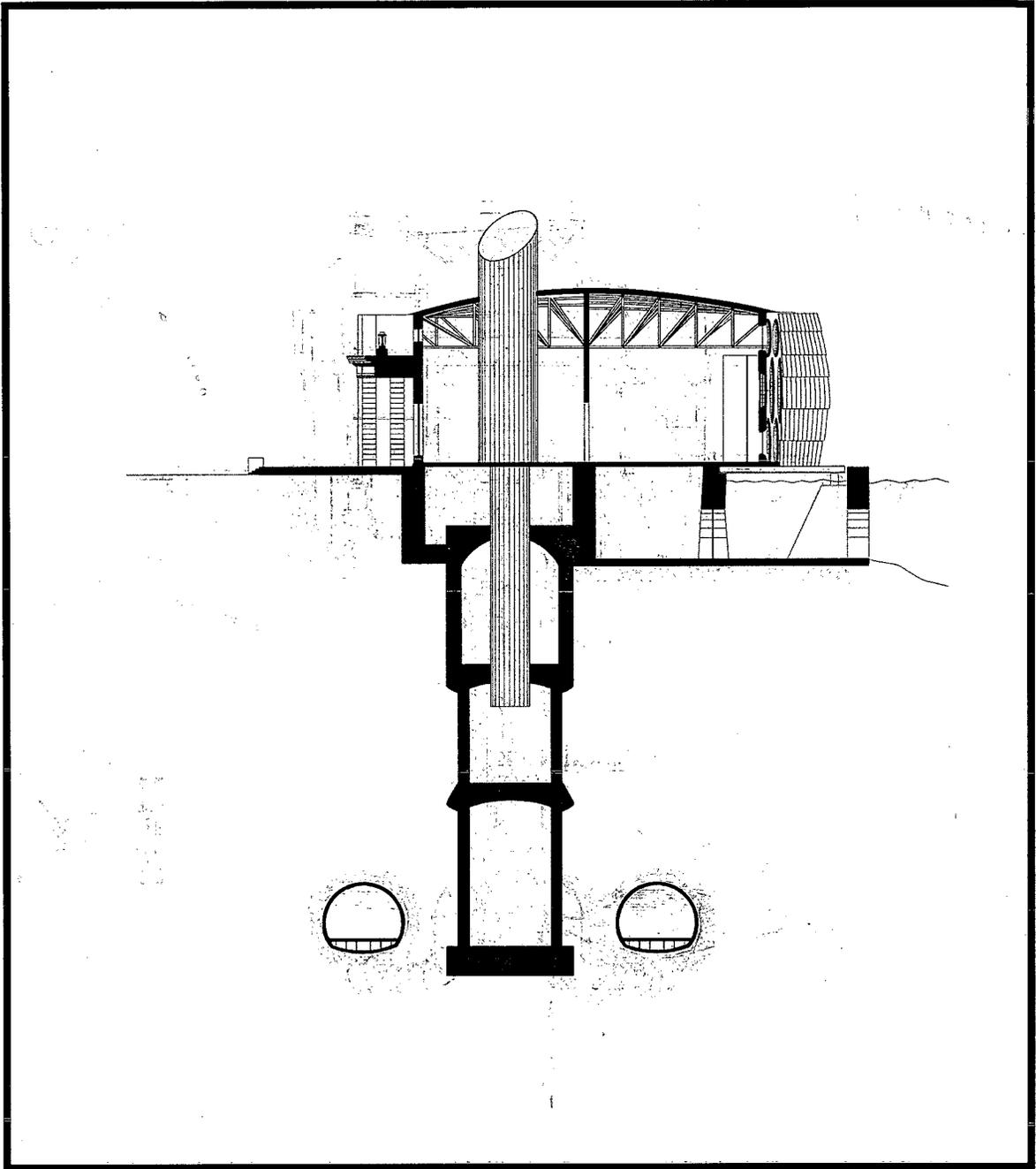


Figure 22. Section

By Author

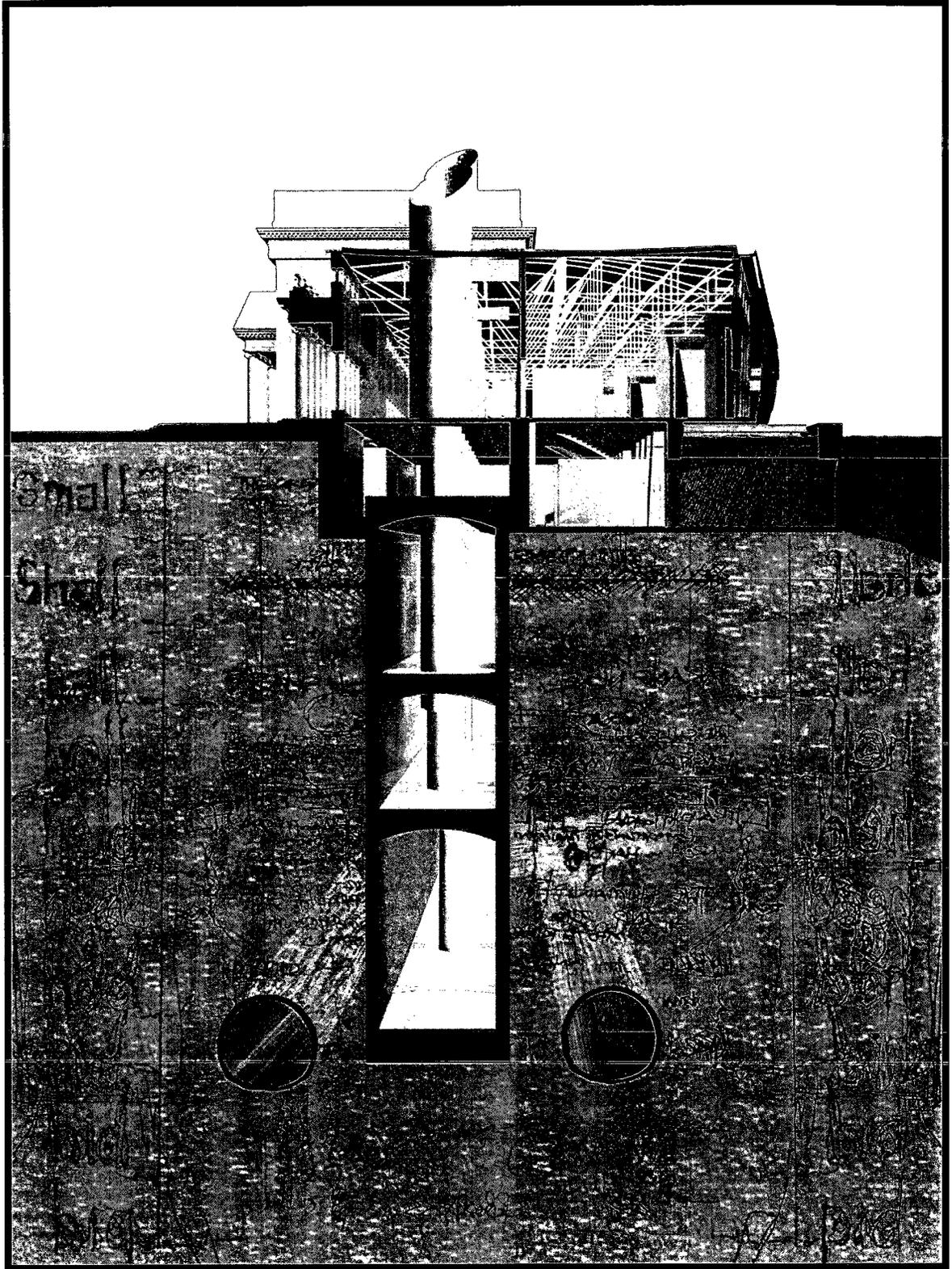


Figure 23. Sectional Perspective

By Author

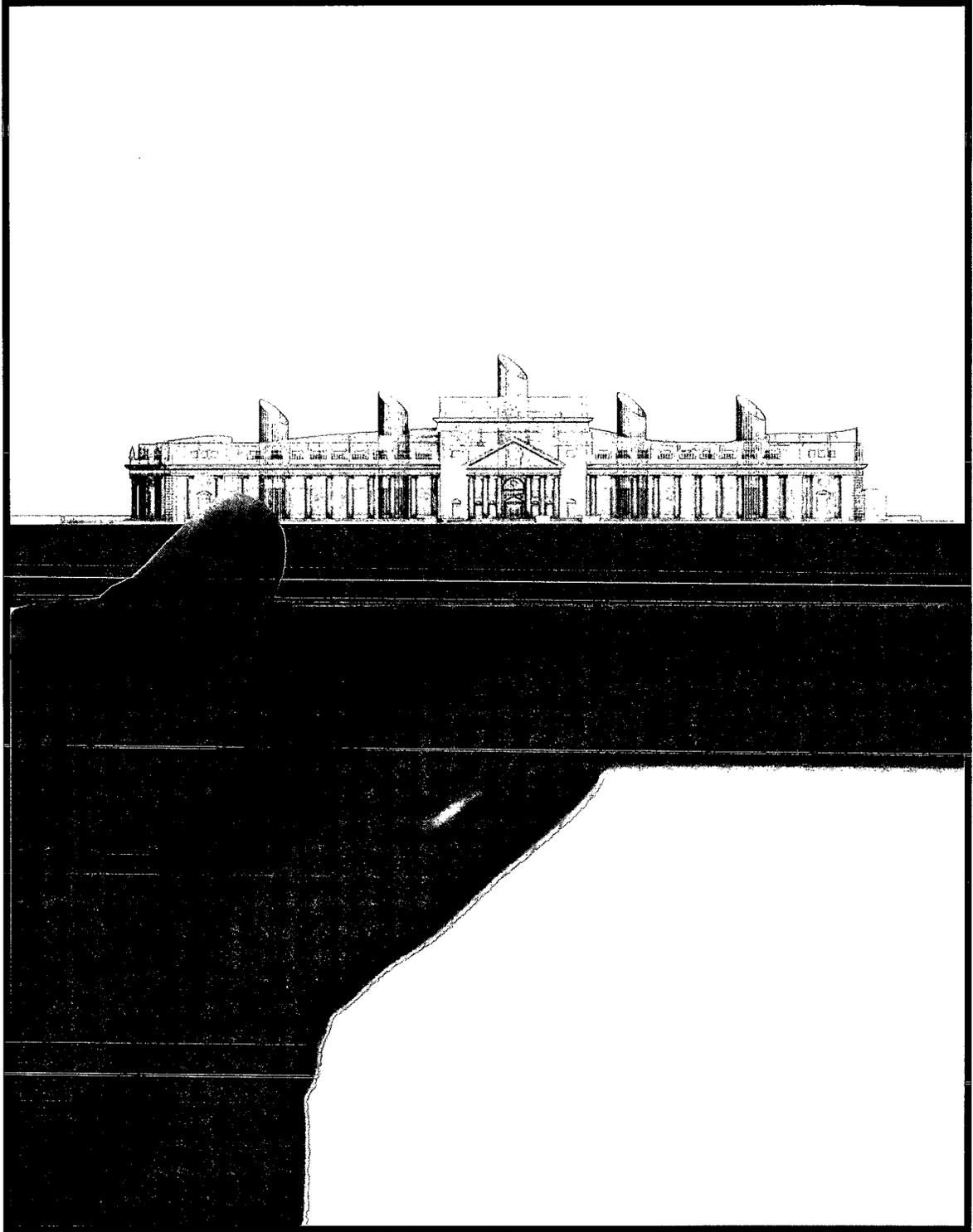


Figure 24. West Elevation

By Author

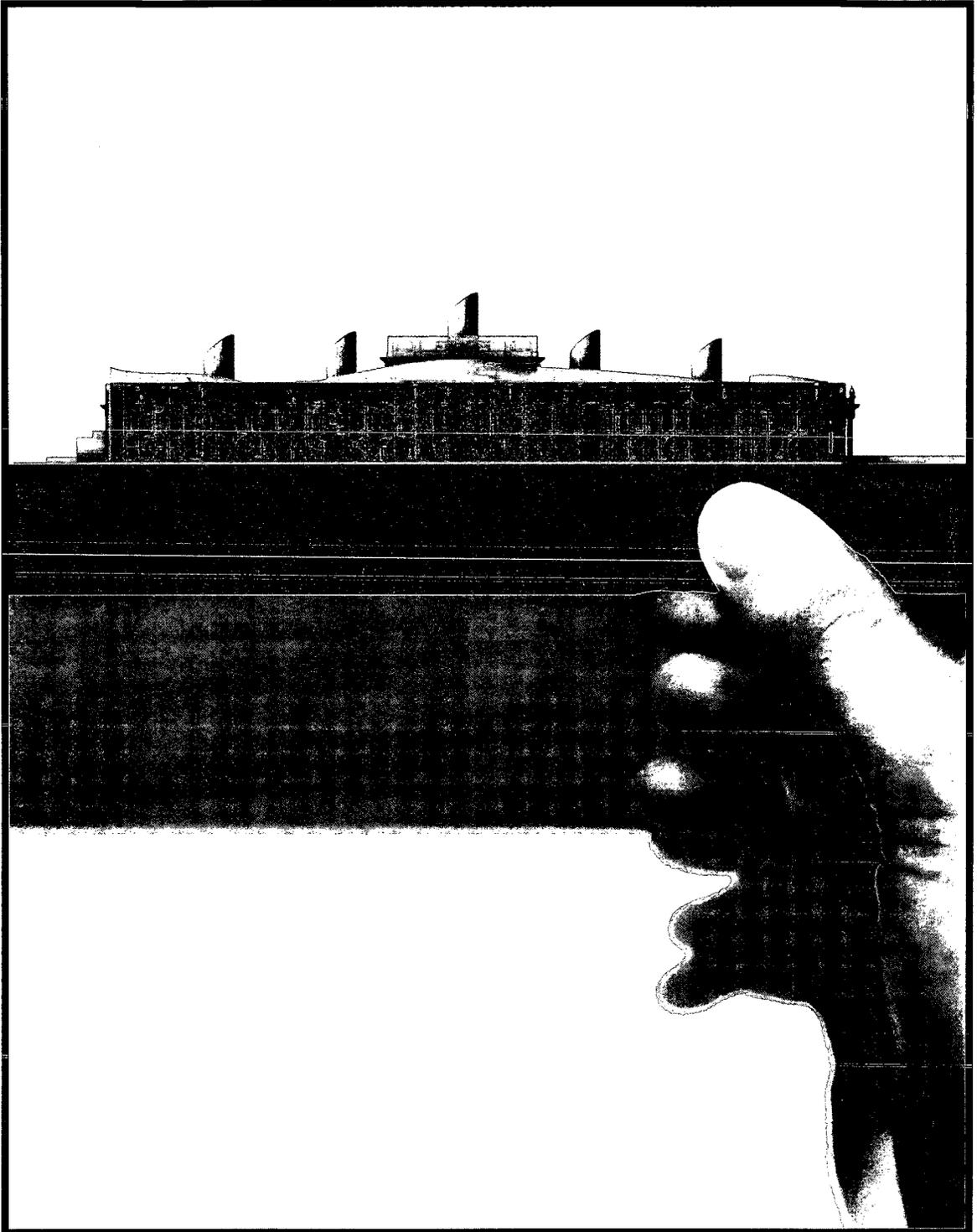


Figure 25. East Elevation

By Author

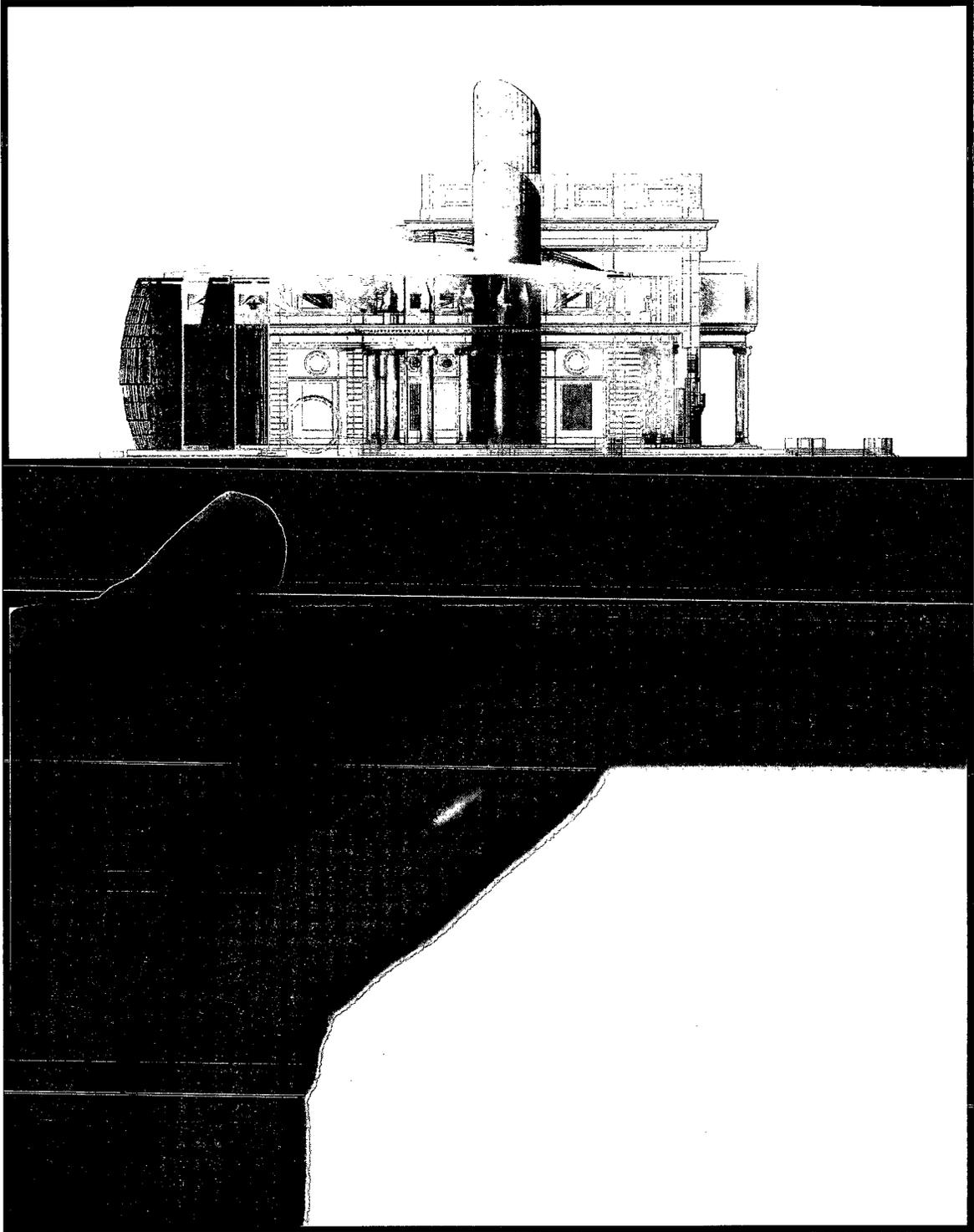


Figure 26. North Elevation

By Author

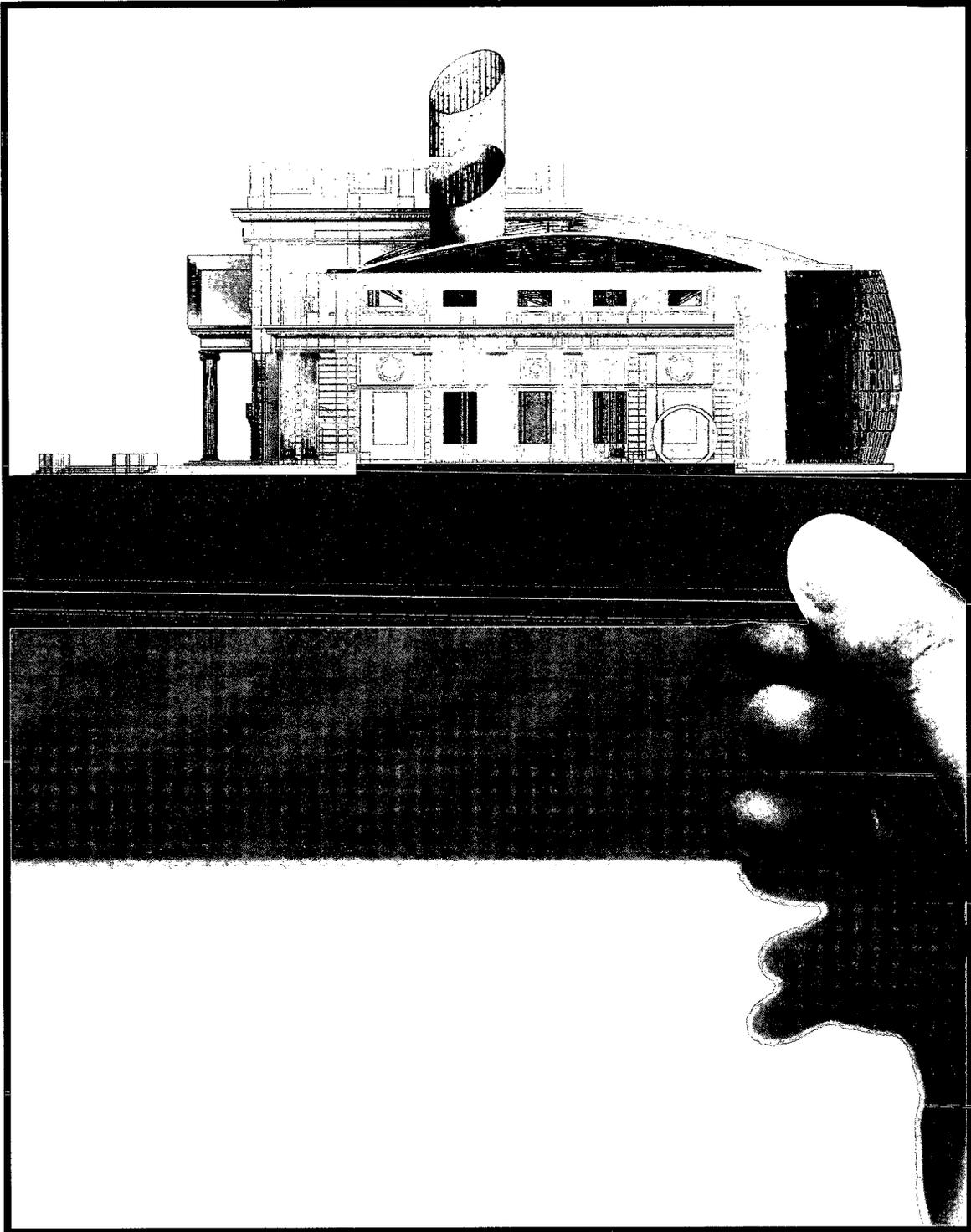


Figure 27. South Elevation

By Author

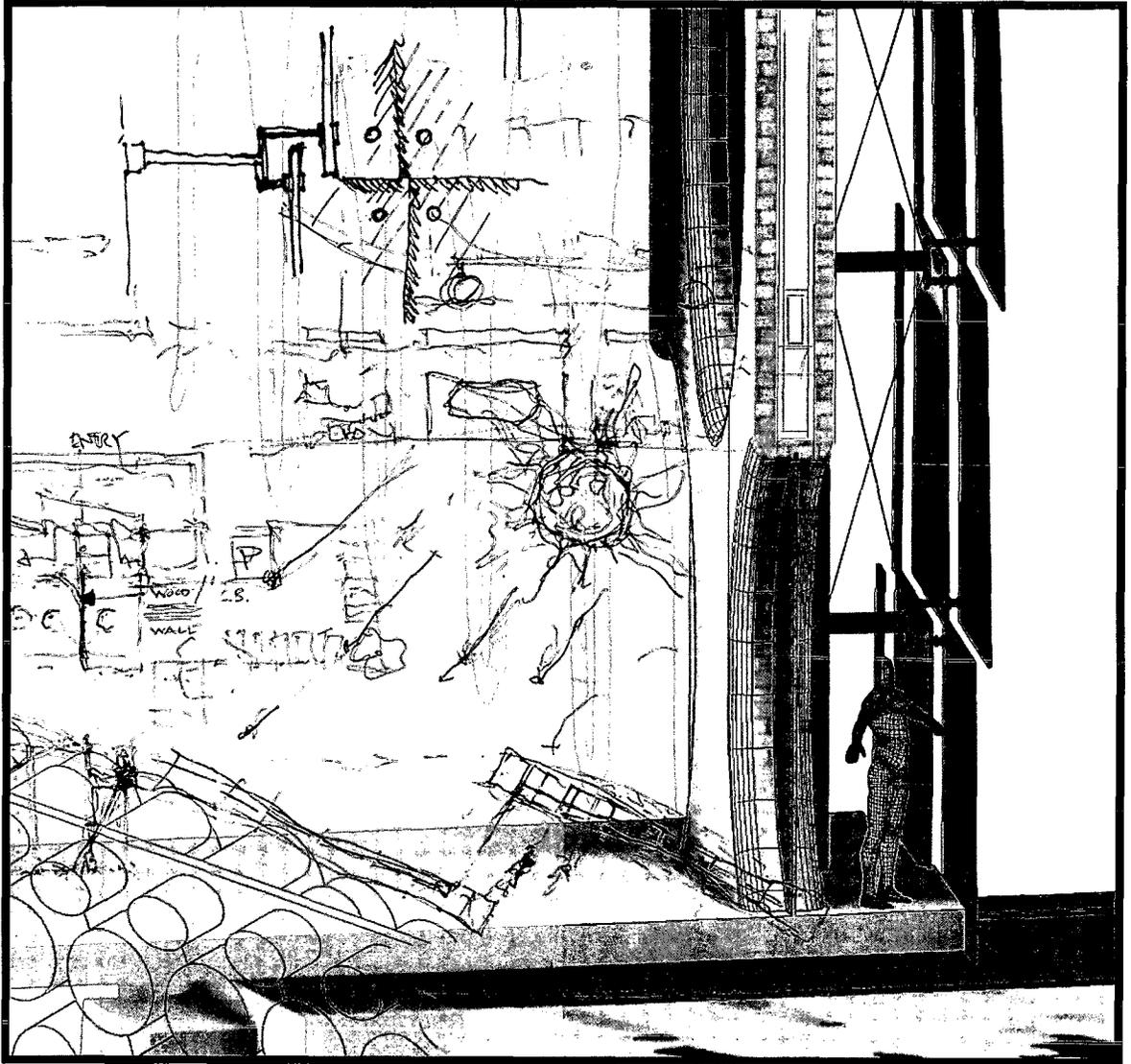


Figure 28. East Wall Section

By Author

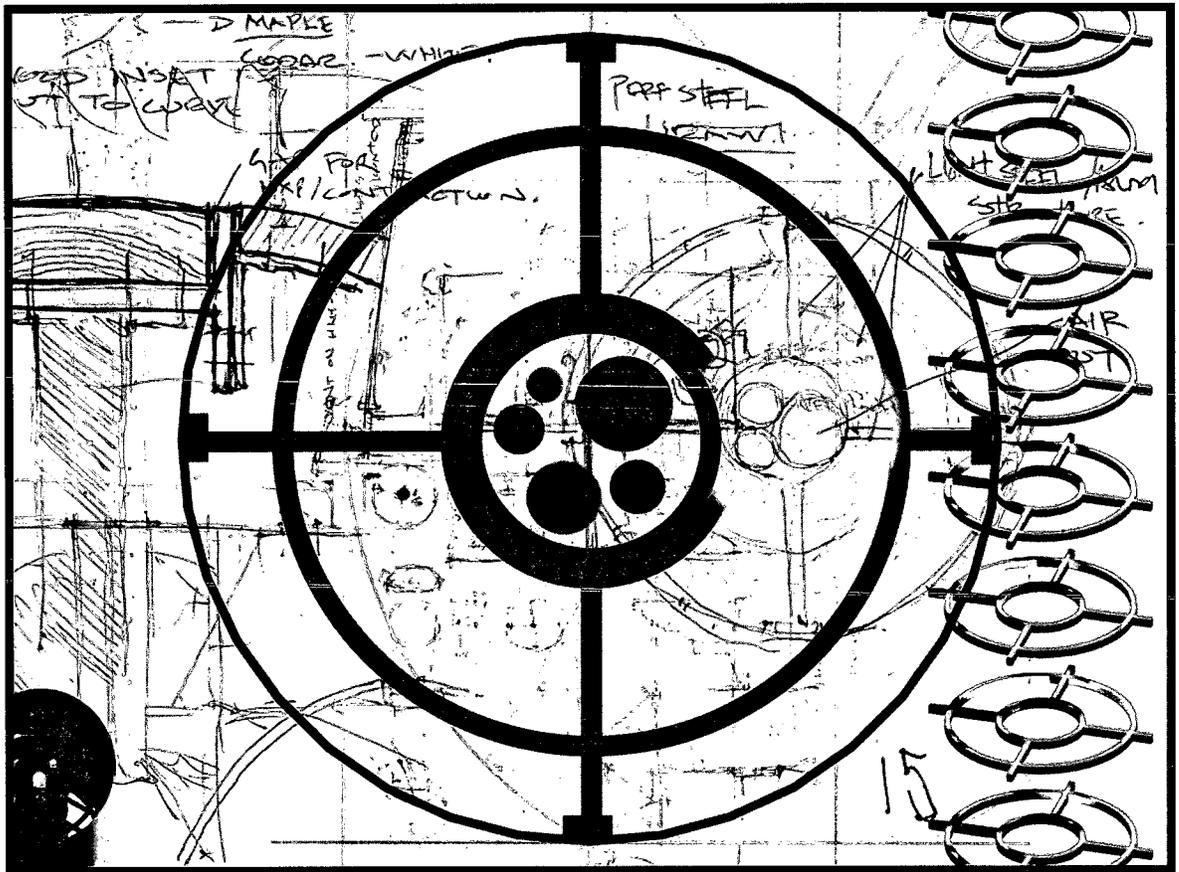


Figure 29. Lightwell Detail

By Author

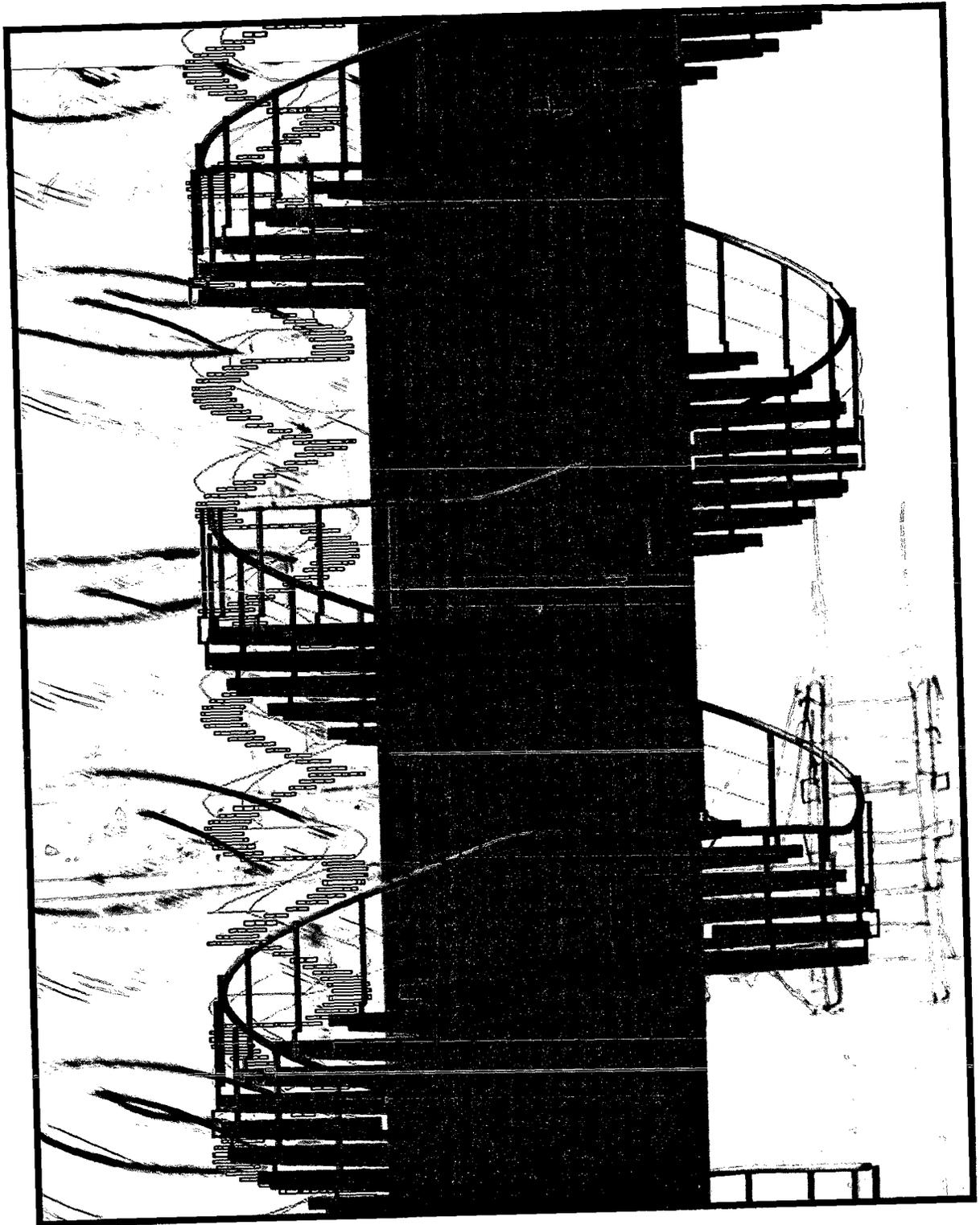


Figure 30. Stair Detail

By Author

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