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George Nakashima's Arts Building and Cloister: A Program for Conservation

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Abstract

This is the first thesis generated under the Memorandum of Understanding between the University of Pennsylvania and the Nakashima Foundation for Peace and George Nakashima Woodworker, S.A. entered into on the 1st of July 2014, which allow to study and document the Nakashima complex located at 1847 Aquetong Road, New Hope, Pennsylvania. The Nakashima complex comprises twenty-one buildings including family residences with furniture making facilities and storage spaces. Particularly, this thesis contributes to provide an informed understanding of the George Nakashima's Arts Building and Cloister (1964-1967) through an examination of its contextual history, design and construction, changes over time, and a comprehensive building conditions assessment. As a conclusion, this thesis presents a series of recommendations for both the physical preservation and the long-term stewardship of the building.

Keywords

George Nakashima, The Arts Building and Cloister, recent past conservation, craft, modern materials

Disciplines

American Art and Architecture | Architectural History and Criticism | Historic Preservation and Conservation | Modern Art and Architecture

Comments

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GEORGE NAKASHIMA'S ARTS BUILDING AND CLOISTER: A PROGRAM FOR CONSERVATION

César Bargues Ballester

A THESIS

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*The recent past is part of the future of preservation (*Mike Jackson, 1991)

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1. Introduction

This is the first thesis generated under the Memorandum of Understanding between the University of Pennsylvania and the Nakashima Foundation for Peace and George Nakashima Woodworker, S.A. entered into on the 1st of July 2014. This thesis contributes to provide an informed understanding of the George Nakashima's Arts Building and Cloister (1964-1967) through an examination of its contextual history, design and construction, changes over time, and a comprehensive building conditions assessment. As a conclusion, this thesis presents a series of recommendations for both the physical preservation and the long-term stewardship of the building.

The origins of this thesis begin with a chair. Early at the beginning of his stay in the United States, the author became interested in searching a representative piece of American design to create a good study environment at his residence. In November 2013, during an informal discussion with his academic advisor, Professor Frank G. Matero, about furniture making and American woodworkers, the author was first introduced to a number of Pennsylvanian artists and craftsmen including George Nakashima and Wharton Esherick. Providentially, the opportunity to develop a thesis on George Nakashima's woodworking and architecture emerged during Spring 2014, at the same time that the George Nakashima Woodworking complex was designated a National Historic Landmark.[1]

First introduced to the site on April 2014, the author was invited to select a building upon which he would develop his thesis. The author felt special interest in the Arts Building and Cloister, not only because of its soaring hyperbolic paraboloid roof, which represented a

[1] On April 23, 2014, Secretary of the Interior Sally Jewell and National Park Service Director Jonathan B. Jarvis announced the designation of George Nakashima Woodwoker.

challenge, but also because the building expressed George Nakashima's ideas, evoked feelings of serenity and inspired the desire to learn.

The Arts Building and Cloister stands in a peaceful place within the property, distant from the woodworking activity. The unusual architectural composition, elegant design and exceptional craftsmanship of the building deserve recognition and preservation. Thanks to regular maintenance, it has retained most of its integrity and its overall state is very good.

The Nakashima complex combines family residences with furniture making facilities and storage spaces. The buildings are sent in a landscaped setting and are interconnected by gravel driveways and visitors paths. The site comprises twenty-one buildings, nineteen of which are considered contributing to its National Historic designation.[2]

Year	Modification	Building	Contributing
1946	1959, 1970, 1988	The Workshop	Yes
1946		George Nakashima House	Yes
1954		The Showroom	Yes
1955		The Finishing Department	Yes
1956	1968	The Main Lumber Storage Building	Yes
1957		The Chair Department	Yes
1957-1960		The Conoid Studio	Yes
1958		The Lanai	Yes
		The Pool Storage House	Yes

[2] The National Historic Landmark Nomination was prepared by David Kimmerly, a Historic Preservation Specialist, and Catherine C. Lavoie, from the National Park Service, and presented the 7th of February 2013.

1960	The Pool House	
	The Swimming Pool	Yes
1964-1967	The Arts Building and Cloister	Yes
1970	The Mira Nakashima House	Yes
1971	The Mira Nakashima Guest House	Yes
1975-1977	The Reception House	Yes
1977	The Heating House	Yes
1982	The New Lumber Storage Building	Yes
1985	The Mira Nakashima Garage	No
1990	The Pole Barn	No

The site complex integrates the best of Nakashima's architecture, furnishings, landscape, and woodworking. Only a few examples stand outside his property in New Hope: Ben Shahn's house expansion (1950s) in Roosevelt, New Jersey, the Catholic Church of the Christ the King (1965) in Katsura, Japan, the Chapel of the Monastery of Christ in the Desert (1972) in New Mexico, and *La Soledad* Chapel (1975) at *San Miguel de Allende*, Mexico.

Archival research into published and unpublished material was conducted at George Nakashima Woodworker, the Architectural Archives of the University of Pennsylvania and the Michener Museum.

Chapter 2 begins with a summary of the historical research conducted during fall 2014. This chapter provides an analysis of the training and earlier influences on George Nakashima through 1941, the design and construction of the Arts Building, the rise of the hyperbolic paraboloids in the US, and Nakashima's architecture conceptualization, which drew from his dissatisfaction with the contemporary practice and his commitment to craftsmanship. The chapter closes examining the relationship with the arts and the craftsmanship.

Chapter 3 examines the as built conditions of the Arts Building and Cloister and provides a description of its architectural characteristics, assemblies, and materials. Emphasis is placed on the building's materials related to the twentieth century. Ben Shahn's Mosaic, the roof assembly, the building envelope, the reinforced concrete, and flooring addressed are in separate sections. Each section includes a technical description of the materials and their historical evolution where available. Architectural drawings, which are the result of this effort, are included in Appendix C.

Chapter 4 concerns change over time as determined through comparative analysis of archival images and photos taken by the author during the onsite visits.

Chapter 5 presents the findings of the on site conditions assessment as well as possible causes of deterioration. It also includes a brief description of the environmental context and use. Appendix D provides a set of plans with graphic representation of the conditions and annotations on the architectural drawings. Appendix E contains an illustrated conditions glossary.

Chapter 6 contextualizes a preservation philosophy by exploring scholarly and professional discussions in preserving modernist architecture and two case studies in preservation: the Sydney Opera House and the Eames House and Studio. The chapter presents a short history of modernist architecture preservation, reviews the key theoretical debates, and contextualizes a suitable preservation approach for the Arts Building and Cloister.

Chapter 7 includes a series of recommendations for further research and recommendations for building conservation. Ultimately, the aim of this thesis is to provide a detailed assessment of the building, its conditions, and the pertinent conservation issues to support the development of a future conservation management plan.

2. Historical Context

While the 2013 National Historic Landmark nomination presents a broad historic context for evaluating the significance and the integrity of the site, little has been provided specifically for the Arts Building and Cloister. Drawing upon the NHL nomination, this chapter examines various themes regarding the Arts Building and Cloister and intends to expand the previous knowledge for benefit of future researchers.

Aiming to generate an appropriate context, this study began with the compilation of primary and secondary resources and continued with a critical analysis of their contents. Essentially, this chapter is divided in two main sections: exploring, first, George Nakashima's architectural development through 1941, with and emphasis on his early training and apprenticeship, and, secondly, the design development of the Arts Building and Cloister itself. The narrative of this second section focuses, in particular, on Nakashima's use of the hyperbolic paraboloid as a roofing system, the organizational setup of the building construction, and his relationships with art and craftsmanship.

2.1. George Nakashima's Training and Apprenticeship

The many publications about Nakashima contributed to create a spirit of legend and mysticism around the artist, who has been essentially introduced and studied as furniture maker; his work as architect, however, being less represented. In fact, before turning to woodworking, Nakashima was formally trained as architect, and after a short stay in Paris, followed a career as architect in his early years that lead him to be in contact with modernist ideas, essentially with Antonin Raymond in Japan and India. These previous experiences, especially Japan, proved instrumental to the particular architectural synthesis Nakashima exemplified in the Northeastern United States.

During the 1920s, Nakashima attended the schools of architecture at the University of Washington, where he graduated in 1929, and the Massachusetts Institute of Technology, where he obtained his master's degree in 1930. Both institutions imparted an education primarily adapted from the methods and theories of the *École des Beaux Arts* in Paris, although in the case of the MIT it was amalgamated with a polytechnic system.[3] However, the climate was sensible to the rising modernist ideas in Europe, which Nakashima might have been exposed to during his sponsored stay at the *École Américane des Beaux Arts* in France, where he received the Prix Fontainebleau in 1929.

This first exposure was supplemented with a second stay in Paris in 1933, where he witnessed the construction Le Corbusier's *Pavillon Suisse*.[4] This student dormitory offered Nakashima a first-hand introduction of the modernist interests spreading trough Europe; an experience that would be enriched greatly by his work in Japan and India.

Aiming a taste for the East, Nakashima moved to Japan and joined Antonin Raymond (1888-1976) in April 1934. Antonin Raymond, who has been recognized as a "father of Modern architecture in Japan", [5] had established his own practice in Tokyo in 1921, after working, along with his wife Noémi Pernessin Raymond (1889-1980)[6], in

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[3] Joan Ockman Ed, and Rebecca Williamson, R.Ed. *Architecture School: Three Centuries of Educating Architects in North America* (Cambridge, MA: The MIT Press, 2012)
[4] George Nakashima, *The Soul of a Tree*, (Tokyo, New York: Kodansha International, 1981), 50
[5] As described on Antonin Raymond's obituaries published in the Japanese newspaper *Mainichi shinbun*, 28 October 1973, and in the British newspaper *Times,* 22 November 1976. Kurt G.F. Helfrich and William Whitaker, Ed, *Crafting a Modern World: The Architecture and Design of Antonin and Noémi Raymond* (Princeton Architectural Press: New York, 2006), 29
[6] After being trained as an architect in the Czech Polytechnic Institute and in Trieste, the Czech-born Antonin Raymond immigrated to the United States in 1910, and worked in the office of Cass Gilbert, before studying painting and moving to Italy for work as a painter. In returning from Italy, because the war inception in 1914, he met Noémi Pernessin during the journey aboard the S.S. San Giovanni, and shortly after they married. Noémi received education in fine arts and design at Columbia's University and at the École de la Grande Chaumière in Paris. Their marriage started a long-lasting support and stimulating collaboration, both in Japan and in the U.S. Ibid,20-21

different positions serving Frank Lloyd Wright (1867-1959), in 1916 in Taliesin, Wisconsin for nine months, and then in 1919 and 1920 at Taliesin and in Tokyo, as paid staff member supervising the construction of the Imperial Hotel and the design of other projects.[7]

This apprenticeship was influential to the Raymonds, although they would ultimately break away from Frank Lloyd Wright by embracing Japanese traditional craftsmanship as "a process to be mastered on its own terms to meet contemporary needs."[8] In fact, the Raymonds were disillusioned with Wright's superficial use of Japanese inspired ornament in the Imperial Hotel, which they considered as a vacuous mannerism completely separated from the Japanese climate, traditions, people, and culture.[9] In part, this course recalled Antonin Raymond's earlier training in Prague, where he was in touch with the flowing ideas connected to the rediscovery of traditional folk architecture to question the contemporary ways of designing architecture: the eclecticism.[10] Other influences drew on Auguste Perret's (1874-1954) experiences with concrete and Le Corbusier's (1887-1965) experiments on collective housing, known through magazines, Raymond's personal exposure and various European architects hired by him.[11]

The Raymonds successfully practiced a synthesis of Western modernist ideas with Japanese lifestyle and construction, which would be ultimately internalized by Nakashima. Working at Raymond's office, Nakashima was exposed to a climate of interchange, were modernist ideas were discussed and filtered with a Japanese vision, where the spirit of the Daiku, traditional carpenters, and the Minka, vernacular farmhouses, were admired. In fact,

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7 Ibid, 21
8 Ibid,24
9 David B. Stewart, *The Making of a Modern Japanese Architecture: From the Founders to Shinohara and Isozaki* (Tokyo: Kodansha International, 2002), 89
10 Christine Vendredi-Auzanneau, "Antonin Raymond and the Modern Movement: a Czech Perspective" in Kurt G.F. Helfrich and William Whitaker, Ed, *Crafting a Modern World: The Architecture and Design of Antonin and Noémi Raymond* (Princeton Architectural Press: New York, 2006), 32
11 Ibid.

Antonin Raymond had been hiring European and Japanese architects to catalyze the modernist ideas, nurturing thus this climate. Nakashima worked with architects such as Maekawa Kunio (1905-1986), Junzō Sakakura (1901-1969), and Czech František Sammer (1907-1973), who had worked for Le Corbusier before joining Raymond's office.[12] More importantly, perhaps, was Junzo Yoshimura (1908-1997), also colleague at Raymond's office, who guided Nakashima in his study of the Japanese spirit, traditions, and architecture, including a travel to visit the shrines and temples of Kyoto. Raymond's publication also played an influential role, like *Antonin Raymond: His Work in Japan 1920-1935* (1935) and *Architectural Details* (1938), which included architectural details evolved from Japanese traditions that Nakashima "used them almost literally in both his buildings and his furniture."[13]

During his stay in Tokyo's office, Nakashima absorbed Raymonds' synthetic approach and practice, particularly through two projects that would be early precedents of Nakashima's architecture in New Hope: the Raymond's Summer Studio (1933) and the St. Paul's Catholic Church (1934-35), both in Karuizawa, a retreat established by Western missioners among the mountains of Nagano prefecture few hours to the northwest of Tokyo, which would become a popular destination for wealthy Japanese by the 1930s.[14]

At the Raymond's Summer Studio, Antonin Raymond dealt with the site, local materials, and the construction craft, which stemmed from Daiku, the vernacular Japanese carpenter traditions, to build a complex that included a residence, a studio, and a caretaker's house. The residence and studio laid out in an asymmetrical floor plan of interconnected

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12 Ibid.

13 Mira Nakashima, *Nature, Form & Spirit: The Life and Legacy of George Nakashima* (New York: Abrams, 2003), 21

14 William Whitaker, and Ken Tadashi Oshima, "Portfolio" in Kurt G.F. Helfrich and William Whitaker, Ed, *Crafting a Modern World: The Architecture and Design of Antonin and Noémi Raymond* (Princeton Architectural Press: New York, 2006), 154

spaces, was a hand-hewn chestnut and cedar framed structure constructed upon poured concrete plinth. The house metal roof was covered with branches of Japanese larch, to protect the roof from the heat and to dampen the noise of the recurrent rains during summer. The main space was the living room, a double-height space organized around the fireplace and the ramp, which connected the studio in the upper floor. Overall, interior spaces flowed into the views of the surrounding landscape through a wide opening in each elevation.[15]

Fig. 2.1: Karuizawa Summer House. South and East Facades. Source: Kurt G.F. Helfrich and William Whitaker, Ed., *Crafting a Modern World: The Architecture and Design of Antonin and Noémi Raymond*

Revealing an interest in the raw qualities of the materials, the house and the furniture were of the simplest. By retaining the prints of the wooden formwork, made of the same species than the walls, the imperfections of the crafted wood were harmonized with the plasticity of the concrete. In so doing, the concrete, as new material, dialogued with the

[15] Ibid,154

deep-rooted tradition of wood construction in Japan.[16] The Raymond's Summer Studio was thus a defining model for Nakashima, who witnessed in first-hand the possibilities of the vernacular traditions in crafting modern architecture. In fact, Nakashima among a selected group of staff members was residing in the caretaker's cottage during their visits and his work in St. Paul's Church. The caretaker's cottage and the swimming pool, which was added between the public and the private wings of the residence, might constitute the earliest references for articulation of the exterior spaces and the idea of the Cloister itself in New Hope.

Local and their inner qualities materials were also favored in St. Paul's Church, where Nakashima collaborated on the design and construction. In 1935, the father Leo Paul Ward (1896-1942) commissioned the Raymonds to build a Catholic church, after their Summer House and Studio to serve the spiritual needs of the foreign community sojourning in Karuizawa. Sections and floor plants showed an asymmetrical basilica arrangement, the pitched roof and the bell tower with the steeple being reminiscent of Slovakian churches. However, the building and the furnishings were expressed through the Japanese carpenter traditions, this hybrid offering a new conception on the design of sacred spaces.[17]

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[16] Ibid, 72
[17] Ibid, 162-165

Fig. 2.2: St. Paul's Catholic Church in Karuizawa. Entry Facade. Source: Kurt G.F. Helfrich and William Whitaker, Ed., *Crafting a Modern World: The Architecture and Design of Antonin and Noémi Raymond*

Deepening in the possibilities of the Raymond's synthesis, the experience in St. Paul's Church exposed again Nakashima to the use of concrete and the craft of wood. In this occasion, both wood and concrete were polished with straw and sand to emphasize again the natural qualities of the materials.[18] Nakashima also contributed to craft the furniture, which was made of leftover lumber.

After Karuizawa, other influential experience would challenge Nakashima in the use of crafts, but in this occasion in a different context and without the assistance of trained carpenters. In the same year that St. Paul's Church was erected, in 1935, Sri Arubindo Gosh (1872-1950), the leader of a spiritual community or ashram, commissioned Antonin Raymond to project and build a new residential dormitory for his disciples in Pondicherry, India. Previously, Raymond had been introduced by Philippe B. St. Hilaire (Pavitra), a

[18] Ibid, 72

French engineer and ashram disciple himself, who was a close friend of the Raymonds in Tokyo. In this project, Nakashima was assigned to an initial visit, and later to supervise the execution of the construction along with the František Sammer. Sammer contributed with his previous experiences in the Centrosoyuz, the Palace of the Soviets competition (1931), and the Pavilion Suisse (1931-32), and undertook the Golconde project until its completion.[19]

The Golconde Dormitory (1935-42) was projected as a concrete structure faced north and south. Essentially, it was comprised of two rectangular volumes, which were offset to each other, joined and served by a central service tower containing and the stairs the and hygienic facilities. Modest rooms dedicated to sleep and the study were placed on the upper levels, whereas the dinning and common rooms were located at the ground level. The building was engineered to adapt to the tropical and humid Pondicherry's climate characteristics. A roof of precast concrete barrel shells, louvers and overhangs play a role of sun shield and heat control.[20]

Supervising and living in the ashram, Nakashima gained essential experiences both in the spiritual dimension and in his practice as an architect and craftsman. However, unlike the experiences in Karuizawa with the Japanese carpenters, Nakashima dealt with a casual labor integrated by members of the ashram, who were primarily inexperienced in the field of building construction.

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[19] Kurt G. F. Helfrich and Mari Sakamoto Nakahara, 37
[20] William Whitaker, and Ken Tadashi Oshima, 170

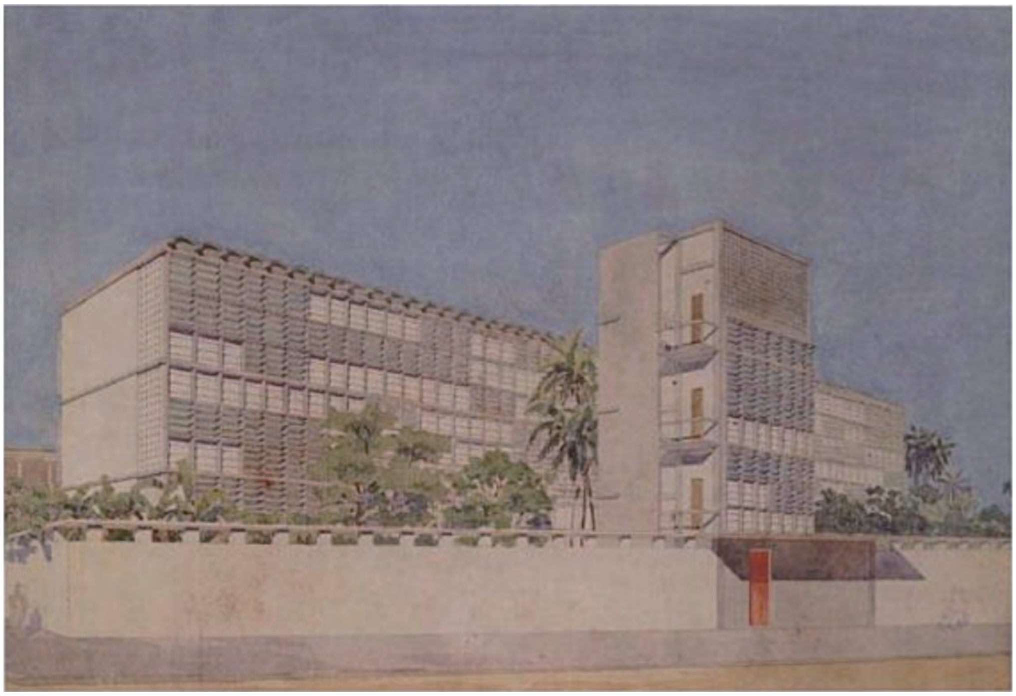

Fig. 2.3: Golconde Dormitory. Perspective from North. Source: Kurt G.F. Helfrich and William Whitaker, Ed., *Crafting a Modern World: The Architecture and Design of Antonin and Noémi Raymond*

As a project architect, Nakashima explored and refined the construction materials and details through the construction of scaled models, which would ultimately constitute a model for his own practice in New Hope. Once again, he was in touch with the reinforced concrete technology and with the craft. Nevertheless, in this occasion, the lack of materials, due to the political unrest in Asia and Europe, and the inexperience of the ashram members compelled Nakashima and Sammer to improvise and to develop alternative solutions through the craft,[21] which ultimately would help Nakashima to deepen even more in the possibilities of the materials.

Employing the craft as a means of facing the lack of manufactured materials for building construction or acceptable furniture had been already proved a successful path by

[21] For example, Nakashima and Sammer built a foundry on the building site to produce Golconde's hardware. Pankaj Vir Gupta and Christine Mueller, "Golconde: The Introduction of Modernism in India" in 2005 AIA Report on University Research (Washington, D.C.: AIA, 2006), 150

the Raymonds, who designed their own modernist furniture in a Japanese context not sufficiently exposed to the western taste. As described earlier, Nakashima participated in this process in Karuiwaza, now in Pondicherry, and would supplement and improve this training during his later internment in Idaho as explained later in this section.

As an ashram disciple, Nakashima, who was called Sunderananda, which means 'one who delights in beauty', evolved a deeper understanding of life and a spiritual sense that ultimately influenced Nakashima's position upon craft and organizational approach in New Hope. The Sadhana, a "spiritual training to attain deep concentration resulting in union with the ultimate reality,"[22] would be implemented in New Hope, each workmen having the opportunity of develop himself and judge the most suitable path to do their work within certain guidelines. In fact, Nakashima aspired to create "a center for the evolution of life moved by higher consciousness, a life of the spirit."[23] These ideas would be summed up in his book *The Soul of a Tree*, published in 1981, where Nakashima revealed a spiritual interpretation of the woodworking interweaved with a utilitarian dimension.

Having completed most of the concrete work in Golconde's structure, George Nakashima left India in 1939, to work for few months in Tokyo with Kunio Maekawa (1905-1986), a former colleague of Raymond's office, before returning to the United States. During this time Nakashima met his future wife the American Japanese Marion Sumire Okajima (1912-2004). After marrying in 1941, they moved to Seattle, Washington, were Nakashima worked as an architect for Ray Morin and began to make furniture as a part-time activity. However, shortly after the Pearl Harbor Japanese attack and the war started, Nakashima was interned with his family in Minidoka, Idaho, as other American Japanese. At

[22] George Nakashima, *The Soul of a Tree*, p.138
[23] Mira Nakashima, 18

the camp, Nakashima had another further influential experience; he met Gentaro Hikogawa, an Issei carpenter who improved Nakashima's craft skill in training him in the use of Japanese hand tools and traditional wood joinery.[24]

After receiving a communication from the Dean of the MIT, Nakashima's former employers, the Raymonds dealt with and sponsored the Nakashima family release, which settled on the Raymonds' farm in New Hope in 1943. Since most of the Raymonds' commissions were government-related, Nakashima could not work as architect. He was dedicated to farming and eventually to woodworking, until he established by himself in 1946 having bought a three-acres property along Aquetong Road in exchange for carpentry work. There, Nakashima began a woodworker complex where he brought all the above experiences in Europe, Japan, and India together, which Nakashima interpreted and synthesized on his architecture, the constant evolution of which leaded to the construction of the Arts Building and Cloister in the mid-1960s.[25]

2.2. The Arts Building and Cloister (1964-67)

When Nakashima decided to build the Arts Building, he had already designed and built eight buildings at the property, answering the demand of a business in expansion.[26] The location was the low-lying eastern limit of Nakashima's property, where the slope leveled off, an isolated location distant from the rest of the compound. In using a tilted hyperbolic paraboloid roof, the Arts Building culminated a decade of experimental research on expressive roofing within the property and signified a continuation in the use of traditional

24 Ibid, 40-41

25 According to Kurt G. F. Helfrich, several Antonin's former protégés continued to explore the influence of Japanese lessons in the contemporary American design during the 1950s and 1960s. Kurt G.F. Helfrich and William Whitaker, 59

26 An article publishes that there were 20 workmen at this time. "Names: George Nakashima" in Architectural and Engineering News (September 1963), 119

and manufactured materials. In addition to this striking feature, the Arts Building and Cloister introduces the idea of bridging art, craft, and education into a sole compound, which also became a marketing tool for both artist and woodworker.[27]

In New Hope, in accordance with his previous experience in Pondicherry, Nakashima had been constructing scaled models to understand and control the practical details for a subsequent larger construction, such as the Chair Department (1947) and the Pool Storage House (1958), which established the model for the Conoid Studio (1957-60) and the Pool House (1960) respectively. In the case of the Arts Building Nakashima used the technology previously experimented at the Main Lumber Storage Building in 1956, in which the American, Hungarian born, Paul Weidlinger (1914-1999) acted as the consulting engineer.[28] Having collaborated in Reader's Digest Building (1948-1951), which was built in Tokyo by Raymond and Rado's office, Paul Weidlinger was probably introduced to Nakashima by Antonin Raymond.

This was not the solely collaboration between architect and engineer, together with Mario Salvadori (1907-1997), Weidlinger proposed to cover Nakashima's Conoid Studio (1957-60) with an undulating conoid concrete shell of 2 1/2 thick.[29] Besides, the engineering firm was also the consultant for the Chair Department (1957) and the Pool House (1960), both using plywood as a roofing material.

Nakashima eventually built five roofs of various warped shapes on New Hope, two hyperbolic paraboloids, and three conoidal shapes of different materials and shapes. In the

[27] Nakashima's business nature offered an opportunity to market their production by other set of practices and activities. George Nakashima, *The Soul of a Tree*, 72-73
[28] Paul Weidlinger (1914-1999) was born in Budapest, Hungary, and received an MS from the Swiss Polytechnic Institute, Zurich, Switzerland. He apprenticed in Paris with Le Corbusier and in London with László Moholy-Nagy before coming to the United States in the late 1940s and establishing Paul Weidlinger Consulting Engineer in 1949. http://www.wai.com/pressrelease.aspx?id=146#sthash.TXxRJXGH.dpuf, accessed February 28, 2015
[29] "Sea Shell Roof: Adventure in Structure" in *Architectural Record* (November 1957), 183-188

case of the Arts Building, while the use of a hyperbolic paraboloid appears to be decided from the beginning by Nakashima, the exteriors, the general layout, and the elevations arrangement evolved during the conception phase. In addition, drawings including detailing gives a particular air of precision required for crafting wood.

Although few landscape elements appear to have considered in the beginning, the relation of building and site was expressed in a site plan with the existence of a pond, a terrace, a footpath encouraging the promenade, and the inclusion of a road and parking area separating in a modernist manner the pedestrian flow from the road traffic. It appears that the definition of the landscaped area surrounding the Arts Building probably came up after the building was being completed, when he addressed the design of the Cloister and the pathway connecting to the Arts Building.

Fig. 2.4: George Nakashima Woodworker before the Arts Building construction. Unknown date. Source: George Nakashima Woodworker SA, Ltd. Archives.

In the front yard area, articulating the Arts Building and Cloister areas, Nakashima introduced a pond that is probably reminiscent of the swimming pool in the Raymond's Summer Studio in Karuizawa, which separated the living area of the sleeping area and integrated a water feature as a functional and visual element in the architecture. An existing large stone partly delimited the pond conceived in the front yard area. This stone generally has been defined as the element of inspiration of the building shape,[30] but in fact it is revealing an intended poetic relationship between architecture and landscape, as Nakashima desired in following the Japanese traditional principles.

The main change on the layout during the conception phase was related to the location of the fireplace. First it was projected in the northeast elevation, which was pierced with two windows that appears to provide views of the exterior breaking the massive perception of the wall rather than light, since lighting was guaranteed by the existence of four skylights. The duo formed by window and fireplace finally found their place in the northern wall, generating a sitting area within the exhibition space.

This sitting area was eventually conceived as visible through a squared opening in the wall closing the north side of the vestibule, which provided a larger view counterbalancing the short view of the walls. One might conclude that Nakashima was especially sensitive to the visual qualities and phenomenological aspects of the architecture, and had a genuine understanding of how to use the elements to manipulate the experience of the architectural space.

The change on the fireplace location was also accompanied by alterations on the west and south elevations design. Starting with large areas covered by wood grill, Nakashima

[30] George Nakashima, *The Soul of a Tree*, 72

gradually broke down this shading solution and created a composition with a broader direct interrelationship with the exterior, which in turn enriched and modulated the elevations. Essentially, the wood grill was a Japanese inspired frame of vertical cypress strips supported by horizontal cypress strips, which ultimately were designed as operable sunshades.

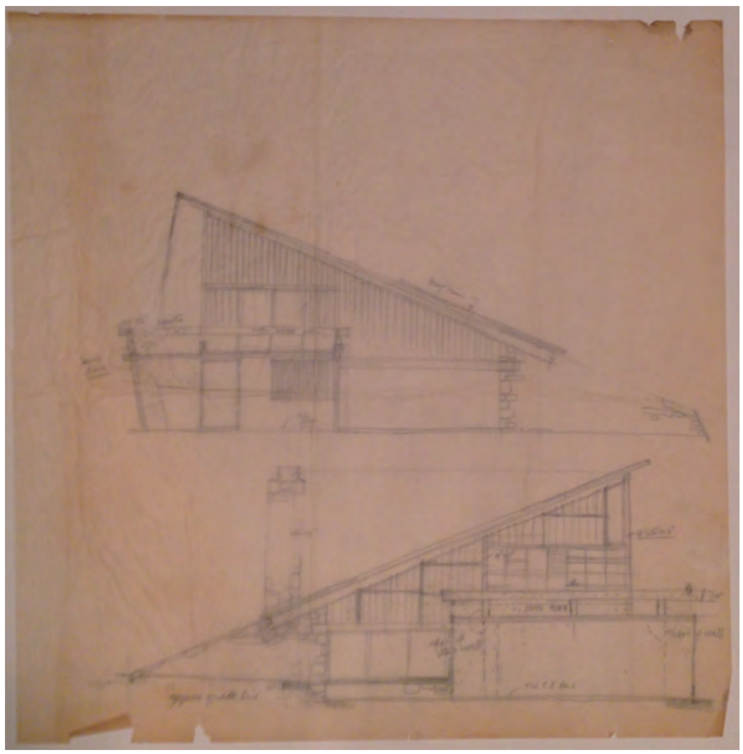

Fig. 2.5: George Nakashima's hand drawing. South and west elevations. Source: George Nakashima Woodworker SA, Ltd. Archives.

As in earlier buildings, Nakashima used materials at hand, not only those traditional such as local stone and wood, he also took advantage of industrial hardware and materials, some of them recalling Japanese traditions such as the ochre colored rough surfaces of the Structolite™ coat for exposed wall plaster. This practice was a constant in Nakashima, as it happened on his own house or the showroom, where he had used asbestos cement panels, flats or corrugated, for covering walls and roofs.

The Arts Building was initially intended to exhibit graphic works by Benjamin Shahn (1898-1969) along with Nakashima's furniture.[31] The building, promoted as a private museum, covered a period of around 33 years of Ben Shahn's work, beginning with "Seward Park, 1934" through approximately 55 graphics[32] in Nakashima's frames that were "reminiscent of Shinto shrines."[33] In placing pieces of furniture and artworks together inside the building, Nakashima also generated a suitable context for the business promotion, which portrayed high-minded ideals and a sense of moral coherence with his craft-rooted practice.

Besides, the use as museum was soon supplemented with spiritual and educational dimensions. Though no precise evidence supports it, there is a strong possibility that George Nakashima decided to build the adjoining Cloister in relation to his participation with Minguren, which means "People's Tool Guild" and was a newly group of designer-craftsmen based in Japan that fostered the traditional Japanese craft through its modernization in engaging American and European designers. Membership requirements for Minguren were a sincere engagement with creation and the fact of creating within an equalitarian fellowship. This idea may have also encouraged Nakashima's decision to build the Cloister as a way of reinforcing this artistic fellowship trough a monastic model. This connection was so much strong that by 1967, the Arts Buildings was already promoted as the Minguren museum, even before Ben Shahn's death.[34]

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31 An earlier hand drawing is titled "Arts Building & Workshop", which suggests that Nakashima might have considered the idea of locating part of the manufacturing process in the building besides of exhibiting artworks. In the same drawing, the Cloister, which is named "utilities", is barely outlined.
32 Peggy Lewis, "Minguren Museum-Building Shape" in *Sunday Times Advertiser* (May 21, 1967), 10
33 Andrew Ellis, "Woodworking and a Search for Wisdom, Bucks County's George Nakashima: Serene and Simple Furniture form a Troubled and Complex Man" The Sunday Bulletin Magazine, January 28, 1968, pp. 8-9
34 "Minguren Museum - Building Shapes Idea" in *Sunday Times Advertiser* (May 21, 1967)

Fig. 2.6: Interior of the Arts Building. Source: George Nakashima Archives digitized by the Architectural Archives of the University of Pennsylvania.

2.2.1. Hyperbolic paraboloids

Inspired by the growing interest in the functional and visually striking qualities of the warped roofs during post war America, Nakashima experimented with the use of plywood as the essential building material to construct three early roof examples: the Main Lumber Storage, using a hyperbolic paraboloid, which became the prototype for the Arts

Buildings, a conoidal roof clubhouse for workers, which shortly became the chair assembly shop or the Chair Department, which became the model for the Conoid Studio, and the Pool Storage House, which became the model for the Pool House.

Of European origin, hyperbolic paraboloids widely spread across America during the 1950s within a general climate of innovation. Two main factors favored this context: engineers, architects, and builders, who had emigrated from Europe fleeing from war ravages, searching for new opportunities; and manufacturers associations, like the Douglas Fir Plywood Association (1933-1964), which promoted the use of materials used during the war through experimentation in domestic construction and design.[35] Simultaneously, a myriad of publications in journals, university researches, and conferences accompanied the rising interest in hyperbolic paraboloids. In publishing an article devoted to this type of roofs in 1955, *Architectural Forum* illustrated the trend and offered a concise definition:

> Hyperbolic paraboloid is warped double-curved surface, saddle shaped, generated by straight line that slides along two straight line directrices not in same plane and remains parallel to plane director. Any intersection of surfaces with vertical plane parallel to its diagonals produces parabolic curves. Although it is double-curved surface, its intersection with vertical plane parallel to edges of surface produces straight lines. Only central lines are horizontal.[36]

The article showed various structural combinations, including the two eventually used by Nakashima. *Architectural Forum* was familiar to Nakashima, as his Showroom (1954) had been published few months ago accompanied with some photos in color. Although there is no documented evidence of it, in the case of the Main Lumber Storage, the most direct typological reference might be the sweeping roof built in Raleigh, North Carolina, in 1954, which was designed by Argentinian architect Eduardo Catalano (1917-2010) for his

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[35] Tyler S. Sprague, "Beauty, Versatility, Practicality: the Rise of Hyperbolic Paraboloids in post-war America (1950-1962)" in Construction History, vol. 28, no. 1, 2013, 167

[36] "A New Way to Span Space" in *Architectural Forum* vol. 103 (November, 1955), 174

own house. Catalano used bent timber planking for constructing a shell. This was the result of a research program that he implemented at North Carolina State College, continuing the efforts of his predecessor Polish architect Matthew Nowicki (1910-1950). Nowicki, Raleigh-based architect William H. Deitrick (1895-1974), and engineer Fred Severud (1899-1990) had designed J.S. Dorton Arena (1952), also in Raleigh, a structure covered with a parabolic cable roof, which earned ample recognition in the United States.[37] *Architectural Forum* also published Catalano's hyperbolic paraboloid roof,[38] and other influential works such as those of Pier Luigi Nervi (1891-1979). Progressive architecture did the same with Félix Candela (1910-1997),[39] who had attracted attention with his hyperbolic paraboloids in the early 1950s. Nervi and Candela became leading figures that also contributed to the general interest in creating greater and more exciting structures.[40]

In the Mid-West, contemporaneous to Nakashima's Lumber Storage, the Department of Architecture and Architectural Engineering of the University of Kansas began their own research on hyperbolic paraboloids using plywood sponsored by the Douglas Fir Plywood Association (DFPA) and leaded by professor William Strode and Donald L. Dean. As a consequence of this research, in April of 1956, students of the department built an experimental combination of two hyperbolic paraboloid shells each 20 by 20 feet connected along one edge. Essentially, the shell was a lattice structure that

37 Building Engineering section in *Architectural Forum*, vol. 98 (May, 1953), 170-71 and Tyler S. Sprague, 167-168
38 "A New Way to Span Space" in *Architectural Forum,* vol. 103 (1955), 170-177
39 Progressive architecture 36 (Jul 1955): 106-115
40 Architect Félix Candela (1910-1997), Spanish émigré in Mexico, lectured in the US as early as 1954 and became a reference in hyperbolic paraboloid reinforced concrete construction. The works of the Italian engineer Pier Luigi Nervi (1891-1979) were mostly related to domes and parabolic structures. Nervi's parabolic hangar in Rome illustrated the first page of an article focused on space-frame structures: "Is this Tomorrow's Structure?" in *Architectural Forum* vol. 98 (February, 1953), 150-151. Candela and Nervi, along with Mario Salvadori, were admired by George Nakashima as Mira explained in *Nature, Form, and Spirit*.

consisted of two layers of 1/4-inch plywood strips nail-glued to plywood box beam perimeter members. Three reinforced concrete abutments supported the roof structure.[41]

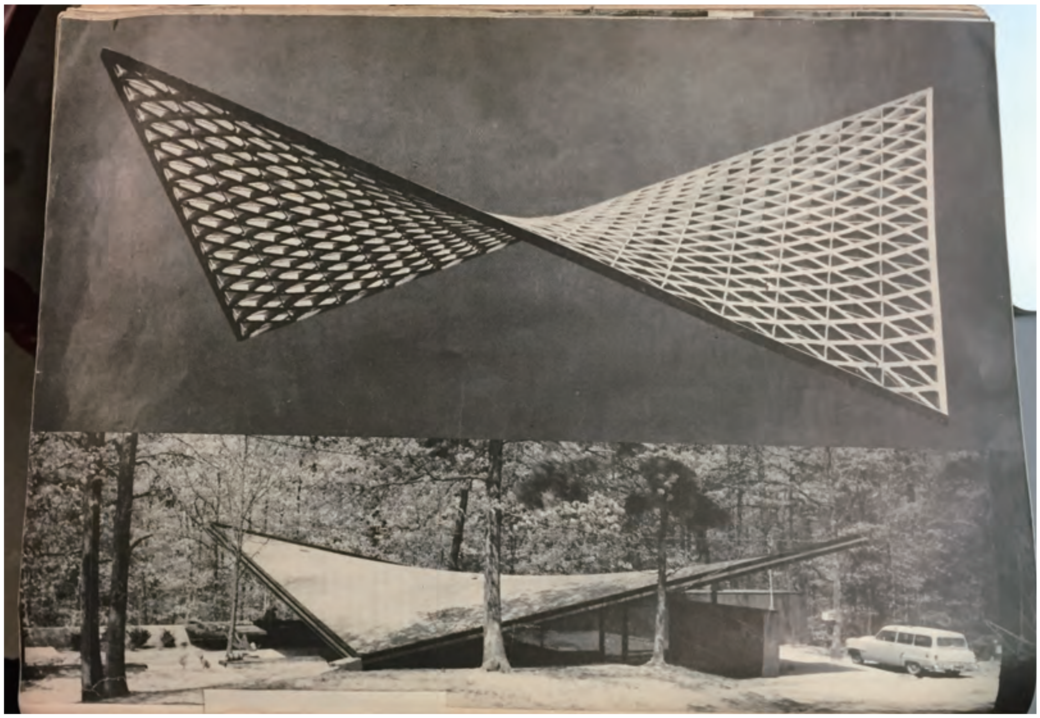

Fig. 2.7: Eduardo Catalano's hyperbolic paraboloid. Source: *Architectural Forum*, November 1955

The results of the research were lectured widely in conferences and symposia; likewise DFPA continued sponsoring researches and advocated the use of plywood with technical and promotional publications such as *Exciting new leisure-time homes of fir plywood* (1958) and *Second Homes for Leisure Living* (1960). It is worth mentioning that *Architectural Forum* published in 1953 an article illustrated with a molded plywood roof experiment by students of the University of Pennsylvania under the guidance of architect Paul Rudolph.[42]

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41 Tyler S. Sprague

42 "Space Frame Defined" in *Architectural Forum* vol. 98 (February, 1953), 154

This suggests an increasing interest in using plywood as building material, the use of which became a natural path for Nakashima.

Although there is no documental evidence for affirming that Nakashima knew about of all these experiments before building the lumber storage, it is likely the engineer Paul Weidlinger and associates did. In fact, Mario Salvadori, who began his collaboration with the engineering firm in 1945, had already discussed the overall virtues of thin shells, their various shapes, and suitable materials in a series of three articles in *Architectural Record* in 1954.[43] Besides, Nakashima was early in touch with this modern material through the Raymonds, who had used plywood for his house in New Hope (1938-39) and earlier works in Japan.

2.2.2. The Hands-on Approach on the Arts Building: Organization and Hierarchy

George Nakashima's dissatisfaction with the contemporary practice of architecture in America catalyzed his primary adherence to woodworking, a process that he could control from the beginning to the end, which demanded an integrated relationship between the processes of design and production. When looking this approach in the context of both the particular conditions in Bucks County and his apprenticeship with Antonin Raymond, why Nakashima did few drawings in comparison to other contemporary architects becomes clear. Yet, as the hand drawings portray, Nakashima's sketches are not necessarily empty of details, and are mirroring the hierarchy in the construction process.

[43] Mario Salvadori "Thin shells" in *Architectural Record* (July 1954), 173-179, (September 1954), 212-217, (November 1954), 217-223. Besides, as Matthew Levy indicated, Mario Salvadori was the theorist, while Paul Weidlinger and Levy himself worked on the design and solved the practical problems. Tom Weidlinger. "Nakashima's Roof." http://restlesshungarian.com/nakashimas-roof/ (accessed in May 2015).

As the Raymonds, Nakashima found New Hope vicinity an appropriate location for establishing his workshop. In fact, since the late nineteenth century, New Hope had been attracting group of artists searching both a sense of community and a relatively cheap location in the proximity to New York and Philadelphia. At the time the Raymonds established their farm in 1939, various visual artists, writers, playwrights, and wealthy New Yorkers had been buying and restoring countryside stone farmhouses to settle in the area, which would have generated a vibrant artistic community.[44]

Within this context, Nakashima adhered to the "model of the solitary craftsman"[45] and began to work into a single studio applying a philosophy that echoed the tenets of Antonin Raymond, who believed that "life philosophy and design philosophy are one thing, and if the fundamental precepts of life's philosophy become confused, so will design in any field of art become confused."[46] Intriguingly, this approach resonated with other craftsmen and designers in the Northeast of the United States, such as Wharton Esherick (1887-1970) and previously with Henry Chapman Mercer (1856-1930).

However, despite Nakashima's aloofness, a successful business demanding new facilities, offered him a chance to apply his hands-on approach in architecture that stemmed on the earlier experiences in India and Japan, which were discussed in greater detail in the previous section.

In Pondicherry, while supervising the Golconde construction, two main factors were instrumental for Nakashima's architectural approach: the lack of training of the disciples of the ashram, who were the only builders on the construction according to the explicit wish of

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44 Kurt G.F. Helfrich and William Whitaker, 60

45 Jeannine J Falino ed, Crafting Modernism: Midcentury American Art and Design (New York: Abrams, 2011), 228

46 Mohsen Mostafavi quoted Antonin Raymond in an article regarding the Golconde Dormitory. According to Mostafavi, this spirit was in tune with the spiritual of Sri Aurobindo, and might influence in the commission. Mohsen Mostafavi, "Antonin Raymond's dormitory for the Sri Aurobindo Ashram, Pondicherry, India (1936-8)" in *AA Files*, no. 44 (2001), 3-5

Sri Aurobindo, and the lack of materials due to political disturbances in Europe and Asia. While Sammer was in charge of completing the construction drawings, Nakashima drew detailed and measured drawings for the construction of concrete formwork to explain and guide the construction processes to his spiritual colleagues.[47] Craft became a necessary and unexpected action to solve the details stipulated on these project drawings. The lack of materials stimulated the search of alternative solutions on-site, such as the construction of a foundry for producing the necessary hardware, and evolved in Nakashima a sense that "an architect is at the mercy of materials- that he can design only in set patterns because methods of handling materials are so hard to change."[48]

The difficulties found supervising the Golconde construction probably helped Nakashima to understand even deeper Raymond's respect for Japanese master-carpenters: the craftsmen who control the process and explores the possibilities of the materials understanding their intrinsic qualities. This approach was connected to the idea of simplicity and honesty in every act of construction.[49]

Above attitudes soundly resonated with Nakashima, and rather than acting as a mere designer who conceives the initial idea and plans, Nakashima conceived architecture as an ongoing process in close collaboration with builders. In fact, during a guest lecture at a school of architecture, George Nakashima offered a clear vision of how the education of an architect ought to be. Opposite to the established academic training, involving mainly theoretical and the design creative action, George Nakashima upheld a hands-on approach through the appreciation of the materials and workmanship. For Nakashima, "only with that

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47 Pankaj Vir Gupta and Christine Mueller, 52
48 Bern Ikeler, "George Nakashima: Tenet and Tools" in Bucks County Traveler (December 1951): 45-46
49 Kurt G.F. Helfrich and William Whitaker, 47

knowledge can a designer rise above the status of theoretician and create buildings that in his view successfully synthesize structure and aesthetics, as well as form and function."[50]

In fact, Nakashima more often than not spoke out against a modernist practice too much focused on questing meaningless innovation and on drafting in the drawing board. For Nakashima "building is essentially practical problem, and we must face the hard fact that the fundamentals are tools and not paper."[51] Nakashima felt that the division between designer and craftsman "compromised the aesthetics and the literal foundation of a building".[52] Undoubtedly, Nakashima merged this practice with the Raymonds' principles, earlier enounced, and the appreciation of Daiku; accordingly, he said, "designers should be in the same business as contractors. That is the way the master carpenters of pre-modern Japan operated, and it is a good sound system."[53]

In the case of the Arts Building and Cloister, various and detailed sketches were delivered to the builders, action that does not contravene the widespread idea that Nakashima was intuitive and produced only few project drawings, but which certainly loose strength at operation and process levels. This practice agrees with a constant supervision by George Nakashima, and even with his own direct participation in the construction process. Known drawings for the Arts Building include exterior elevations, plan, section and elevation of different specific sections, such as the Cloister, the stone masonry abutments, and the fireplace, and highly defined detailing of architectural elements such as post connection and windows. This collection of drawings reveals the breakdown of the project

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50 Ibid.

51 This was said in occasion of an article related to a shop and exhibition at the Full Circle Gallery (April 27th-May 10th, 1986). Rob Howe, "A Lifelong Dedication to Craftsmanship: George Nakashima's One-Man War with the Ordinary" in The Washington Post, Washington Home (April 24, 1986): 1, 18-21

52 Ibid.

53 Charles S. Terry, "George Nakashima, Woodworker" in Japan Architect (February 1963), 59-68

in a manageable scale depending on the operation; nevertheless, it is difficult to know which was the sequence because the absence of dates.

At the time the construction had already begun, Nakashima had embarked in a trip that began with a visit to his daughter Mira in Tokyo, then continued to meet the Minguren group, and finished in Ahmedabad, India. Besides, on this same trip Nakashima also started to work on another hyperbolic paraboloid roof: the Catholic Church of Christ in Katsura (1964-65), near Kyoto. This project came up through an old friend from Seattle, the Father Tibesar of the Maryknoll Missions. Mira Nakashima assisted on this project, which as expressed in reinforced concrete.[54] This fact implies that George Nakashima had to remotely supervise the construction of the Arts Building, and the realization of fully detailed drawings, which implicitly reveals a construction hierarchy.

One of the actors in this process was Bob Lovett, who had begun his collaboration with Nakashima working on the workshop on the winter of 1946. Bob's brother, Frances, had introduced him to Nakashima after Bob had been temporarily laid off from his regular job. First, Bob Lovett was involved in the furniture making, and eventually, after sporadic collaborations, became the builder of different buildings at Nakashima's property, among them the Arts Building.

An interview with Bob Lovett has shed interesting light on understanding the difficulties of the building techniques and the construction process. Works began between September and October of 1964. He collaborated with the stonework and constructing the fireplace and chimney. Eventually, he was in charge of the roof, the construction of which appeared to follow the Lumber Storage hyperbolic paraboloid falsework system.[55]

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[54] Mira Nakashima, 190-191

[55] Interview with Bob Lavett by John Nakashima

The carefully detailed and measured drawings, which also incorporated basic annotations, were reminiscent of Nakashima's task in Pondicherry: a reflection to show what was to be built. In fact, although builders may be used to Nakashima's architecture and techniques, since the final solution portrayed a high level of craft, the construction process required detailed drawings to communicate the ideas and not mere sketches of the idea, as it happened when the work was initiated and presented to the builders for the first time.

2.2.3. The Relationship with the Arts and Craftsmanship

The Arts Building and Cloister were intended as an exhibition space and as a place of interchange in relation to craftsmanship and arts. This original idea probably influenced the location of the new building that stood apart of the rest of the complex, which essentially includes a combination of business-related buildings and residences. Undoubtedly, Nakashima's friendship with Ben Shahn and his later involvement with Minguren in the 1960s nurtured Nakashima's personal interest in establishing an association with the arts and the craftsmanship that transcended his woodworking activity in New Hope.

In the 1950s, George Nakashima became friend of the Russian American visual artist Ben Shahn (1898-1969). Both fellows implicitly shared beliefs about the redemption power of the arts and their ephemerality as well, although they reached their ideals from distinct spiritual paths.[56] This acquaintance eventually resulted in a fruitful collaboration in the arts and architecture. Ben and his wife Bernarda Shahn acquired various pieces of furniture by Nakashima, and Nakashima designed and built the addition of Ben and Bernarda Shahn's

[56] Ibid, 182

house in Roosevelt between 1960 and 1967.[57] Besides, Ben designed a mural that was eventually installed in the west concrete wall of the Arts Building.

Benjamin Shahn, son of Russian Jewish émigrés[58], naturalized American, was a famous and resourceful plastic artist who expressed his ideas using different media such as easel pictures, illustration, photography, mosaics, and murals, within a long career amply recognized by museums, critics, and audience. While Shahn attained wide success during the depression period in America, the triumph of abstract expressionism during the post-World War II relatively set him aside in the artistic scene, although the MoMa organized Shahn's first retrospective in 1947 and he was selected to the Venice Biennale's American Pavilion together with Willem de Kooning in 1954.[59]

In 1960, Ben Shahn commissioned George Nakashima the extension of his house in Jersey Homesteads, a New Deal community now called Roosevelt, New Jersey, a single-story cinderblock structure designed by Alfred Kastner, Louis I. Kahn being the assistant architect at the office. Mira Nakashima described this addition as a patient process in which George selected the required wood for each purpose. As in earlier buildings, Nakashima crafted built-in furnishings, ensured quality, and adjusted the project to the human scale through its sensitivity and know-how.[60] Some architectural elements at Nakashima's extension greatly resemble those used at the Arts Building: an exposed beam, a grill, and exterior poles. The beam of poured concrete reposes on and extends beyond a random masonry of roughly dressed stone in the western aisle. This detail is repeated in the interior mezzanine at the Arts Building; an interior grill bears highly resemblance to the work in the Cloister, and exterior

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[57] Ibid, 182
[58] Ben Shahn was born in Kaunas in 1898, today in Lithuania, although it was part of the Russian Empire at that time.
[59] Diana L. Linden, "Modern? American? Jew? Museums and Exhibitions of Ben Shahn's Late Paintings" in Barbara Kirshenblatt Gimblett and Jonathan Karp, Ed. *The Arts of Being Jewish in Modern Times* (Philadelphia, PA: University of Pennsylvania Press, 2008), 197-207
[60] Mira Nakashima, 182

poles preserve a peculiar shape less concerned with a perfect appearance, which echoes the utilitarian and aesthetic Japanese folk traditions. Other elements are usual in earlier buildings such as the Showroom: exposed post and beam structure, a raffia plaster that echoes Japanese wattle and daub technique, and a stone fireplace with a metallic hood.

Unfortunately, Shahn died in 1969, shortly after the Arts Building was concluded and the first exhibition of his artwork took place. On one of the visits to the property, "Ben noticed that George had designed a wall with a perfect cant for a mosaic"[61]. To this end, Ben Shan painted a gouache titled "The Poet's Beard"[62], which had to be enlarged 5.5 times and eventually used as the base for the mosaic. In 1970, George Nakashima hired the services of Gabriel Loire through the *Société d'Exportations d'Art Religeux* and the agent of Loire in the United States, which had headquarters in New York.[63] Gabriel Loire (1904-1996) was a well-known French artist maker of stained glass and other decorative pieces, including murals. Among his commissions in Pennsylvania were the Main Line Reform Temple in Wynnewood (1960), Saint Thomas Moore Church in Allentown (1969),[64] and the mural at the Arts Building, which was fabricated at the Gabriel Loire Atelier (1946) in Chartres, France. The mural was divided in eight panels that were mounted together during the process of manufacture to control and minimize as much as possible the visual impact of the joints.[65] Finally, the mural was shipped to New Hope in October 1970 and installed on the exterior of the building.

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[61] Ibid, 187
[62] Ibid, 187
[63] Letter from Pierre M. de Miraval to George Nakashima, March 10, 1970. George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.
[64] John Wanamaker's Fine Arts Gallery brochure, n.d. George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.
[65] Letter from Pierre M. de Miraval to George Nakashima, October 13th, 1970. George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.

In 1964, the same year that Nakashima began the Arts Building, he became involved with the Japanese sculptor Masayuki Nagare (1923), founder of Minguren, who was in New York for an exhibition of his work at the Staempfi Gallery in Manhattan, and supervising the execution of a stonewall of volcanic rock called "Stone Crazy" at the 1964-1965 World's Fair in New York.[66] The acquaintance of Nagare and Nakashima produced a fruitful friendship that led Nakashima to visit the Minguren group in Japan and to rename the Arts Building as the Minguren Museum as previously described.

In the fall of 1963, and to participate in the Japanese pavilion construction, Nagare brought a group of seven craftsmen from Shikoku for constructing the traditional stone masonry of Japanese castles at the pavilion.[67] The Japanese pavilion, which intended to embody the best of Japan, combined three buildings that merged traditional Japanese and contemporary designs, emphasizing the contrast between old and new, both in architecture and content. It offered an overview of Japanese technology, products, and food along with a glimpse to preindustrial Japan.[68]

Nakashima possibly abhorred the technological purview of the fair, however the improvised character that Nagare showed during the construction probably arouse his sympathy.[69] In response, Nakashima being a craftsman himself, Nagare invited him to join Minguren. Nakashima did not hesitate to collaborate with this group, establishing a strong

[66] Mira Nakashima, 190
[67] Lawrence R. Samuel, *The End of Innocence: the 1965-65 New York World's Fair* (Syracuse, NY: Syracuse University Press, 2007)
[68] Official Guide: New York World's Fair 1964/1965 (New York: Time Incorporated, 1964), 140-142
[69] Lawrence R. Samuel explains that the cultural differences between American workmen and Japanese craftsmen soon arouse. "Stones for the pavilion were prenumbered for easy assembly on the site, and Nagare's sudden decision to interchange number 7 with number 43 did not go over well with union workers trained to think of architectural plans as the gospel. It took two hours and much persuasion for the Americans to agree to swap the two stones". Lawrence R. Samuel, 159

tie that was memorialized when the Arts Building was renamed Minguren museum.[70] Two other material evidences corroborate this connection: Nakashima obtained some black volcanic stones of Nagare's stone wall, which were used eventually in the construction of the interior masonry wall that supports the cantilevered steps leading the second story at the Arts Building.[71] Additionally, Nakashima placed a volcanic rock from Tokyo sculpture by Masayuki Nagare near to the entrance. This sculpture is called "keyhole" and it was also made for the Japanese Pavilion.[72]

Along with the spiritual lessons of life, the intention of erecting an annexed building, the Cloister, to host Japanese craftsmen visiting New Hope was probably related to the experiences Nakashima had in Japan, while visiting Minguren's members in the fall of 1964, and possibly reinforced with the fact that he was also designing and consulting for the National Design Institute in Ahmedabad, India.[73] As described previously, the earliest precedent might be the outbuilding at Raymond's Summer Studio in Karuizawa, where a selected group of staff members stayed, among them Nakashima.

2.3. The Foundation for Peace

Having an aspiration for something beyond his identity and using two massive slabs of American walnut, Nakashima envisioned the craft of a first altar of peace, which was a culminating expression of his spiritual interest in bringing peace to the world across the years. The altar of peace eventually became six, one for each continent, to be placed in a space in agreement with the symbolism of the altars. Ultimately, the Arts Building would

70 Although some publications point out that the Arts Buildings was renamed Minguren after Ben Shahn's death in 1969, the fact is that in 1967 the Minguren Museum titled an art review in the Sunday Times. Peggy Lewis, "Minguren Museum - Building Shapes" in Sunday Times Advertiser, Trenton, NJ (May, 21,1967)
71 Interview with Bob Lavett by John Nakashima
72 Recorded in notebook found in the Arts Building. N.d.
73 Mira Nakashima, 190

house the headquarters of the Foundation for Peace, who aimed to promote and expand the 1984 Altar of Peace Project.

In 1983, Nakashima purchased a large walnut log from his logger, Frank Kozlosky, and cut by Scot Wineland, a California-based logger. The log was obtained from a 300-year-old tree in Long Island, 12 feet long, and tapering in diameter from 5 feet and 7 inches.[74] The process of cutting the log and obtaining the boards was thoughtful and sensitive, and deserved the attention of the media, which interpreted it beyond a utilitarian approach to link it with a transcendental dimension.[75] The boards obtained from the log possessed a suitable size and magnificent grain to become the expression of Nakashima's spiritual endeavor. In fact, Nakashima envisioned each Peace Altar:

> as a genuine expression of nature and an act of beauty... Peace in a tangible form, instead of an abstract idea and an absence of war... the pure spirit of peace for which all people yearn and the world politicians spurn... A shrine for all peoples and owned by no one.[76]

A first Altar, to be installed in the Catheral of Saint John the Divine in New York City and sponsored by Steven C. Rockefeller and Dean James Parks Morton, was finished in 1986, the dimensions being 10.5 by 10.5 feet. The altar was formed from two walnut boards built upon a base, connected by butterfly keys, and engineered to allow expansion and contraction because of thermic loads.

George Nakashima passed away in 1990 seeing this first Altar Peace installed and negotiating the installation of a second one in Russia, which eventually was housed in the Academy of Sciences in Moscow in 2001. In 1996, a third Peace Altar was dedicated in

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74 Jay E. Wright. "Altar for Peace: a Tale of Two Artists" in Popular Woodworking Magazine (1986), 19
75 As described by Jay E. Wright, "newspapers sent reporters and the National Geographic Society had video film crew on hand to get footage". Ibid, 20
76 Mira Nakashima, 236

Auroville, an international spiritual community near Pondicherry found by Sri Aurobindo and Mother Mira in 1968.[77]

The Altar of Peace Project was renamed as the Nakashima's Foundation for Peace in 1995, which would set the Altar of Peace Project and the advocacy of the cultural programs related to the various Peace Altars as its main goals. Marion Nakashima, George Nakashima's wife, gifted the Arts Buildings and the Cloister to the foundation in 2003, adding a new layer of significance to the buidling, which became the foundation's headquarters. Now, the Arts Building houses personal objects gathered through the years by George Nakashima and his family, prototype furnite and archival material, and it is used for concerts and other events related to the Foundation for Peace's goals.

2.4. Conclusion

Built between 1964 and 1967, the Arts Building and Cloister exemplify a fusion between traditional Japanese craftsmanship, Daiku, and the vernacular American architecture with 20th century modernist notions, following the path Nakashima initiated in 1946 in New Hope. The compound stands apart of the woodworking complex as an exhibition building, housing for visiting artists, and the Nakashima's Foundation for Peace headquarters. The Arts Building mirrors the rising interest on expressive roofs and monumental structures during the 1950s and 1960s. The striking hyperbolic paraboloid roof houses an interplay of structural and functional elements that creates an enticing interior. The austere and monastic Cloister counterbalances the Arts Building creating a pleasant asymmetric composition, which is articulated by the standing covered pathway, the exterior terrace, the pond, and landscape features.

[77] An extensive narrative about the dedication of each Peace Altar and the process of negotiations can be found in *Nature, Form, & Spirit.* Mira Nakashima, 236-242

As it happens in previous building within his property, the Arts Building and Cloister summarizes the skills and knowledge Nakashima gained during his training and apprenticeship, particularly working for the Raymonds both in Japan and India. Consonant with his architecture practice, Nakashima used the hyperbolic paraboloid roof of the Main Lumber Storage Building (1956) as a model for the Arts Building, perfecting the roofing system and refining the architectural elements. The Cloister might be based on the Raymond's Summer Studio in Karuizawa, probably filtered by the spiritual interests, which were constant in Nakashima's life, and the ties he established with Minguren.

The Arts Building was originally intended to exhibit artworks by Ben Shahn, who gifted a design for a mosaic mural that was eventually installed in the exterior west concrete wall in 1972, and pieces of furniture. Over time, other artists, designers, and craftsmen, as Nagare and Harry Bertoia, outstanding wood boards, supplemented Ben Shahn's artworks, along with archival material and personal objects collected by George Nakashima and his family members. Now, the Arts Building houses the Foundation for Peace, and the Cloister still maintains its function of offering temporary lodging for visiting scholars and craftsmen.

3. Architectural and Material Description

When attempting to identify construction materials found in an existing building, the first sources to check are documents related to the building itself: specifications, receipts, and other primary materials along with any oral histories of testimonies, remembrances, and interviews with those who had an active role either during the construction or the repair campaigns. Construction books, trade catalogues, directories for building materials, such as Sweet's Catalog, period magazines, and advertisements, may also prove useful for the context of the building period. During the preparation of this thesis, material identification was based primarily on all these sources and on the visual survey conducted during two different visits to the site on February and March 2015.

Herein, it is possible to find a combination of traditional materials, such as stone and different wood species, with genuine innovative twentieth century materials, like plywood and concrete block. Starting with a brief description of the Arts Building and Cloister, and following with a more comprehensive study of the primary building materials employed by Nakashima, particularly those related to the twentieth century, this chapter attempts to expand the technological aspects of the construction regarding the as-built condition.

3.1. Brief Description of the Arts Building and Cloister

Visitors walking down the pathway from the Conoid Studio soon recognize the expressive Arts Building with its tilted hyperbolic paraboloid roof that contrasts a restrained and smaller Cloister. Both buildings stand apart in a wooded isolated area in the eastern limit of the property, where the slope starts to flatten out. As described earlier, the compound finds an echo of Japanese and American influences, which are recognizable through the use of different typical architectural elements of each culture that is merged in a new way of expression.

The Arts Building is about 23 feet tall and measures approximately 36 by 40 feet; the Cloister is about 11 feet tall and measures approximately 19 by 39 feet including a porch. The Arts Building structure consists of the interplay of wood, a reinforced concrete grid slab and walls, and uncoursed random rubble masonry walls and abutments, which ultimately support the hyperbolic paraboloid roof. The Cloister structure is comprised of common exposed concrete block masonry walls. Both the Arts Building and Cloister are connected by a covered walkway, creating an asymmetrical composition.

The Arts Building opens entirely towards the south and west orientations trough interplay of structural elements made of cypress and simple and double-glazing infill[78], which is locally shielded by Japanese-inspired hinged grills also made of cypress. The varying combination of glazed spans and grills generates different degrees of privacy while offering shade and different relationships with the surrounding landscape.

These elevations noticeably contrast with the massive and solid east and north elevations. On the southwestern corner a reinforced concrete structure partly intersects the main volume while giving form to three main functions: to announce the main entrance, to serve as exterior terrace, and to act as Ben Shahn's mosaic support. Upon this volume, an interconnected combination of wood and poured concrete rails define the terrace.

Covering the Arts building, the tilted hyperbolic paraboloid roof, with noticeable slightly curved eaves, rests on two triangular stone masonry abutments and a reinforced concrete section. The roof is held by two tapered white oak beams, on the west and south

[78] Double-glazing for the fixed windowpanes stands with simple glazing for the sliding windows and doors and some fixed windowpanes. It has been noticed two different cavity thickness in the double-glazing with 'air seal' engraved in the spacer.

elevations, and on plates connected to concrete block masonry walls on the north and east elevations. Each tapered beam is supported on their lower ends by the two triangular abutments of 18 inch-thick local uncoursed random rubble masonry, whereas the thinner upper ends, are joined and probably bolted together with a trough wedged tenon joint, which is supported by a white oak post connected to a concrete dado built upon a concrete grid slab. Tapering and adjusting the main beams to their final position took about three weeks. The roof is pierced in its north side by a chimney, which consists of uncoursed mixed rubble masonry and a skylight, which allow additional daylight to the interior.

Sliding windows and doors establish a clear relationship between exterior and interior on both elevations, progressing from a controlled environment to the wild, passing through a landscaped ground area that combines organic forms, such as a pond surrounded by rock arrangements, with rectilinear elements like a stone masonry fence to create an exterior foyer.

In the main entrance, the transition between the exterior and the interior is formally materialized through a single ample door housed on a white rendered 12 inch concrete block unit masonry wall, which stands recessed under the south side of the terrace. The door leads to a compressing space known as the "cave", which is the vestibule of the Arts Building.

This vestibule is delimited by the mentioned exterior wall on its south side, an oblique concrete slab reinforced with concrete ribs on the west side, and a stone masonry wall in the north side. The east side remains open to the main exhibition area. Stone slabs of various sizes and shapes form the flooring, which is heated by a system of pipes installed underground. A lower ceiling, which consists of a six by five reinforced concrete grid, emphasizes the compressing effect. A bar in a closet serves this space, which is illuminated by five skylights with fixed shoji screens and a window with sliding shoji screens.

The exhibition space reads as a flowing, variable-height large room, divided into two areas: a large exhibition area and a sitting area around a fireplace. The north and east wall are plastered with Structolite™.[79] The flooring is of vinyl asbestos tiles emulating travertine. Referencing the exterior materials, the fireplace is constructed of uncoursed random rubble masonry. The firebox back is partially constructed with firebrick, and the front hearth is polygonal flat sandstone. On the left side of the fireplace, a casement window with a fixed pane of glass, which terminates directly into the stone wall, provides light, ventilation, and views from the north side of the building.

A second sitting room is placed on the second floor, accessed via cantilevered steps, the shape of which echoes Nakashima's earlier milk table design. This mezzanine overlooks the main space of the gallery and has direct access to the exterior terrace trough an opening with sliding doors. A walnut floor, built-in spindle-back settees, and built-in shelves enriched with a variety of different connections characterize the space. For ventilation, there are two casement windows of a single leaf with an operator handle.

The tapered beams hold seventeen ribs of tapered section, which are the support for the plywood deck. These ribs are based on those utilized in the New Lumber Storage, which was the model for the Arts Building as described in the previous chapter. The half-lap scarf joints with exposed bolts used at the lumber storage to transmit stresses were stylized. Now Japanese-inspired scarf joints, which are secured with a single screw on the sides, display conspicuous craftsmanship. Over the ribs, Nakashima harnessed three layers of 5/8-inch

[79] This information was provided and recorded in a meeting held in the Arts Building between representatives of the University of Pennsylvania and George Nakashima Woodworker Company on February 14th, 2015.

plywood boards and a non-ventilated roofing system, which, according to Robert Lovett's interview, consists of a vapor barrier, insulation, an asphalt impregnated lining, and marble chips.[80]

Providing exterior shelter for visitors moving from the Arts Building to the Cloister and vice versa, the pathway structure incorporates a light interplay of ipe posts, beams, 1 inch thick plywood, and a bituminous waterproof skin. Pavement comprises reddish fieldstone flat slabs directly placed upon the ground and with gray gravel, which covers the rest of the pathway.

The austere geometry of the Cloister is reinforced by the modesty of its materials. While the front of the Cloister opens up to the landscaped yard with the pond in a different level, in the rear, the Cloister walls directly meet the ground level.

Divided by concrete block wall partitions, the Cloister layout comprises four spaces: a storage room, used now to house archival material, a service area with kitchenette and bathroom, a room for the heating system, and a small-sized multifunctional living/sleeping area. The front elevation reveals the access to the main spaces, while the rear houses the access to the room that contains the heating system.

Upon the walls, douglas fir wood plates[81] rest upon the concrete block walls, and provide the necessary connection between rafters and walls. The roof is a built-up system upon a one 5/8 inch plywood board substrate. Ceiling and eave soffits are made of tongue and groove fir boards, probably 1/2 by 4-inch.

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[80] Interview with Robert 'Bob' Lovett by John Nakashima
[81] 4-Square™ kiln-dried provided by Weyerhaenser

In the rear elevation, openings house sliding windows. The concrete lintels mimic those used in other buildings such as the Workshop and the New Lumber Storage. Indoors, a shoji screen diffuses the light; outdoors, a utilitarian metallic mesh protects from insects.

On the front elevation, doors, which are an interplay of wood and glass covered with paper, give access to the interior spaces. As in the Arts Building, the flooring is a vinyl asbestos tiles emulating travertine. In the living/sleeping area, three walls are covered with Structolite™, recalling the Arts Building.

3.2. Ben Shahn's Mosaic

As described earlier in this thesis, Ben Shahn painted a gouache cartoon to serve as the design for a mosaic mural to be ultimately installed on the concrete wall at an angle in the west elevation of the Arts Building. Nakashima described the location as follows:

> It is somewhat forward at the top and slopes back, so that it is well protected from the weather. There is almost no rain that falls on this wall and it does not freeze, so we feel that it would be very favorable for a mosaic of this kind.[82]

And offered some indications:

> It will be principally black and white, with a few areas of brilliant color. We think it is very beautiful and it is at one end of a large field, with a few small trees in front of it. The vista to the mural is quite long; it can probably be seen from something like 300 feet away.[83]

The seven feet high by approximately twenty-three feet wide mural was manufactured in eight panels by Gabriel Loire in Chartres, France and shipped to New Hope during the fall of the 1970. Supplementing the panels, detailed plans and instructions

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[82] Letter from George Nakashima to Gabriel Loire, January 26, 1970. George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.
[83] Ibid.

for the installation were delivered. Although the archival documentation does not contain information about the materials employed for the manufacture, the tesserae are possibly marble or a highly metamorphosed limestone/dolomite and stained glass, the backing being unknown.

External visual investigation reveals that the panels are screwed to a hidden frame. The correspondence between Pierre Massin de Miraval, the art agent, and George Nakashima are a very illuminating source and explain the process of how the panels had to be installed. Additionally, the detailed drawings of construction with hand corrections also provide useful information to understand the elements that were probably installed in order to maintain the mural in place. The joints between panels were designed to show the minimum possible. For this purpose, the mural was completely mounted and demounted at Gabriel Loire's workshop.

Although a letter signed October 13th, 1970, indicates that the total number of screws should be nineteen, only twelve perimetric screws, separated by approximately 20 1/2 inch, and around other five on central positions have been identified in each panel. According to this letter, eight bags were provided together with the panels, each one containing nineteen numbered tesserae corresponding to the locations of the screws to be covered. The explanation was clear, "when the screw is screwed, you have to cover the screw head with the numbered piece of mosaic for that screw with epoxy. You can easily understand that this way, the screw heads become invisible."[84] It appears that the final solution was to employ a type of elastomeric adhesive, although it could be a repair treatment where the epoxy failed.

[84] Letter from Pierre M. de Miraval to George Nakashima, October 13th, 1970. George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.

Regarding the wooden frame, Nakashima modified the detailing proposed by Gabriel Loire. A wooden frame was intended to house the mosaic, however as Nakashima's corrections show (Fig. 2.1.), the upper rail was eventually excluded, and the tapered sill section was changed to a squared one, in which Nakashima would ultimately use a Japanese-inspired joint. A grid of dimensional lumber screwed to the concrete wall was proposed to serve as the backing for supporting the panels. A total of 24 strips were used. Seven 4 by 1 3/16 inch strips, wider to receive a screw, placed each 35 1/4 inch center lines, and 10 3 by 1 3/16 inch strips regularly arranged in between.

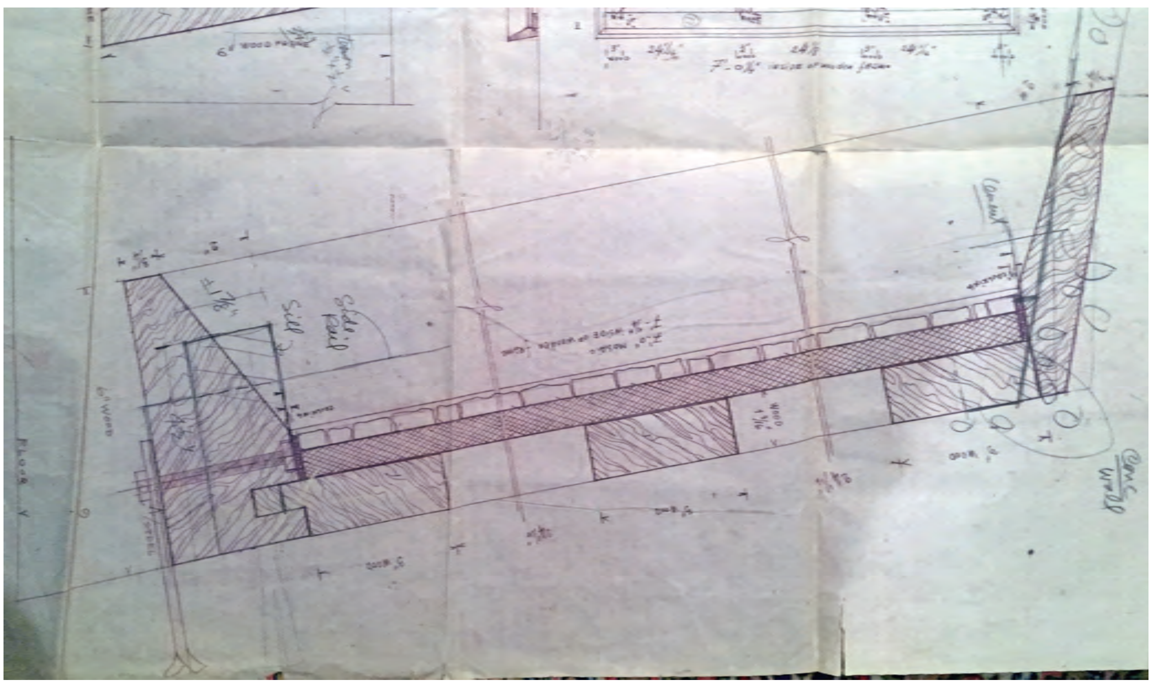

Fig. 3.1. Detailing for installation provided by Gabriel Loire, June 1970, with corrections by George Nakashima. Source: George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.

3.3. The Hyperbolic Paraboloid Roof: the Use of Plywood, Copper, and Impervious Materials

As discussed earlier, for the Arts Building, Nakashima reproduced the plywood shell roof first developed for the Main Lumber Storage (1956). However, the intentional display of visible craft at the Arts Building required carefully designed ribs and joints, and the application of a delicate white translucent finish on the exposed faces of the plywood.

Published in 1959, an article in *Architectural Record* defined the Main Lumber Storage as "the guinea pig for (another) new method of constructing a hyperbolic paraboloid",[85] exalting the experimental approach of using plywood as a base material. Nakashima used three layers of 3/4 inch plywood laid over two by four nailers[86] set upon twelve-inch concrete block masonry randomly pierced by openings, and with an eight foot rise on each side following the reverse twist of the roof. The triangular gaps in the stepped block walls were filled in with reinforced concrete, acting as a border beam shaped following the slope of the roof upon which plates to receive the roof were installed. During the construction process, nailers were maintained in place with the aid of interior scaffolding comprised of 2 by 12 inch girders that divided the building into quadrants, with beams at the quarter points in one direction only."[87] A central post and props at the ends, in contact with the walls, supported the girders.

In the case of the Arts Building, the New York engineering firm of Paul Wiedlinger suggested the use of three layers of half-inch plywood, shifted ninety degrees to overlap

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[85] "A Lumber Storehouse. New Hope, Pennsylvania" in *Architectural Record* (July, 1959), 217
[86] Paul Weidlinger probably used the term nailers, which are substructure elements that receive nails, to avoid the confusion that might have produce the use of joists or ribs in interpreting the plywood hyperbolic paraboloid as an operative shell.
[87] Ibid.

joints, and nailed with twelve 6d nails by foot.[88] Bob Lovett, one of the builders, revealed that the three layers of plywood comprised 160 sheets, which needed to be trimmed, screwed, nailed, and glued together.[89] Hand measuring revealed that each panel is 5/8 inch thick, and 4' wide and 8' long, which was a common standard in the plywood industry since the early 1930s.[90] Opposite sides are laid on the ribs and opposite ends, which appear not to be glued on the ground visual survey, abut to the contiguous panels.

Unfortunately, it could not be observed how the plywood shell is attached either to the plates upon the walls or the tapered beams. Nevertheless, a preliminary sketch by Matthys P. Levy, one of the associates of Paul Weidlinger Consulting Engineer, is very telling. In a first step, a 3/4 inch bolt, passing thru the plate and anchored 7 inches into a 12 inch concrete block wall, secures the plywood shell. A handwritten annotation with red pencil upon the later solution offers the possibility of countersinking the bolt and nailing the plywood down in addition.

Beyond the perimetric structure, the plywood shell projects to form two wide eaves, which taper towards the hyperbolic paraboloid upper corner. The exterior edges on the eaves are protected with a wooden strip made of wood, probably cypress, abutting the edge of the second layer of plywood; the first layer simply sets back and is currently finished with white paint. Since the wooden strip was not available in the required length, scarf joints were used in the south and west elevations, whereas in the north and east elevations the strips

[88] In view of the correspondence and the few project documentation available at the Michener Museum Archives, it appears that the main advisor was Matthys P. Levy, associate at Paul Weidlinger Consulting Engineer. Annotated sketches appear to be signed by Matthys P. Levy. Nakashima - Arts Bldg., Paul Weidlinger - Consulting Engineer, June 3r, 1969, George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.
[89] Interview with Bob Lovett by John Nakashima
[90] Thomas C. Jester "Beyond the Balloon Frame: Engineered Wood Comes of Age in the USA" in *DoCoMoMo Journal,* 20

appear to be abutted and screwed to the plywood shell. Half blind corner half lap or perhaps a half blind corner joint was used on the intersections at 90º degrees in the lower ends, whereas on the top southwestern corner and in the northeastern corner beveled joints were used.

A similar solution was used on the Cloister's porch, according to the construction sketches, where an inset detail shows a 1 1/8" thick wooden strip trimmed to receive and house a plywood panel edge, whereas on the walkway an inset detail depicts a 1 3/4" by 5 1/2" cypress soffit also trimmed to receive and house the plywood panel edge. Therefore, these components perform a double function: they protect the edge and stiffen the border, which has more proclivities to deterioration. In case of deterioration, they can be replaced without affecting the plywood edge.

The roof was finished with sheet copper flashing all around the edge. Copper is rigid enough to hold its shape when formed on the jobsite but pliable enough for easy shaping to meet flashing details. Marble chips were placed on top of the asphalt lining, creating all together a non-ventilated roofing system. Even though it was the second hyperbolic paraboloid that George designed, Lovett attested that everyone was skeptical about the roof. However, the roof only settled about an inch and a quarter gradually as they took the falsework out.[91]

3.3.1. Plywood as Building Material

Plywood is fundamentally a twentieth century material, however the earliest known precedent is the 1865 John K Mayo's "scale boards", which had the same basic manufacture:

[91] Interview with Bob Lovett by John Nakashima

"a plurality of thin sheets or veneers of wood, cemented or otherwise firmly connected together, with the grain of the several scales or thicknesses crossed or diversified".[92] In the late nineteenth century, similar concepts were fabricated, primarily used in furnishing, and contributed to a variety of names to designate the same material: scale boards, pasted wood, and built-up wood. However, in 1919, in proposing the name to the Plywood Manufacturers Association, the Veneer Manufacturers Association, as known earlier, formalized the use of the term plywood, which was already in use in Europe.[93]

The rise of the plywood industry took place in the first half of the twentieth century, especially after World War II. This development was hinged on the introduction of superior water-resistant and resilient adhesives to glue the veneers, a condition necessary to create a product with reliable properties suitable to a wide range of applications, such as building material.[94] As a construction material, plywood owed its relevance to the market eagerness, the modernist interest on experimentation, and the evolution of standards as early as the 1920s. Sponsored by a thriving industry, architects, builders, and institutions experimented with housing prefabrication, during the 1930s. This decade also saw the use of plywood as an exterior material by renowned modernist architects like Richard Neutra. The standardization and the establishment of grades assisted the construction industry in the use of plywood, which eventually found more favorable reception for sheathing, subflooring, and other interior uses.[95]

In the early 1960s, the Douglas Fir Plywood Association defined plywood as "an engineered panel, consisting of an odd number of veneer sheets placed crosswise to one

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[92] Thomas C. Jester. "Plywood" in *Twentieth Century Building Materials* (Washington, D.C.: McGraw-Hill, 1995), 132
[93] Thomas C. Jester. *DoCoMoMo Journal,* 17
[94] Thomas C. Jester "Plywood", 134
[95] Ibid.,135

another and bonded together under high pressure, with either a water resistant or waterproof adhesive that is stronger than the wood itself."[96] Regarding mechanical properties, "the cross-laminated construction, by providing longitudinal grain both lengthwise and crosswise, also provides bending strength and stiffness in these directions", thus surpassing the mechanical properties of natural wood crosswise, and making it a suitable material to build a hyperbolic paraboloid shell.

Cross-laminated assembly has an additional advantage upon the natural behavior of wood in relation to moisture content changes. Wood considerably expands across the grain, however the plywood structure minimizes this expansion because "any tendency for veneers to expand or contract crosswise is greatly minimized by one or more adjacent veneers running lengthwise", thus guarantees certain dimensional stability.[97]

Standard plywood panels' manufacture comprised fundamentally six steps encompassing the production of the plies, the control of moisture content, gluing, and grading:

> a. Selected 'peeler' logs, cut from the lower portion of a tree, are used for plywood.
> b. At the lathe, a sharp steel blade peels the log into thin (1/16"-3/16") 'veneer.'
> c. The drier (a long, scientifically controlled oven), reduces the 'veneers' moisture content to provide the best glue-bond and panel stability possible.
> d. 'Veneers' are 'laid-up' into panels after passing through a glue spreader for uniform coverage.
> e. 'Laid-up' panels are finally placed in a press which pressures the 'veneers' and glue into plywood panels.
> f. In the finishing department, a careful check is made of the panels for grade, appearance, and the accuracy of dimensions and thickness.[98]

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[96] Nelson S. Perkins, C. E., *Plywood: Properties, Design and Construction* (Tacoma, Washington: The Douglas Fir Plywood Association, 1962), 3.
[97] Ibid, 20
[98] Ibid, 5

Standard plywood panels were available in two types: exterior and interior, and graded depending on their quality using an A-D letter system, which is a classification that continues today. Type refers to the type of glue bond used between plies. Exterior type comprised panels manufactured "with a hot pressed phenolic resin adhesive, which becomes permanent and insoluble under practically any exposure condition, including boiling",[99] and suitable for permanent exterior exposure. The interior type mainly used "protein glues having soya-blood base."[100] Regarding grades, A was used to designate veneers with "a smooth 'paint' grade permitting a number of neatly-made repairs, plugs, patches, etc. with certain restrictions", whereas B "may have a considerable number of neatly-made repairs." The lower qualities C and D could have knots, small knotholes, and splits; the difference lied in the dimensions of the defects, which were bigger on the D grade in addition to possible pitch pockets. Panels, regardless their thickness, were designated by two letters, the first one being the face veneer and the second one the back veneer. For example, an A-C panel had an A face and a C back. Usually, the inner plies were C in the exterior types and C or D in the interior types.

After examining the available sources of the time, it is possible to infer some characteristics of the panels used by Nakashima:

- The lack of knots, small knotholes, and splits on the exposed faces of the plywood panels, suggest Nakashima probably used the better grades for the exposed interior layer, possibly A-B or A-C (the appearance of one side was important).[101]

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[99] Ibid, 6
[100] Ibid, 6
[101] During a meeting hold on July 24th, 2015, it was pointed out that for the repairs was used CDX Plywood for the two layers disposed under the roofing felts, while for the interior exposed layer was an higher grade. C and D represent the lower grades. C is the minimum veneer permitted in exterior type. D is used only for inner

- The use of plywood panels as sheathing and their permanent exposure to the exterior environmental conditions in the eaves and the walkway, which show a good rate of conservation, suggests that the panels are exterior type.

Plywood was manufactured using three, five, or seven plies depending on the final board thickness. Industry standards allowed three plies in thickness up to 3/8-inch. 5/8-inch panels had five plies. Although three-ply plywood was a more economical assembly, five plies enhanced the mechanical properties of the panel, since "the greater the number of plies, the closer the equalization of strength in the two directions, and the better the distribution of load across the panel."[102]

Technical literature indicates different methods to finish plywood, among them light stain finish is one of the recommendations for interiors. Although the whiten finish noticed on the plywood in the Arts Building is unknown, for obtaining a whiten panel Perkins' technical guide suggested to use "pigmented resin sealer or thin interior white undercoat, mixed one to one with turpentine or thinner. After 10 or 15 minutes (before it becomes tacky) dry brush or wipe with dry cloth to permit grain to show. Sand lightly with fine paper when dry."[103]

3.3.2. The Use of Copper

Dating back up to 8,500 BC, copper was the first metal used by humans. Easily producible, ancient and classic cultures, including the Middle East and China, also used copper and copper alloys for both decorative and functional purposes. In the American

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plies and the back of interior type. Technical literature indicates that a major use for CD grades was underlayment free of moisture.

102 The number of permitted plies was specified on the Industry Standards USC45 and 122. 3-ply 3/8" thick was only allowed in C-D interior panels. Ibid.,17

103 Nelson S. Perkins, 129

context, Native Americans have been using copper since 5000 BC, and more recently in colonial American buildings.[104] Typical architectural uses for copper in the twentieth century included limited decorative detailing, flashing, gutters and downspouts, piping systems, and electrical wiring.[105]

Copper (Cu) can be found in its pure form, but it is present usually combined with other chemical elements forming compounds, named copper ores, like copper-iron sulphide or chalcopyrite ($CuFeS_2$), chalcocite (Cu_2S), and bornite (Cu_5FeS_4). Other ores can be copper oxides or copper carbonates, such as cuprite (Cu_2O), malachite ($Cu(OH)_2 \cdot CuCO_3$), and azurite ($Cu(OH)_2 \cdot 2CuCO_3$), and other mixed ores. The manufacture of copper varies depending on the ore, however the basic steps are: mining, concentrating, smelting, refining, and casting.[106]

When exposed to atmospheric conditions, copper oxide conversion film forms, changing the surface color from the initial light reddish-brown copper to light brown to darker colors and then to greenish turquoise over the years. This patina makes copper resist further corrosion.[107] In addition this patina can be artificially produced to obtain the desired finish for the architectural element. However, the noticeable different grades of patina in the Arts Building and Cloister are indicative of changes over time and maintenance operations, rather than an original Nakashima choice. This point will be discussed in greater extension in Chapter 5.

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[104] Lyndsie Selwyn. *Metals and Corrosion: A Handbook for the Conservation Professiona*l (Ottawa, Canada: Canadian Conservation Institute, 2004), 51
[105] US. General Services Administration "Historic Preservation - Technical Procedures" http://www.gsa.gov/portal/content/113058. Accessed May 1, 2015
[106] Joseph R. Davis, Ed. *Copper and Copper Alloys* (Materials Park, OH: ASM International, 2001), 10-12
[107] Lyndsie Selwyn, 60

The current state shows that the hyperbolic paraboloid roof eaves are covered with copper sheets, which are overlapped and present sealed joints. By bending the outward ends over an edge nailer, the outer sheets form the edges of the eaves and allow water to shed from the roof eaves. The outer edges of the inward copper sheets turn up to form an edge strip that houses the roofing materials, such as the insulation, impervious materials, and marble chips. Therefore, between the turned up edge and the nailer, this roofing solution forms a flat wide channel to carry water towards the gutters. Expansion joints are not recognizable. The green patina covering most of the copper surface suggests that the copper sheets were installed in an earlier period.

In addition to the wide eaves, box-style copper gutters (approximately 3 1/2" x 3 1/2") were installed and directly fastened along the drip edge of the eaves in the northeast and northwest sides to carry off rainwater. Instead of outlets, the gutter ends are open and extended approximately one foot and a half beyond the eaves' limits to drain the rainwater directly to two ponds, which were strategically situated since the beginning. Gutters appear to be custom made, manufactured from 0.250" patinated copper sheet and the sections assembled by overlapping and nailing their ends. Numerous copper gutter hidden hangers help to preserve the squared section shape and to connect the gutters to the eaves edges, also crafted with copper sheets.

A copper canopy installed over the sliding window in the west elevation was also designed. The canopy, which is also a change from the original state, was built using a raised seam tarnish cooper roof-like system. Upper and lower pans are connected by means of standing seams, which are laid where the canopy meets the copper flashing attached to the wood frame. Seams and edges appear to be properly sealed.

Copper is also used on the flashing of the stone masonry chimney and in the patinated copper edge strips installed in the covered walkway, which connects the Arts Building and Cloister, as well as in the Cloister's roof and porch.

3.3.3. The Roofing System: an Unventilated Solution

Confined by the cooper flashing and upon the three layers of plywood, felts impregnated with asphalt and covered with marble chips forms a non-ventilated roofing system. In a non-ventilated roofing system the thermal, moisture, and air control boundaries are confined to the roof. Although the interview to Bob Lovett disclosed the use of a Solitex membrane and insulation between the plywood deck and the saturated felts, the real assembly of the roof is unknown until new repairs or sampling provides accurate information.[108]

The roof was finished with 4 layers of felts saturated with asphalts and marble chips. Bituminous materials, which include asphalts and tars, are viscoelastic materials usually employed in construction because of their waterproof, adhesive, and cohesive qualities, which make them suitable for being used as a binder or as glue.[109] Chemically, asphalts are "colloidal systems with the highest molecular-weight constituents, the asphaltenes, dispersed as discrete insoluble particles in the fluid continuous phase of the lower-molecular-weight oils and resins."[110]

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[108] The described assembly has been based on the information provided by Lovett's interview, the builder of the Arts Building during its construction. However, on July 24th, 2015, during a meeting on the Arts Building, Aram Dadian, builder who participated in the roof repair in the 1990s, pointed out that the asphalts felts were found directly laid upon the plywood shell.

[109] *ROTCM 145-5-1: Construction materials, concrete construction, and engineer computations* (Washington, D.C.: 1960), 98

[110] *Symposium on Bituminous Waterproofing and Roofing Materials* (Philadelphia, PA: ASTM International, 1960), 6

Asphalts can be found in natural deposits, such as open-air asphalt lakes and impregnating rocks, or produced by controlled refinement of crude petroleum. In the later case, the crude oil is heated and the vapors sent to a fractionating column where the different volatiles, the gasoline, kerosene, and diesel, are segregated from the crude oil. The residue of this operation is an admixture of asphalts and heavy lubricating oils, which requires further refinement until obtaining an asphaltic material, which is the base of the commercialized asphalts.

The use of asphalts dates back up to 3000 BC; it was found in artifacts and details using asphalt as a binder, artistic medium, mortar, and waterproofing material in the Sumerian culture. The earliest mention to distillation processes of crude oils appears in Arabic texts of the 13th century, soon followed by Italian writings. Asphalt extraction took place in Europe as early as the 16th century. During the nineteenth century, most of the asphalt used in the United States was imported from natural resources, such as those from Trinidad and Venezuela, which were used for paving.

With his patent, F.X. Byerly did the first blowing of asphalt on a commercial scale in the United States in 1894. The product was called Byerlite and was produced in Ohio.[111] Asphalt manufacture as a consequence of the development of the petroleum industry comes to age in the 1930s. The ASTM Comittee D-8 on Bituminous Materials for Roofing, Waterproofing, and Related Building or Industrial Uses, specify the technical and scientific qualities of such materials since 1905.

In 1960, the industry basically supplied two classes of bituminous roofing materials: prepared roofing, built-up roofing, and coatings and cements. Prepared roofing is saturated

[111] Ibid, 38

felts, roll, and shingle products saturated with asphalt and manufactured for direct application to a roof. These products could be mineral surfaced, as it happens both in the Cloister and the pathway roofs. Minerals provided a good protective surface and protect the underlying asphalt coating from impact damages.

Built-up roofing consists of alternate layers of asphalt cement heated and asphalt saturated felts. Depending on the number of layer, this roofing system may be called 3-ply, 5-ply, etc. Usually, this ply designation does not include a layer of unsaturated felt disposed was generally applied first except on concrete.[112]

In the case of the Arts Building, the asphalt coating acted as the waterproofing coat as well as the adhesive material to maintain the white marble chips in place. Taking into account the dates of construction, it is necessary to know that bituminous coatings may involve either liquid bitumen with nothing added, or may have asbestos fibers admixed.[113] Consequently, it will be necessary to take precautions when handling materials in the original parts of the roof.

3.4. The Envelope: Masonry, Wood, and Glass

3.4.1. Stone Masonry

In the *Soul of a Tree*, Nakashima praised the Bucks County barns and admired the stone masonry traditions of the English Quakers, which ultimately established the model to build architecture connected to the place. This preference can also be seen when Nakashima

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[112] Caleb Hornbostel. Materials for Architecture: an Encyclopedical Guide (New York: Reihold Pub. Corp., 1961), 79

[113] *Symposium on Bituminous Waterproofing and Roofing Materials*, 40

stated, "There is a wonderful feeling to be had in erecting a stone wall. There is a sense of order and permanence. A good wall will last for generations and even millennia."[114]

Nakashima's craft of stone masonry is evident in most of the buildings throughout the property, first in his own house, and then in the Showroom, the Conoid Studio, the Arts Building and Cloister, and the Reception House. In the case of Nakashima's House, the family collected most of the stone on his own land and the proximities. In the case of the Arts Building, Nakashima used a massive uncoursed random rubble masonry technology to construct load-bearing 18-inch thick abutments. The provider was Delaware Quarries founded by Joseph Busik in 1946 after buying a company that historically operated on the banks of the Delaware River. Busik expanded the business and diversified the stone offer under an agreement reached with other quarries, becoming thus a stone yard. Consequently the origin of the stones at the Arts Building is probably diverse.

The stone masonry are comprised of a variety of stones of different type, size, and color: granite, yellow sandstone, brownstone, argillite, granite, possibly diorite, possibly basalt, Pennsylvanian black limestone, possibly siltstone, possibly shale, and other sandstone of different colors. In addition and as mentioned earlier, in the interior there are some volcanic black stones given by Masayuki Nagare.

In the abutments, the stones are arranged in a random pattern with some regular courses interrupted by large stones (fig. 2.2.), a technique which is reminiscent of the Bucks County stone masonry barns. Overall, shapes are irregular, from more rounded stones to a more squared stones. Stone finishes comprise slightly dressed rubble, which include some work on face, beds, and joints. Quoin stones are squared, and are placed either as headers or

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[114] George Nakashima, *The Soul of a Tree*, 71

stretchers; some acts as bond stones. Special stones are carved and interlocked with the lower end of the tapered beams, creating a joint that involves both wood and stone.

Unlike the abutments and the stack, the chimney is a mixed rubble masonry with predominately roughly squared units, particularly in the corners. The cap consists of a flat stone slab resting upon concrete bricks.

The stones are laid with a lime or lime-cement mortar, the color of which ranges from light brown to light grey, a quality that is likely related to the type of aggregate employed. Joints range from half an inch to one inch and a half and are irregularly recessed from the stone faces approximately one inch.

3.4.2. Concrete Block

Concrete block, also known as a concrete masonry unit (CMU), is a standardized building material, with single or multiple hollow cells, made of water, portland cement, and aggregates, such as sand, gravel, and crushed stone. Types of aggregates were increased over time and included air-cooled slag, coal cinders, expanded shale or clay, expanded slag, volcanic cinders, pumice, and scoria, which ultimately determined the CMU's final weight, color, texture, heat transmission, and other characteristics.[115]

A genuine material of the twentieth century, the history of the concrete block dates back to last decades of the nineteenth century. Multiple experiments using a variety of methodologies intended to cast concrete into blocks suitable for building construction. These experiments resulted in the granting of various patents throughout the nineteenth

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[115] Caleb Hornbostel, 162-163

century in England and America, however, none of these patents led to the mass production and commercialization of the concrete block.[116]

The beginning of the modern industry had to wait until 1900, when Harmon S. Palmer's invention and patent of a hand-operated cast iron block machine with removable core and adjustable sides, enabled the casting of concrete into single masonry units, thus marking the dawn of concrete block manufacture. Shortly after, Palmer founded the Hollow Building Block Company,[117] which drove the first steps of a newborn industry and ultimately advanced the use of concrete block in the building industry.

Technical development, market opportunities, fair exhibitions, public acceptance, and particularly the availability and improvement in the quality and manufacture of Portland cement gave rise to a fast development of the concrete masonry industry, between 1900 and 1920. In parallel, new machines, constituent mixtures, and curing methods were developed.[118] In fact, Palmer's invention was soon followed by keen competition between manufacturers, who developed their own machines to produce concrete blocks.

The manufactures organized soon in professional groups and associations, such as the Concrete Block Machine Manufacturers Association (1905), the Concrete Producers Association (1918), and the Concrete Block Manufactures Association (1919), which promoted the use of the product through trade magazines, catalogues, and books, and led efforts to standardize the concrete block sizes.[119]

The introduction of lightweight aggregates marked a major change in the industry. In 1917, F.J. Straub patented and introduced the lightweight cinder block, which was fabricated

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[116] Pamela Hemenway Simpson. *Cheap, Quick, & Easy: Imitative Architectural Materials, 1870-1930* (Knoxville: University of Tennessee Press, 1999), 11
[117] *Twentieth Century Building Materials* (Washington, D.C.: McGraw-Hill, 1995), 80
[118] Ibid.
[119] Ibid, 82

in Lancaster, Pennsylvania.[120] In cinder block, coal cinders were used as the aggregate, Portland cement being the binder still. However, in the 1930s and 1940s further research and experiments took place and succeeded in introducing other lightweight aggregates, such as natural pumice, cinders, slag, expanded shale, clay, and slate.[121]

By the 1960s, concrete block manufacturing was already highly automatized involving the following steps: raw materials, aggregate, and cement preparation, blending process, block forming, stacking and curing the blocks by air-drying in kilns, and yard storage. Some manufacturers used a wet steam-and-pressure curing process, which enabled a faster production.[122]

Concrete block could be hollow load bearing, hollow non-load-bearing, and solid load bearing. The typical nominal modular size measured 8 by 8 by 16-inch.[123] Nevertheless, the industry could supply a large variety of modular and non-modular dimensions, as well as special shaped blocks. The CMU has thicker webs and face shells on top than on the bottom, which facilitate the handling by the mason and provide the mason more surface area for placing mortar.

Generally, the height, the structural conditions, loads, and the final building purpose, defined the type of concrete block and mortar to be used.[124] The construction process requires similar tools and procedures as for laying brick.

Although it only represents approximately 7% of the masonry wall area, mortar has a major role: it bonds individual concrete blocks together creating a composite structural

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[120] This product is mentioned in Lovett's interview by one of Nakashima's family members.
[121] Pamela Hemenway Simpson, 27
[122] Caleb Hornbostel, 167
[123] Concrete block actual unit dimensions are 7 5/8 by 7 5/8 by 15 5/8-inch. Cinder & Concrete Block Corporation. *TEK2-1A. Typical Sizes and Shapes of Concrete Masonry Units* (National Concrete Masonry Association, 2002)
[124] Caleb Hornbostel, 167

assembly capable of withstanding loads, it prevents moisture and air infiltration, and connects the required reinforcements and fasteners, which ensure the structure performs as a unit.[125]

Grout is used to fill CMU cores to improve the load-bearing and fire-resistance qualities of masonry. Usually, grouting was used with vertical and horizontal reinforcements to increase the strength and the ductility to bear loads and shrinkage cracking.[126]

The CMU masonry construction is completed by batches. Mortar mixing, placement methods, tooling, and lines are similar to those used in bricklaying. Concrete block should be laid with a full bed of mortar, by extending it fully across bedding surfaces of hollow units for the thickness of the face shell, which guarantee an appropriate joint. The nominal joint thickness is 3/8 inch. For the grouted units, protrusions as a consequence of placing mortar should be removed.[127]

Placing the units involves carefully laying out the wall on the foundation before starting to lay blocks. The first course will be laid dry to check that the construction fits the plans. Then, construction starts by laying the corner units in mortar, which ultimately would help to maintain the modular dimensions and will guide the construction of the rest of the wall. Graded corner poles and taut lines help to lay the blocks correctly.[128]

The first course of blocks is thereafter laid from corner to corner. A closure block, the location of which will vary from course to course, closes the course. This operation requires that all the edges of the opening and the closure block are buttered before placing.

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125 It is recommended to read the technical guide published by the National Concrete Masonry Association, which provides a detailed description of a typical construction sequence, as well as a brief description of the required materials. TEK 03-08A Concrete Masonry Construction (National Concrete Masonry Association, 2001), 1

126 Ibid.

127 Ibid, 2

128 Ibid.

Units have to be leveled and plumbed, and the excess of mortar cut off. At this point, mortar joints should be flush with the wall, awaiting tooling, if required. Once the wall is completed, the surfaces should be cleaned.[129]

Construction with concrete block was limited in height and length regarding the size of the concrete block. The recommended maximum distance between lateral supports of both vertical and horizontal walls was 12 feet for 8 inch CMU, 18 feet for 12 inch CMU and 11 feet 8 inches for 10 inch cavity wall. Vertical dimensions were restricted to 12 feet for 8 inch CMU, and 35 feet for 12 inch CMU, with increments of 4 inches for additional 35 feet in wall height.[130]

Overall, its maximum height around 11 feet, and its maximum width approximately 12 feet, the Cloister follows these limitations. The interior wall partitions, which are keyed to the load bearing walls, are disposed perpendicularly to the Cloister's length contributing, thus to stiffening and stabilizing the building structure against lateral loads.

Although there is no evidence of the use of joint reinforcements, which are steel wires placed in mortar bed joints over the face shells in hollow masonry, the Cloister load bearing concrete walls were probably reinforced by grouting the CMU cores at least on the elements that have to resist higher stresses: corners and jambs. In the east elevation, lintels, which are reminiscent of those used at the Workshop and the Main Lumber Storage, are made of reinforced concrete connected to the CMU masonry. Foundations are unknown.

The construction reveals the use of stretcher units, looking at other closer constructions, and single corner units, the face of which is in plane. Unit nominal dimensions used at the Cloister are 8 by 8 by 16-inch for the load bearing walls, 4 by 8 by

[129] Ibid, 4
[130] Caleb Hornbostel, 164

16-inch for the partitions, and 8 by 4 by 16-inch for the top row in the plinth. Besides, it has been identified two types of concrete blocks at the Cloister that primarily vary in color. A dark grey color was used in the wall footings at the southeastern corner, while a lighter concrete block was used for the rest of the masonry.

The bond pattern follows the typical running bond pattern, which at some point is replaced by a stack bond construction in the plinth. The running bond is a concrete masonry bond having successive courses of overlapping stretcher units with head joints falling in the middle of the unit in the previous row. In the stack bond, the overlap is less than 1/4 of the unit length. It is noticeable that the mortar joint profile is concave, probably produced with a rounded jointer, probably 5/8 inch. This type of joint was recommended for exterior walls because it easily sheds water.

In the case of the Arts Building, Nakashima used a load-bearing wall comprised of a single width of lightweight concrete block rendered with white stucco in the exterior. As revealed by the moisture stains, a running bond was also used.

ASTM active standards were "Standard Specifications for Hollow Load-Bearing Concrete Masonry Units" (C90-64T), and "Standard Specifications for Hollow Non-Load Bearing Concrete Masonry Units" (C129-64T). Regarding the mortar, actives standards were ASTM "Tentative Specifications for Mortar for Unit Masonry" (C270-61T), ASTM "Masonry Cement" (C91-60), ASTM "Specifications for Mortar and Grout for Reinforced Masonry" (C476).

3.4.3. Wood Species

Although wood was a material common in preindustrial and vernacular architecture, it found multiple applications both with few transformations and through by-products or derived products. Nakashima as woodworker crafted wood to generate a variety of utilitarian and structural elements. The joinery that can be seen in Nakashima's furniture is also employed in architecture. Nakashima noticed this practice also in the Bucks County barns, where joinery was shared both by the structural elements and furniture.[131]

Nakashima primarily employed two species: white oak (Quercus alba) and Cypress (Taxodium distichum). Change over time introduced a new species: ipe (Tabebuia spp.) Load-bearing elements, like the beams and lintels are white oak. Extant earlier posts in the pathway are also white oak, while the new posts are ipe. The frame and the architectural elements in the south and west elevations, such as the grills and sliding windows, are cypress. Tongue and groove fir board was employed as sheathing in the Cloister. The stairway is made of three-inch thick white oak planks cantilevered twelve inches into a stone masonry wall. The solid wood ribs of tapered cross section are made of unknown species.

White oak is a heavy resilient hardwood wood, with high shrinkage and shock resistance. The sapwood is approximately white and 1 to 2 inch wide. The heartwood is usually grayish brown. Both with marked rays, the characteristic that differentiates white oak from red oak is the presence of tyloses in the pores that prevent moisture migration, thus the wood is more resistant to decay. Besides, the wood of white oak is slightly denser than red oak. White oak heartwood has good decay resistance.[132]

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[131] George Nakashima, *The Soul of a Tree*, 71

[132] *The Wood Handbook: Wood as an Engineering Material* (Madison, Wisconsin: US Department of Agriculture, 2010), 2-9

Cypress is a softwood species. Unlike the sapwood, which is narrow and practically white, the heartwood ranges from light yellowish-brown to reddish-brown, brown, or chocolate. The wood is moderately heavy, strong, and hard. The heartwood is highly decay resistant and the shrinkage is moderately low.[133]

Ipe is an imported hardwood. The term refers to a group of 20 species of tress occurring in Latin America except Chile. Other common names are guayacan and lapacho. The difference between sapwood, which is relatively wide, yellowish gray or gray brown, and heartwood is abrupt. It is a very heavy wood, averaging about 64 lb ft^3 at 12 % moisture content. The texture is fine to medium. Having a straight to very irregular and often narrowly interlocked grain, these species present moderate difficulty to work or machine. Ipe's hardness is two to three times that of white oak, the wood that it has substituted on various changes described later in this thesis. Ipe is highly resistant to decay and insects, particularly subterranean and dry-wood termites. The heartwood is impermeable, but the sapwood can be readily treated with preservatives.[134]

Specific species of other architectural elements made of wood are unknown, such as doors, the baseboard heater protection, and plates. Further investigation is required to identify and characterize the species of these elements, in order to determine material properties and analyze causes of deterioration, since wood behavior is highly variable depending on the characteristics of the wood species and the conditions of use.

[133] Ibid, 2-11
[134] Ibid, 2-25

3.5. The Use of Reinforced Concrete

George Nakashima chose a grided concrete slab to cover the column-free wide space of the vestibule in the Arts Building. This structural system is a reinforced concrete monolithic thin slab integral with ribs or joists spaced at regular intervals in perpendicular directions. In this occasion, the slab was supported on its perimeter by a stone masonry wall at the north, concrete block masonry wall at the south, and a concrete wall at an angle reinforced with ribs.

The original framing plan,[135] projected by Paul Weidlinger Consulting Engineering, shows a 6 by 6 grid of identical squarish spaces. However, as-built conditions reveal a handling of the engineered elements that provides a less rigid solution while economizing on material. The extant framing is a 6 by 5 grid of identical squarish spaces. In the row adjacent to the wall at an angle, the spans were substituted by openings to conceal five skylights.

As the superficial woodprints reveal plywood was used as a formwork. However, not so much care was taken on pouring the concrete as the imperfections, such as the leaves partially embedded in the concrete and the honeycomb, reveal. At some point, the framing experienced a significant deformation that caused cracks providing an easy path for rainwater and demanded the addition of a new support, a polished wooden log.

3.5.1. Reinforced Concrete as Building Material

Concrete is a composite material consisting of a correctly proportioned mixture of coarse and fine aggregates, water, and a hydraulic binding material, primarily Portland cement. Chemical admixtures and supplementary materials are added to obtain desired

[135] Mezzanine Framing Plan, n.d., George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.

qualities and enhance properties of concrete.[136]Hardened concrete shows excellent compressive strength but relative little tensile and shear strengths, thus steel reinforcing bars (rebar) are used and placed before the concrete is poured to obtain a new composite material called reinforced concrete. Theoretically, both materials act together; consequently, reinforced concrete satisfactorily withstands compressive strength as well as tensile and shear strengths.

Concrete is an ancient building material already used by the Romans, known as *opus caementicium,* to designate a material composed by lime, puzzolana, which gives hydraulic properties to the mix and aggregates. The decline of the Roman Empire signified the loss of the technical expertise to produce and use concrete as a building material until the eighteenth century, when in 1779 John Smeaton (1724-1792) rediscovered the hydraulic properties of puzzolana when mixed with lime.

At the turn of the eighteenth century, a variety of patents for hydraulic cements show remarkable activity in developing a material for durable construction, however it was the discovery and development of an artificial cement known as Portland cement, patented in 1824 by Joseph Aspdin (1778-1855), which is now the basic ingredient in modern concrete.

Experiments adding metal reinforcement to concrete also spread Europe during the mid-nineteenth century. In England, the plasterer William B. Wilkinson, 1854; in France, Joseph Luis Lambot (1814-1887), 1856, the builder Françis Coignet (1814-1888), 1853, and the gardener Joseph Monier (1823-1906), whose patent to manufacture ornamental pots represented the beginning of the development of the reinforced concrete. In the United

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136 American Concrete Institute

States, the mechanical engineer William E. Ward built the first building in reinforced concrete in Port Chester, New York in 1871-1875 after a design by Architect Robert Mook.

The late nineteenth century saw the first attempts in reinforced concrete frames. In Germany and Austria, Gustave Adolf Wayss (1851-1917), who bought Monier's patent; in the United States, Ernest L. Ransome, who patented a system using twisted square rods to help the development of bond between the concrete and reinforcing; and in France, the prolific Francois Hennebique (1842-1921).

Hennebique designed a frame system for reinforced concrete to withstand tensile loads and began the modern era in the construction industry. However, it was the architect Aguste Perret (1874-1954) who pioneered the use of reinforced concrete as an architectural material in building a wide range of building typologies, from residential apartments to churches, including Le Havre, a post-war reconstruction plan for a city in France that exploited the possibilities of concrete.[137]

Undoubtedly, Portland cement was the material that made possible reinforced concrete technology. Portland cement is comprised primarily of argillaceous materials (silica, alumina) and calcareous materials (lime) with iron oxide and small amounts of other constituents, to which gypsum is added in the final grinding process to control the setting time of the cement. Essential constituents of the calcined clinker are dicalcium silicate (C_2S), tricalcium silicate (C_3S), tricalcium aluminate (C_3A), and tetracalcium aluminoferrite (C_4AF). The relative proportion of each constituent determines the various types of cement, and consequently their appropriate use.[138]

[137] Unesco, The World Heritage List. http://whc.unesco.org/en/list/1181 (accessed June 2015)
[138] Caleb Hornbostel, 113

Fine aggregates consist of particles from 0.02 up to 1/4 inch diameter. Coarse aggregates consist of particles of 1/4 inch diameter and over. They can be natural or artificial, produced by crushing blast furnace slag or burning and crushing clays or shale.[139]

Concrete admixtures include accelerators, retarders, finely divide powders, plasticizing agents, air entraining agents, so-called waterproofing compounds, and color pigments.[140]

The proportions of the ingredients in the mixture, and the mixing, pouring, finishing, and particularly curing processes, affect the quality of the concrete. The water-cement ratio ultimately defines the workability, durability of concrete exposed to weather, and the final compressive strength. This relation is inverse, the higher the water-cement ratio, the lower the compressive strength, and the higher the workability. The quantity of aggregate that can be mixed with a predetermined amount of cement paste with a chosen water-cement ratio depends on the size and grading of the fine and coarse aggregate and on the proportions to each other.[141]

In the Arts Building, the grid slab is a tri-dimensional frame of 6 by 6 inch tapered concrete joists with a 2 inch top slab placed monolithically with the joists. Beams and walls in the grid slab's perimeter support it. Although the as-built reinforcement is unknown, during a visit to the Michener Museum in March 2015, a frame plan by Paul Weidlinger was discovered.The plan shows typical reinforcement for the joists and the slab. Essentially, it was recommended to install two #4 rebars in the upper section and one #9 rebar in the lower section of each joist, and #4 rebar at 12 inches between joists. All concrete walls

[139] Ibid, 16
[140] Ibid, 13
[141] Ibid, 150

below the grid slab had to be 8 inches thick with #4 rebar 10 inches each way at each wall. Rebars in the joists in the north are bent and anchored into the wall.

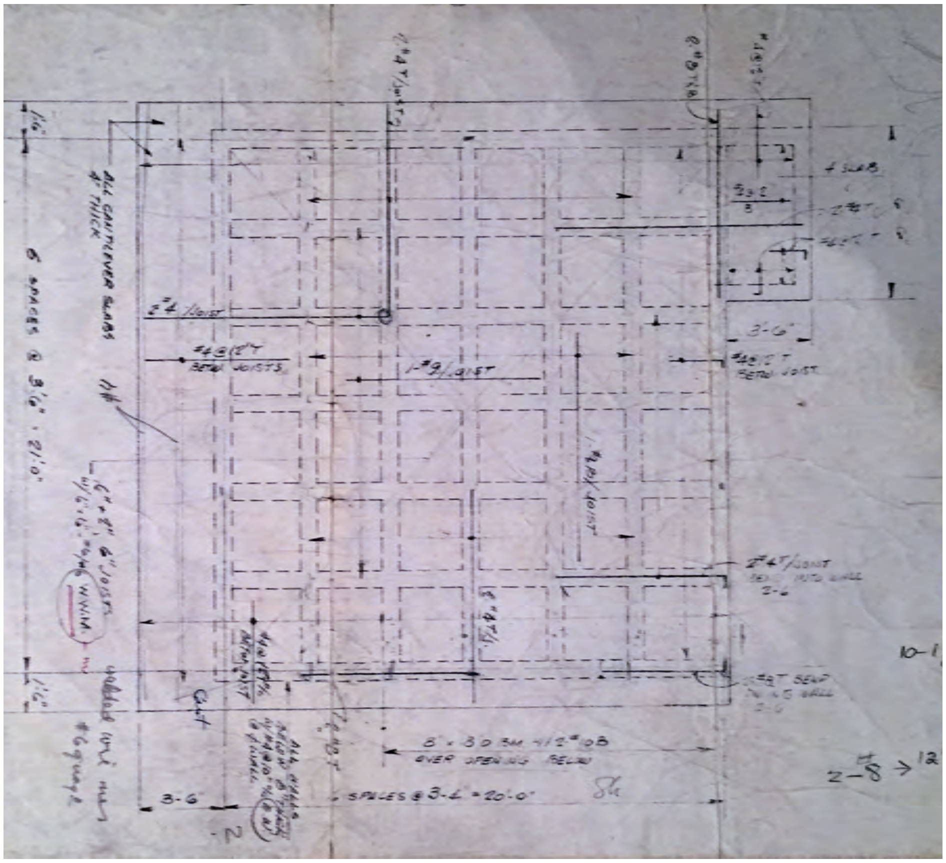

Fig. 3.2. Mezzanine Framing Plan by Paul Weidlinger Consulting Engineer. Date unknown. Source: George Nakashima Collection, James A. Michener Art Museum Archives. Gift of Mira and Kevin Nakashima.

Unfortunately, Paul Weidlinger's mezzanine framing plan was certainly altered before construction, since there is a difference between the number of joists showed in the frame plan and the as-built conditions. The plan suggested a grid of 6 by 6, while the grid constructed is of 6 by 5. However, it is possible that this ultimate construction contains the recommended number of rebars. The use of a pachometer or eddy current device, which is used to detect the presence of ferromagnetic materials embedded in concrete, would be very useful to prove this hypothesis.

Regarding the concrete finish, the greyish shades of the concrete used at the Arts Building and Cloister is primarily due to the Portland cement used in the mixture and, to a lesser degree, the aggregates. The superficial wooden impress is caused by the use of Plywood as form material.

3.5.2. The Use of Plywood as a Formwork

Because concrete is poured in a plastic state, the construction process requires the thoughtful conception and careful installation of forms to mold concrete to the required final shape. Besides, the facing of the formwork becomes particularly important, because it will be the material that will be in contact with the fresh concrete until it sets. According to the technical literature, correct form design provides: strength, rigidity, tightness, good alignment, reasonable economy, desired texture on exposed concrete surfaces, and ease of stripping.[142] As described in Chapter 1, Nakashima was familiar with the design of formwork, and probably it was he who designed and chose plywood as the material for the forms.

Having advantages overheavy wood planks and metal, softwood plywood quickly gained popularity as a formwork material. Softwood plywood panels were first used as a formwork in the 1920s and, by the late 1930s, it had become the most common form material.[143] In fact, large standard plywood panels were the appropriate size to pour concrete when few joint lines (fins) and imperfections were desired. Common thicknesses for concrete formwork were 1/2, 5/8, and 3/4 inch.[144] The 3/4 inch was more cost-

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142 William S. La Londe. Ed. *Concrete Engineering Handbook* (New York: McGraw-Hill, 1961), 2-3
143 Thomas C. Jester, *DoCoMoMo Journal*, 20
144 William S. La Londe, 2-10

effective, the thinner sections requiring stronger bracing to prevent deflection. The 1/4 thickness was appropriate for curved surfaces.[145]

Because of their affordability, lightweight, and mechanical properties, such as stiffness and strength, plywood panels showed capacity to withstand the loads of poured fresh concrete with a minimum amount of reinforcing, particularly during the pouring, vibration, compaction, and curing processes, thus efficiently supporting live and dead loads. Live loads included wind, moving buggy loads, impacts, workmen, vibration, etc. Dead loads involved reinforcement bar loads, pressures transmitted by the fresh concrete, etc.

Besides, since plywood could be removed without damaging the material, it could be reused various times thus lessening the construction costs including the reuse of lumber studs, wales, and fasteners used to maintain plywood sheets in place.

In fact, a major concern in concrete formwork is the hardware, which comprises fasteners, ties, spreaders, and inserts. Usually, wire-cut steel in sizes 4 to 10 penny were used taking into account a simple rule: "to make the length of the nail at least twice that of the thickness of the piece being fastened."[146]

Forms have to resist concrete pressure during the pouring and curing processes, and so may either be braced externally, as probably in the Arts Building's grid slab, or tied one to the other, as in the vertical concrete wall in the terrace area. Prints because of fasteners use have not been noticed in the wall at an angle; however, wide spans are covered with plaster in the interior side and with Ben Shahn's mosaic in the exterior.

In his *Concrete Engineering Handbook*, William S. La Londe recommended the use of either coil ties or snap ties. A coil tie consisted of a "helical wire coil electrically welded to

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[145] *ROTCM 145-5-1*,182
[146] Ibid.

two or four longitudinal wires at their ends. The coil acted as a female thread to receive a reusable hardened-steel bolt and a removable steel cone." [147] This steel cone had two functions: to distribute the bearing of the ends of the tie against the form and also to produce a neat hole, which could be patched after the formwork, bolt, and cone removal once the concrete gained the sufficient strength.[148]

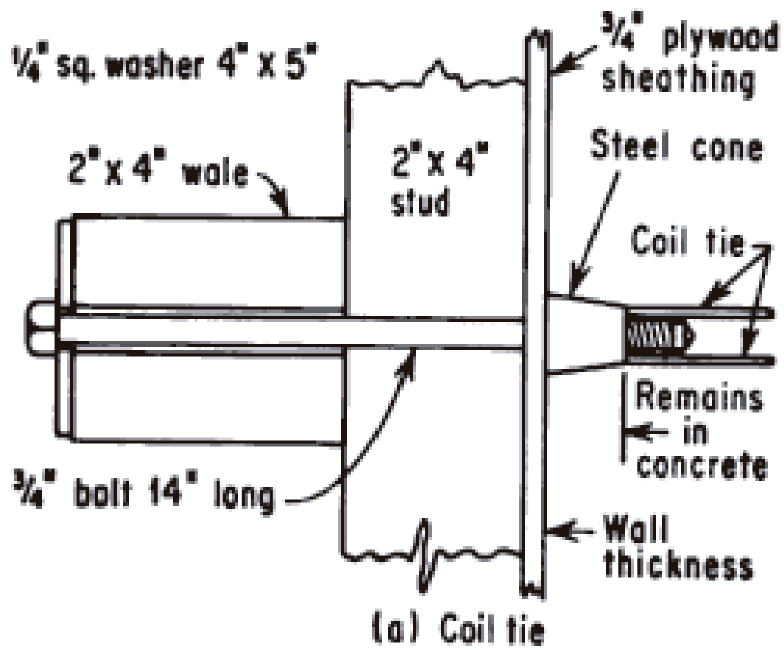

Fig. 3.3. Coil tie for plywood formwork. Source: William S. La Londe. Ed. *Concrete Engineering Handbook* (New York: McGraw-Hill, 1961), 2-5

An economical alternative to coil ties was snap ties. A snap tie was a "thin steel rod made with a button head on each end and other buttons formed on the rod, so spaced as to meet the inside faces of the forms to give the correct wall thickness."[149] Between 1/4 to 1/2 inches inside the concrete surfaces, a notch in the rod provided with a weak point to break off and remove the exposed length of the snap tie by bending the and twisting after the

[147] Ibid, 2-5
[148] Ibid.
[149] Ibid.

formwork stripping. Inside the concrete, a flattened section maintained in place the rest of the rod. Sometimes, as in the coil tie, a wood cone was previously placed to avoid spalls and to get a neat hole to be patched.[150]

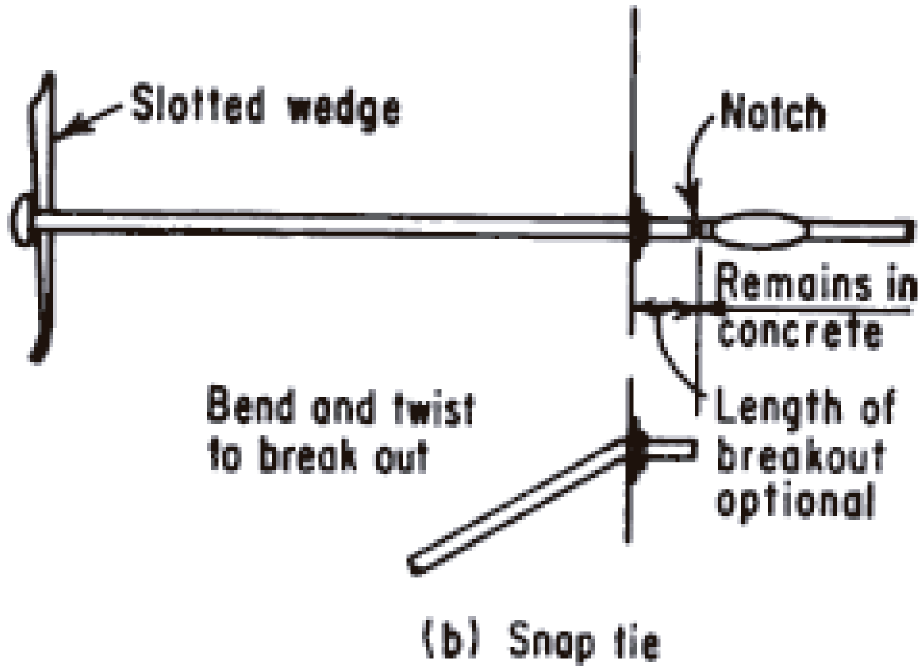

Fig. 3.4. Snap tie for plywood formwork. Source: William S. La Londe. Ed. *Concrete Engineering Handbook* (New York: McGraw-Hill, 1961), 2-5

Size of plywood sheets depended on the dimensions of the wall and the ribs. Forms were probably fabricated in place. The Arts Building's concrete walls height suggests standard 4 by 8-feet plywood sheets were used as sheathing possibly secured with studs and wales, which ultimately supported the studs and facilitated the alignment.[151]

The wales were frequently double 2 by 6s, which enabled the use of tension ties without damaging drilling and weakening the wales. To obtain the wall at an angle, studs might have been disposed horizontally, and the wales in the complementary angle to support

[150] Ibid.
[151] For elements up to 6 feet, studding was enough. Ibid., 2-10

the studs. The stud size and spacing, and consequently the wale spacing, would have depended on the concrete pressure and the probable deflection of the plywood sheathing.

Regarding the Arts Building's grid slab, according to the literature, the planks for the joists should be the exact width of the concrete member, with the joist-side forms resting on the shores. The wood grain prints reveal that plywood forms were probably manufactured in situ to form the soffits between the joists. As in the wall, plywood sheathing was externally secured with battens and supported by a temporary frame comprised of shores, braces, and cap. The soffit sheathing was probably maintained in place by joists and ledger fixed to the joist-side forms.

From an aesthetic perspective, plywood versatility allowed the creation of specific forms for shaping concrete, such as curved elements, which were more difficult to create with other form materials. This property had interest in the creation of architectural concrete, which stressed the creative qualities and aesthetic aspects of the use of concrete. In fact, plywood was easily worked, could be cut in various sizes and shapes, and could be bent. In addition, different operations, such as adapting and installing plywood panels to a conceived module, enabled to create repetitive patterns, which contribute to the building embellishment and could have utilitarian purposes too, such as construction and control joints.

In addition, plywood grain could be transferred to the concrete, either sanding the panels to expose the grain or taking advantage of the anatomic characteristics of the wood. In the latter, the differing absorbency of sapwood and hardwood causes a differing absorbency of water from the concrete, and, consequently, wood grain is imprinted in the concrete surface. This is a quality visible in the Arts Building's vestibule as well as in some non-exposed areas. The presence of some offsets reveals that the form did not fit perfectly at the time of pouring the concrete.

3.6. Flooring materials

Nakashima used a combination of traditional and modern flooring materials establishing an interrelationship between the interior and the landscape. The vestibule floor is laid with local stone slabs of different sizes and shapes, the main exhibition space in the Arts Building floor is laid with Amtico™ travertine,[152] which was also used to cover the Cloister floor. In the mezzanine, a raised walnut floor partially covers the exposed concrete.

In the exterior different sizes of stones add visual interest while at the same time accomplishing a functional purpose. Overall, walkways are made with irregular flagstone, but in the covered pathway, where the flagstone shows a more regular and square shape; white pea gravel complete the path. A dark river rock band is used to cover the ground that receives the water runoff from the Cloister roof.

3.6.1 Vinyl-tile Flooring: Amtico™ Travertine

Vinyl tiles are made from synthetic resin, which is polyvinyl chloride-acetate or pure polyvinyl chloride, fillers, stabilizers, plasticizers, and pigments. The industry could supply a variety of dimensions, colors, shapes, textures, and strips, for domestic, commercial, industrial, and institutional uses. Nakashima was aware of the advantages of this flooring material, categorized as resilient, and used it for both the Arts Building and Cloister.

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[152] Peggy Lewis. "Minguren Museum - Building Shape Idea" in *Sunday Times Advertiser*, Trenton, N.J., May 21, 1967

The history of vinyl tiles begins with the experimental application of plastics as flooring material during the first quarter of the twentieth century.[153] Apparently, in the earlier stages, the flooring industry showed resistance to introduce this new material. In fact, until the end of the 1920s, plastic did not enter in the industry, when a synthetic resin, called coumarone-indene, substituted asphalt as a binder in tile production, enabling a new range of lighter colors unlike the darker colors provided by the asphaltic binders.

In 1931, the building industry witnessed the first vinyl floor produced by Carbide and Carbon Chemicals Corporation, which was a semi flexible vinyl asbestos tile named Vinylite. Vinyl tile had a limited popularity, until after World War II. [154]

The immediate years after World War II, vinyl tile production saw fast development and generated a keen competition with other flooring materials, such as rubber, asphalts, and linoleum. Between 1947 and 1952, the number of companies producing plastic floors increased from 22 to 34 firms. The ease to adapt exiting machinery used to produce asphalt and rubber tiles to manufacture primarily vinyl-asbestos tiles and the lower costs of vinyl resins were decisive to the market and production rapid expansion.[155]

Usually, the industry manufactured three main types of vinyl resilient floors: vinyl-asbestos tiles, solid vinyl, and vinyl composition tile. By the 1960s, the common commercial forms were tile and sheets. Vinyl sheet flooring was offered in two thicknesses, 0.09 and 0.07 inch, in rolls 6 feet wide by 50 feet length. Solid vinyl tiles standards comprised two thicknesses, 3/32 and 1/8 inch, in squares 9 by 9, 12 by 12, 18 by 18, and 36 by 36 inches, and in rectangles 18 by 36 inches. In the case of vinyl-asbestos tiles, the thicknesses were

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[153] For example, Leo Baekeland explored the potential of his 1909 invention, the Bakelite, the first completely synthetic plastic, as flooring material by impregnating paper with Bakelite and epoxying it to high temperatures. Kimberly A. Konrad and Paul D. Kofoed. "Vinyl Tile" in *Twentieth Century Building Materials,* 241
[154] Ibid.
[155] Ibid.

1/16, 3/32, and 1/8 inch, and were offered in squares 9 by 9, and 12 by 12 inch. Some manufactures could offer larger sizes.[156]

The most common plastic resin used in their manufacture is polyvinyl chloride-acetate, which is the result of the copolymerization of vinyl chloride and vinyl acetate monomers. [157] Polyvinyl chloride-acetate is a thermoplastic resin that acts as the binder of the mixing and, together with other plasticizers, imparts various grades of hardness, durability, abrasion resistance, resistance to grease and alkalis, flexibility, and heat and light stability.

Vinyl-asbestos tiles contained asbestos, a hazardous mineral fiber, mixed with the plastic resin. Curiously, asbestos contributed to the durability of the tiles. The asbestos fibers favored the migration of water vapor through the section of the tile, which could be fostered by the asbestos contained in the adhesive too. This breathability, which is a unique characteristic of the vinyl-asbestos tiles, contributed to a long-lasting tile.[158]

Unlike vinyl-asbestos tiles, solid vinyl, and vinyl composition tile, were manufactured without asbestos. Vinyl composition tile used other mineral fillers, like calcite, mixed with the binder, and solid vinyl was deliberately manufactured without fillers.[159]

Vinyl tiles manufacture comprised five basic processes: mixing, rolling, cutting, cooling, and packaging. The first stage involved preparing a soft and moldable dough by mixing under heat and pressure. Pigments were added during this stage to guarantee final homogeneity in the desired effect, which could be variegating, marbling, and flashing. Subsequently, the dough was passed through a series of calender rollers to obtain the required thickness. Still hot, the resultant sheets were cut either with a square knife and

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[156] Caleb Hornbostel, 400-401
[157] Paul D. Kofoed, 242
[158] Ibid, 316
[159] Ibid.

ejector plate or by punching the tiles with a male and female punch. The leftovers of this process can be reheated and reused again to produce additional tiles. Vinyl tiles did not required curing, simple cooling to leave them harden was sufficient.[160]

Vinyl tiles could be mass-produced, and consequently were extensively advertised and showed in exhibitions. Carbide and Carbon Chemicals Corporation first exhibited vinyl tiles in 1933 in the Vinylite House at the Century of Progress Exposition in Chicago. In parallel to the vinyl tiles increasing popularity during the 1950s, manufacturers extensively promoted the advantages of this flooring material in colored advertisements occupying the full page: "This tile is your answer to questions of durability and rich, colorful appearance in flooring. Vinyl tile comes in a wide array of colors -light to dark; soft, warm pastels; unusual marbleized effects. You'll find it ideal wherever wear's a problem. It also keeps its gloss; requires little maintenance and can be used over practically any kind of dry, smooth subfloor."[161]

As described earlier, being a clear material, vinyl enables the production of a wide range of colors, which was used by the manufacturers to market the vinyl tiles and to satisfy the needs of a growing mass of consumers. Soon, color and traditional finishes were expanded with textured surfaces to emulate natural stone. This type of finish was a novelty by the 1960s, as a Ruberoid's advertisements published in *Architectural Forum* reveal. Ruberoid, a New York based company, manufactured travertine vinyl-asbestos floor tile, which were promoted as "the vein-textured marble of ancient Italy... with nature's subtle

160 Ibid, 242
161 Monsanto Chemicals and Plastics. *Architectural Forum*, 1954

shadings and stratifications... has been captured in all its beauty in Vinyl-Asbestos by Ruberoid."[162]

Vinyl flooring can be applied below grade, above grade, and on grade. Solid vinyl sheet and tiles installation required appropriate adhesives, which could contain asbestos, and an impervious underlayment between the substrate and the flooring material, since a leveled rigid base and moisture migration control was necessary.[163] Vynil-asbestos tiles could be installed directly upon a smooth concrete base using the recommended adhesive, which could contain asbestos too. In the cases of wood bases, the installation needed an underlay consisting of 1/2-inch thick asphalt coating.[164]

Nakashima employed Amtico™ Travertine tiles of 36 by 36 inch size with 1/8 inch thickness installed upon a smooth concrete base, the adhesive being unknown. This dimension exceeds the standard 12 by 12 inch, 3/32-inch gauge Amtico Rubber Flooring, a subdivision of American Biltrite Rubber Company, commercialized under the vinyl-asbestos travertine tiles type.

American Biltrite Rubber Company, which still exists, was founded as Ewell Rubber Company in 1908. The company first produced heel, and sole production, entering into the flooring material industry in the first decades of expansion. In 1961, American Biltrite acquired Bonafide Milles, Inc., a manufacturer of vinyl-asbestos and asphalt coverings, which doubled the production abilities of its Amtico Rubber Flooring division, which produced solid vinyl and rubber floor coverings.[165]

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162 Ruberoid Company. *Architectural Forum*, 1962
163 Caleb Hornbostel, 401
164 Paul D. Kofoed, 242
165 *International Directory of Company Histories*, vol. 16 (St. James Press, 1997)

The fact that Amtico produced such a diversity of flooring materials implies two possibilities: that Amtico™ Travertine vinyl-asbestos tiles were manufactured as a special size, costs being higher, or, as described earlier, 36 by 36 inch was a standard within the solid vinyl tiles produced by the company. Consequently, it might be a possibility that the tiles uses by Nakashima are free of asbestos.

3.7 Other Materials

3.7.1 Styrofoam™

Styrofoam™ was an extruded polystyrene insulation lightweight rigid board manufactured by Dow Chemical Company, based in Midland, Michigan. It showed buoyancy, good insulation properties, and a permanent low "k" factor, which served as its own vapor barrier, thus it does not absorb water. These properties are related to the closed-cell foam structure, which is the result of a process for extruding polystyrene developed in 1941 by Ray McIntyre, engineer and research chemist in Dow.[166]

Along with durability, insulation and water-resistant qualities are also related to the type of plastics used for its manufacture, the polystyrenes, which are the result of the polymerization of the hydrocarbon styrene, first isolated from natural resin in 1839, and first manufactured and commercialized by BASF in 1930. This synthetic resin showed high insulation power, mechanical strength, and lower water absorption.[167]

Essentially, the manufacture process involved heating solid polystyrene and a gaseous agent under pressure in a pressure-resistant vessel, causing the absorption of part of

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[166] The Dow Chemical Company. "The Story of Styrofoam™ Brand Insulation" building.dow.com (accessed May, 2015)

[167] Caleb Hornbostel, 397

the gas by the polymer, which remained entrapped in a resultant gel, which expanded when released from the vessel producing thus a cellular structure.

Dow's polystyrene foam was first used during wartime. In 1942, the U.S. Coast Guard applied this plastic foam in a six-man life raft, and continued its application in a wide range of watercrafts. Shortly after, in 1944, the invention was patented, and in 1946, it was first commercialized under the name Styrofoam™.

By the 1950s, the extruded polystyrene boards had substituted other insulating materials such as cork, and had become a standard in the construction industry. It was applied above-grade and below-grade in a wide range of residential, commercial, and institutional buildings. Usually, it was installed in cavity walls, over concrete slab and foundations, and under the built-up roof systems.

Typically, the installation of Styrofoam™ involves fasteners, such as nails, and the use of tape to secure joints against moisture infiltration when the boards used do not have tongue and groove edges. In the Arts Building, the insulation boards are installed between an 8-inch concrete block masonry and the plaster lath.

3.7.2 Structolite™

Structolite™ is a ready-mix basecoat plaster, which is manufactured by United States Gypsum Company still. Essentially, this ready-mix plaster is a milled pre-mixed binding composition of calcined gypsum mixed with expanded perlite as aggregate, other compounds to improve mixing properties, and probably asbestos. George Nakashima applied Structolite™ as a finish in the interior of the Arts Building and in the living area of the Cloister.

In America, the manufacture of calcined gypsum, an ancient and widespread building material, began in New York City in the 1890s, probably based on German manufacture techniques. Calcined gypsum was the primary constituent of various materials ranging from tiles used for floors, partitions, roofs, and plaster. United States Gypsum Company first used and commercialized calcined gypsum as main component of a pre-mixed plaster under the trademark Structolite™ in 1917.[168]

Calcined gypsum, also plaster of Paris, is primarily composed of calcium sulfate hemihydrate ($CaSO4\ 1/2H_2O$). To obtain calcined gypsum, natural gypsum rock, chemically calcium sulfate dihydrate ($CaSO4\ 2H_2O$), is mined or quarried, crushed, ground into a fine powder, and then indirectly heated in a kettle or directly heated in a rotary kiln to approximately 350ºF, which eliminates three fourths of the chemically combined water. The product of this process is ground to obtain the desired final fineness.

The plaster obtained was mixed with expanded perlite, which is obtained by roasting natural perlite, an amorphous volcanic glass that has 2 to 5 % content of water. When heated to temperatures of 1,400 - 2,000ºF, the content of water, silanol and molecular water, causes the expansion of raw perlite to form a lightweight and glassy material with a cellular structure.[169] The perlite is 20 times the original volume of the raw material and its bulk density diminishes by up 90%. Its primarily composition is amorphous silica, aluminum oxide (12-18%), oxides of potassium and sodium, and traces of iron, magnesium, calcium, and titanium.[170]

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[168] United States Patent and Trademark Office
http://tsdr.uspto.gov/#caseNumber=71651548&caseType=SERIAL_NO&searchType=statusSearch. Accessed on May 1, 2015
[169] Floyd G. Anderson, W.A. Selving, Gretta S. Baur, P.J. Colbassani, and Walter Bank. *Composition of Perlite* (United States Department of the Interior, 1956)
[170] *Industrial Minerals and Their Uses: A Handbook and Formulary* (Westwood, NJ: Noyes Publications, 1996), 52-54

Being chemically inert and free of impurities, perlite does not alter the setting properties of calcined gypsum. Particularly, as a lightweight aggregate, expanded perlite helped to obtain a reduced weight mixture in comparison to the traditional use of sand. Among other properties, technical literature highlights higher fire-resistance in comparison to sanded plasters, although it has lesser strength.[171] The ASTM specifications applied were C28-50 and C35-54T. ASTM 35 established the gradation standards of perlite and vermiculite aggregates.

Structolite™ had to be mixed with the appropriate amount of water to reproduce calcium sulfate dihydrate, and could be applied over any plaster base either in two-coat work or three-coat work. When mixed in accordance with ASTM specifications, Structolite™ contained "not more than three to four cubic feet of mineral aggregate per 100 pounds of calcined gypsum plaster, to which may be added fiber and material to control working quality and setting time."[172]

3.8. Building Mechanical Systems and Installations

Building mechanical systems and installations in the Arts Building and Cloister include heating, electricity, telecommunications, water distribution, and sewage collection systems.

Heating is based on a central heating system that feeds pipe radiations.[173] Each radiator is a welded steel pipe that bristles with steel radiating fins, and is connected to the following radiator by the pipes. The radiators are mounted on the wall and are integrated in

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171 *Manual of Gypsum: Lathing & Plastering* (GA 101-72) (Hollywood, CA: Gypsum Association, 1972)
172 A patent presented in October 1967 described some of the Structolite™'s characteristics. Charles Polis. "United States Patent US3519450 A - Binding Composition", October 16, 1970
173 Similar to the pipe radiators produced by American-Standard for Public, Industrial, and Commercial Buildings, and advertised during the 1950s.

the architecture by housing them under a wood board that reads as a baseboard all around the main exhibition space and in the west side of the mezzanine. Pipes installed below the stone paving heat the vestibule area.

The boiler is housed in the Cloister, in a utilities room with access from the east side. The fuel tank stands outdoors in the north side of the Cloister, partly hidden by the concrete masonry and a wood grill. Thermostats strategically placed in the interior assist in regulating the comfort level. During the site visits in the fall and the winter, heating was operative.

Artificial lighting is occasional and strategically located, enhancing the architectural experience. Noguchi lamps are used in the interiors, providing an indirect and filtered warm light. Outdoors, lighting fixtures are solely present in the Cloister porch.

There is no air-conditioning system, however, there are casing windows strategically placed in the mezzanine area and sliding windows and doors to allow enough interior natural ventilation.

Water pipe system distributes water to a faucet installed in the bar at the Arts Building, and to a kitchenette, shower, and toilet housed in the Cloister. The design and sizing of the sanitary sewage system, installed below grade, is unknown.

3.9 Conclusion

Built of a combination of traditional materials and new twentieth century materials, the Arts Building and Cloister show a variety of building techniques thoughtfully selected and crafted by Nakashima. The particular arrangement of materials of a diverse nature recalls Nakashima's understanding of the intrinsic properties of materials and their contribution towards functional and aesthetic expression, much like his attitude toward designing furniture. Wood elements elegantly interlock with the reinforced concrete and the stone, and some of the architectural joints are practically identical to the joinery used in furniture. The parallels between the connecting joint in the exterior posts and Nakashima's pedestal base or between the cantilevered steps and the Milk House Table are paradigmatic.

Nakashima's reverence for tradition did not prevent him from using mass-produced modern materials, which sometimes emulate natural finishes or are applied suggesting traditional Japanese construction techniques, such as the Amtico™ Travertine flooring or the surfaces plastered with Structolite™ recalling mud plasters. In addition, artificial materials made of natural materials such as plywood played an important role in his designs, either as a structural material for the hyperbolic paraboloid roof or as a form-giving, surface-defining material for the concrete ceiling.

Throughout this chapter, special interest has been developed in researching those main modern materials, with explanation of their nature, description of their properties, and succinct narration of the historical background and construction techniques when possible. Lack of secondary sources, and limitations of time, limited the narrative herein contained, nevertheless, it provides basic information necessary to understand the performance and deterioration processes, which are the main focus of the following chapter.

4. Change Over Time: Architectural Archeology

According to the National Park Service, integrity is defined as "the authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property's historic or prehistoric period."[174] This definition relies on the fact that the tangible qualities of the original historic fabric allow access to the past.

The National Register of Historic Places expands this definition in recognizing that integrity involves seven different aspects: location, design, setting, materials, workmanship, feeling, and association.[175] All these qualities ultimately inform the statement of significance, however for the purpose of this investigation, they help to establish the critical aspects of the Arts Building and Cloister and their changes over time.

This chapter primarily focuses on the investigation of the changes to the Arts Building and Cloister over time to both its physical fabric and its setting. The research was chiefly supported by comparing archival images with its current state, and by a series of interviews with members of George Nakashima Woodworker, which include Mira Nakashima, John Lutz, and Aram Darian.

4.1. Water Disposal Systems

The collection and disposal of rainwater and snowmelt is a critical aspect for any building. In the Arts Building, eaves, gutters and downspouts are the principal means of carrying water off from the roof, which ultimately protects the building. In the case of the

[174] "Secretary of the Interior's Standards and Guidelines." *National Park Services*. http://www.nps.gov/history/local-law/arch_stnds_10.htm. Accessed on May 10, 2015.
[175] "Guidelines for Evaluating and Documenting Historic Aids to Navigation to the National Register of Historic Places." *National Park Services*. http://www.nps.gov/nr/publications/bulletins/nrb34/nrb34_8.htm. Accessed on May 10, 2015.

Cloister, a shed roof carries off water towards a band of grey-black middle-sized river stones laid out at the ground level.

Fig. 4.1: West elevation view. Date: Notice the original gutters, the upper soffit in the sliding window, and the skylight domes. In addition, the concrete floor of the terrace as originally built. Source: George Nakashima Woodworker SA, Ltd. Archives.

Two photographs, taken shortly after construction, reveal that the original copper gutters envisioned by George Nakashima were an L-section of unequal angles. These gutters appear to connect to the lower ends of the eaves and to the north and east roof edges by their larger angle. In their placement, Nakashima exhibits sensitivity to their effect on the overall roof's appearance. In effect, forming a continuous surface with the roof, the gutters are perfectly integrated into the eaves' slope with their larger angle parallel to the slope plane. In each corner, wooden plates connected to the wall accompanied the gutters by extending beyond the wall planes in order to convey the rainwater off into the ponds: one in the open courtyard between the Cloister and the Arts Building and the other attached to the Arts Building on the west side. Gutters were open at their ends.

Today, a new drainage design has been implemented and areas of the original copper flashing have been replaced along the eaves, particularly at the lower ends. Differences in the green patina between original and replacement flashing will eventually disappear over time. In addition, new box-like gutters were designed and attached to the eaves' edges as described in Chapter 2. Although this design does not retain the aesthetic spirit of the original, they appear to function better.

In addition to the changes in the gutters, another major alteration to the exterior was the replacement of the upper soffit of the sliding window in the west elevation and the construction of a standing copper canopy. The original building solution was a cypress soffit interlocked in the oak beam (Fig. 4.1) and reinforced in the middle by an additional piece of wood that was placed perpendicular to the larger length.

To control leaks, the original exposed concrete terrace was waterproofed with an impervious membrane in a first campaign and painted white with an epoxy based coating in a second campaign. This intervention disrupted the original finish and aesthetic qualities of the exposed concrete, although providing a watertight seal that protects the interior from moisture penetration.


Fig. 4.2: West elevation view. Date: December 2014. Notice the new gutter system, the copper canopy, and the new skylights. The various copper patinas are indicative of new and old flashing campaigns. In addition, the concrete floor of the terrace shows a waterproofing coating painted in white, which disrupts the original aesthetic. Furthermore, landscape features have been changed over time. All photographs by César Bargues Ballester, unless otherwise noted.

4.2. The Covered Walkway

In the south elevation, the white oak posts supporting the walkway shelter and the Cloister porch were replaced. The intervention also altered the original finish of the plywood soffit in a large area of the porch.

A photograph taken in 1965 confirms these changes. The original crafted oak posts stood directly upon the concrete block masonry in the porch area and upon concrete bases in the rest of the walkway. These posts were reminiscent of the details of traditional Japanese farmhouses. The model for the post was the *menkawa*, a post with four planed sides, and four unplanned surfaces that are left with the natural contours.[176]A Japanese-inspired cross-

[176] George Nakashima, *The Soul of a Tree*, 136

shaped open mortise is cut in the top of each post to connect three joist members on three faces of the post: two porch girders and a roof rafter, which pass through. The joint similarly works like a triple plug-connecting joint. The first two elements to be connected are the two girders, which have a tenon of the same length that projects half the distance of the post section. The second part of the assembly is the roof rafter, which is perpendicular to the other two girders, placed over them securing the connection in its upper part. In the inside face, the joist has a vertical slot to house the rafter.

As of now, the five original White oak posts in the porch and the five white oak posts supporting the walkway shelter have been replaced by ipe posts, which appear to be machine made. Unlike the original posts, the new ones rest upon ipe Japanese-inspired bases, which are a truncated square pyramid. This detail was modified presumably to discourage rot at the post base. Upper connecting joints were replicated to connect new and original members.

The girders and roof rafters appear to be the original in the porch area; however, although the plywood sheets appear to be the original, they have been relocated and painted with an opaque paint different from the original translucent white 'stain' originally used by Nakashima. Also on the north side, where the parking area is located, two joists have been replaced by machine made members, one of which is a glue-laminated joist. Replacement has also involved roof waterproofing and new copper flashing.

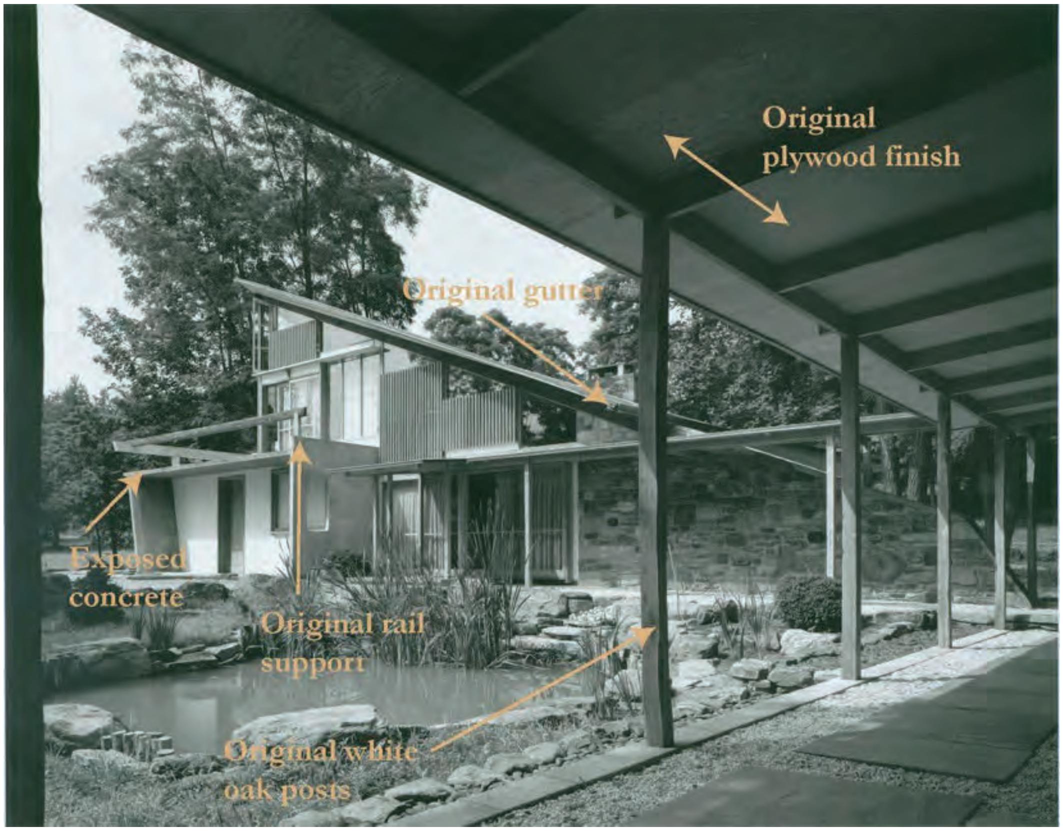

Fig. 4.3: South elevation view. Date: 1965. Notice the original white oak posts, plywood soffit finish, rail support, and gutter. Source: George Nakashima Woodworker SA, Ltd. Archives.

4.3. The Exterior Envelope

Overall, the Arts Building's as well as the Cloister exterior envelope possesses a high level of integrity. Areas of subtle repair have occurred as elements have deteriorated, usually in kind. In the area above the sliding window in the terrace, the thin walls were cleaned and repaired with similar finish. Besides, the sliding window's sill was replaced because it was rotten. During this intervention, the contractor found some difficulties in replacing the original element because of the craftsmanship-inspired details, and he stated that the building was "like a cabinet" because its members were interlocked. In addition, the wooden rail support appears to have been replaced as well.

Below the terrace and facing south, the wall span that contains the main entrance and window appears to have been replastered with a cementitious stucco reported to be composed of, 2 parts white Portland cement, 1 part lime, and 3 parts white sand.

The north and east concrete wall stucco was repaired in areas where the white cementitious coat came loose or cracked. Particularly in the east wall, a white cementitious mortar was randomly used for filling cracks, resurfacing spalled areas, and repairing chipped edges.

Fig. 4.4: South elevation view. Date: December 2014. Notice the new gutter system, the new ipe posts upon ipe bases, and the opaque white paint covering the plywood soffit. As shown in fig. 4.1, the concrete floor of the terrace has been waterproofed.

The terrace and the skylights have had the greatest alterations as described in the previous section. The five acrylic skydomes observed in Fig. 5.1 where first replaced in kind and eventually by customized skylights.[177] The earlier skydomes consisted of a fiberglass dome installed in an aluminum frame. In the 2000s, where substituted by new skydomes,

[177] This change will be discussed in Chapter 4.

which were thought to cause again water seepage, and eventually were substituted by functional skylights, which were manufactured by Aram Dadian with wood and Polymethyl methacrylate sheets. Similar solution was installed upon the skylight located in the hyperbolic paraboloid roof.

4.4. Interiors

In addition to changes to the exterior of the complex, several major changes in the interior were detected as well. These alterations affected the lobby area, the corner of the north wall, and the fireplace.

An early photograph of the lobby reveals that a patterned fabric covered three of the four bays between the concrete stub walls. It is possible to observe at least two different motifs in the fabrics. Three shelves inserted between the spans, were located at different heights and projected slightly. Shoji screens, which diffused natural light from the skylights, were flush to the lower face of the concrete grid. No folding door[178] is visible in the bar area as today, instead there is a standing divider.

In response to structural deformation of the gridded concrete slab, a wooden column was installed to underpin the slab. In the area surrounding the post base, removal and reinstallation of the floor stone can be observed. Original stone slabs were removed, probably to place the footing for the wood column, and cut later as they were adjusted to the column perimeter. A change in the color of the cementitious mortar used for the joints is noticeable.

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[178] The folding door was produced by Panefold**™**.

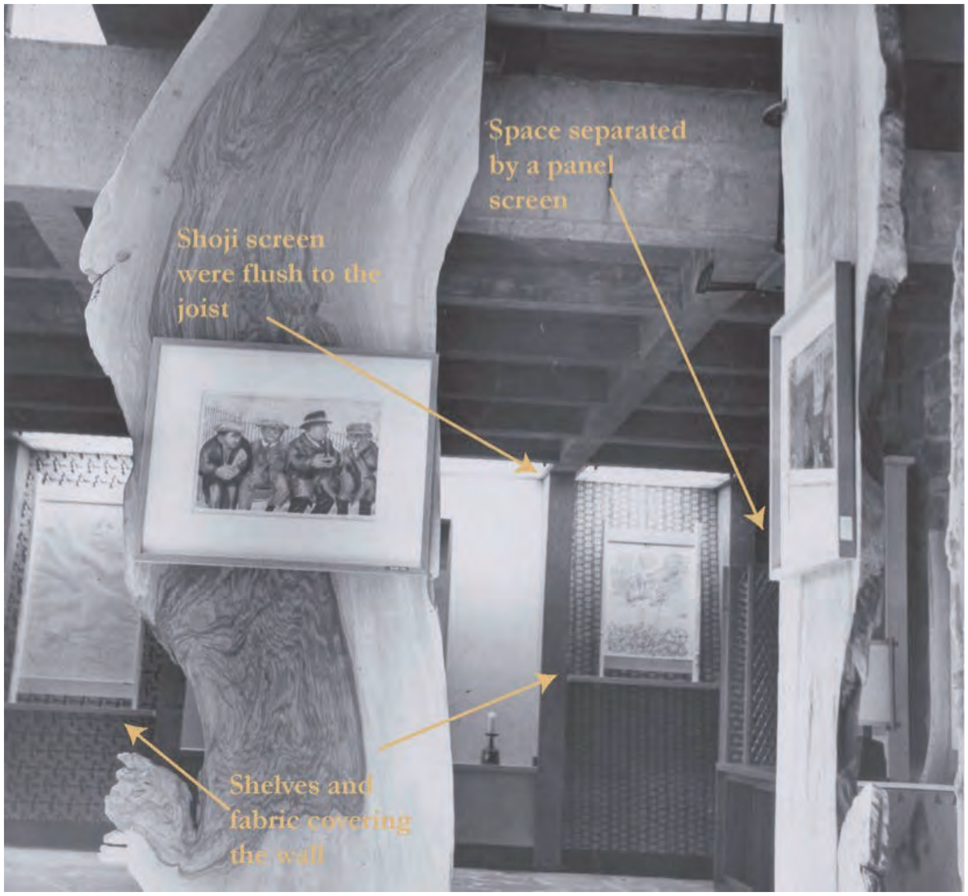

Fig. 4.5: Vestibule view. Date: Unknown. Notice the fabric covering the walls, the shelves, and the standing panel screen to create a partition. Besides, the shoji screens are flush to the joists' lower face. Source: George Nakashima Woodworker SA, Ltd. Archives.

Additionally, there are other recognizable changes. Because of the deterioration caused by moisture penetration, the shelves and the fabric covering three spans of the four between stub walls were removed and the concrete wall was roughly plastered with white plaster. Ghosts on the sides of the concrete stub walls indicate the original position of the former shelves, which stood in place without connections. Mira Nakashima remembers that when the wood shelves shrank, because of the hygroscopic nature of the wood, they became loose and usually fell off.

Besides, the shoji screens are housed now in the upper part of the spaces between the joists, and a folding door conceals the bar, creating a closet with furnishings designed by

Mira Nakashima. Earlier, a photo published in *The Soul of a Tree* reveals the use of a curtain to hide the bar.

Fig. 4.6: Original shelf ghosts. Date: March 2015.

In the north wall of the Arts Building and especially in the area around the fireplace, as a consequence of moisture penetration, other replacements and repairs were made in kind to the fireplace lintel and adjacent window.

Below, a 1967 photograph (fig. 5.7) partly shows the original white oak beam over the fireplace. As the wood was cut parallel to the grain direction and tangent to the growth rings, a wavy plain grain characterized this beam. Other photographs supplement the information and show the six plugs that concealed the bold heads. Unfortunately, there is no image of the previous window, although it is clear that the fixed pane of glass directly terminated into the stone masonry wall. A direct examination reveals that the stones were cut to house the glass.

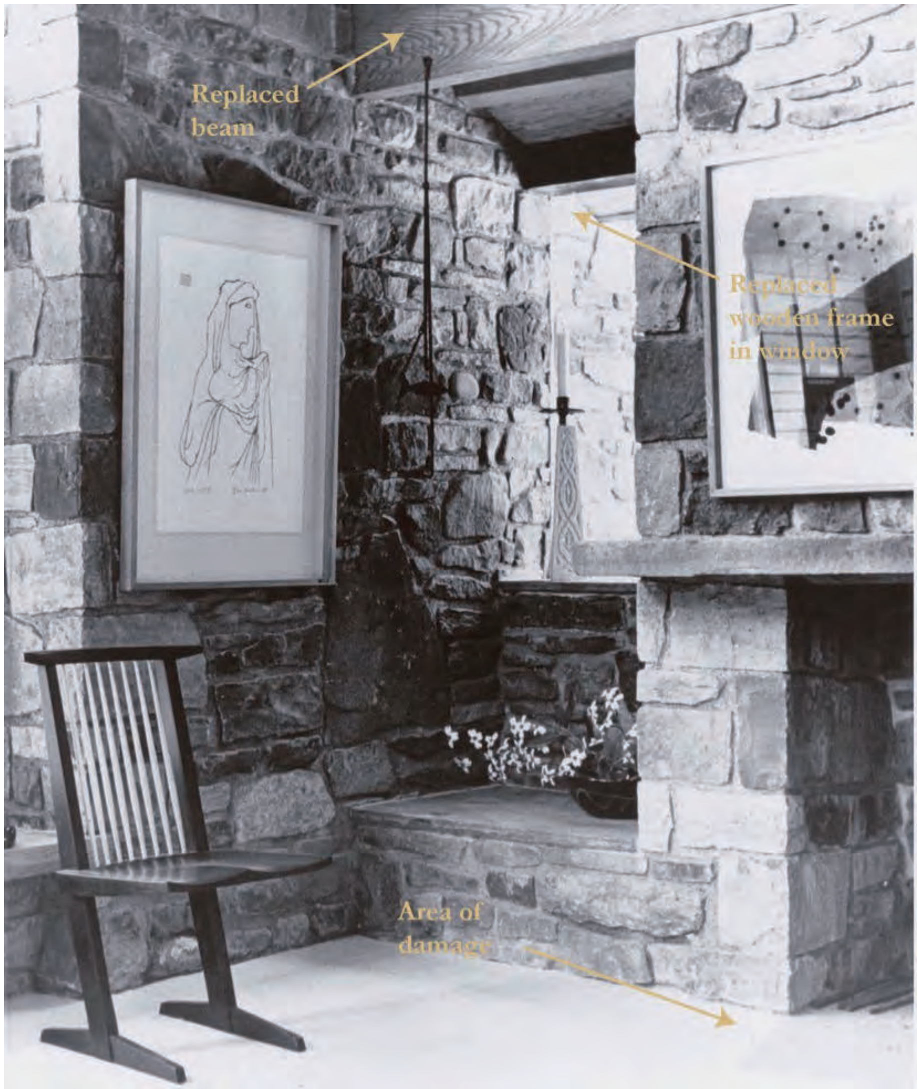

Fig. 4.7: Fireplace corner. Date: 1967. Author unknown. Source: George Nakashima Woodworker SA, Ltd. Archives

The grain figure of Nakashima's original fireplace lintel was undoubtedly selected in relations to the heavily patterned exposed plywood ceiling, which is still visible. Although the replacement lintel reveals a sensitive repair, this visual relationship is now lost (fig. 58). Likewise, the northern corner was replaced and repaired in kind to mend the deterioration caused by leaks. During this intervention, the skylight was also replaced in the same manner as those in the exterior terrace.

Changes also affected the mezzanine. Historically the shelves contained shoji screens that created a composition providing a subtle filtered light through the translucent white paper mounted on a wooden lattice (fig. 5.9).[179] Evidence suggests that the shoji screens were probably damaged by water condensation in the internal face of the glass, and consequently removed but not replaced.

Fig. 4.8: Current state of the fireplace corner. Date: November 2014.

In summary, failures related to deterioration from moisture have compelled specific alterations to the Arts Building and Cloister over time. Changes have ranged from sensitive in kind replacement such as the fireplace lintel and window to repairs that have modified the visual appearance, and presumably improved the functionality of certain details such as the replacement of the posts in the covered walkway. Within the latter group is it possible to include also the white waterproofing coating applied on the concrete terrace and the general substitution of the skylights.

[179] Ellen Kaye, The inquirer magazine, January 16, 1983. It shows the Arts Building still with the game of shoji screens.

Fig. 4.9: George Nakashima in front of the Arts Building. Date and author are unknown. Probably from late 1970s. From outside, shoji screens are recognizable. The exterior plywood eaves' soffits share the same finish as the interior ceiling plywood thus connecting inside and outside.

5. Condition Survey and Assessment

5.1. Introduction and Methodology

A condition survey and assessment was prepared to identify the primary processes of deterioration observed at the Arts Building and Cloister. Conditions were recorded by material and location, and explained in combination with the nature of the original materials used and subsequent alterations and maintenance, as well as their environment. Ultimately all conditions describe the past, current, and future state of the structure and affect its overall integrity.

Conditions were recorded during two site visits in February and March 2015, and included a visual ground survey. Architectural drawings and photographic montage was used together to identify the type and location of conditions recorded.

Conditions were noted and categorized according to standards such as the *ICOMOS ISCS: Illustrated Glossary on Stone Deterioration Patterns*, *ACI Concrete Terminology*, and the National Park Services' *Preservation Briefs*. Additional categories were created to cover all identified conditions not included in these documents. As a result, specific terms are defined in an illustrated glossary that is organized by categories depending on the building parts: roof, stone masonry, concrete block masonry, concrete structure, wood frame, mosaic, interior finishes, and flooring.

Structural analysis was not attempted other than the visual symptoms where found. In some cases, the causes of decay will need further research through the laboratory characterization and analysis.

5.2 Environmental Context and Use

Determining the deterioration mechanisms present in the Arts Building and Cloister involves the consideration of enabling factors present in the environment and the use of the spaces, both influenced by time. Buildings and cultural resources interact with the physical context that is determined by the topography of the site, landscape features, climate and weather, and other natural factors such as soils, subgrade and surface hydrology. Past and current use, as well as how the building is maintained, illuminated, heated, and ventilated, also affect to the building fabric.

The detrimental effect of moisture in buildings and the importance of temperature fluctuations to judge and explain decay due to condensation or freeze-thaw are crucial. Bucks County experiences a humid continental climate modified by the Atlantic Ocean. As reported by the International Energy Conservation Code (IECC) the climatic zone is 4 A.[180]

According to the weather data provided by the Northeastern Region Climatic Center,[181] summers are warm and humid while winters are drier. The maximum average is 75.7ºF, with a maximum of 101ºF, and the minimum average is 19.1ºF, with a minimum of -3ºF. The average annual precipitation is 46.83 inches. On average, there are 101 precipitation days and 205 sunny days. The snowfall reaches an annual average of 26.4 inches, being the highest registered average snow depth 8 inches and the registered maximum 14 inches in February 2014. The UV index is 5. Cloudiness is more prevalent in winter because cold

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180 Michael C. Baechler. "Guide to Determining Climate Regions by County" in *Building America Best Practices Series* Vol. 7.2 (Pacific Northwest National Laboratory, 2013), 28

181 The weather station is situated in Wertsville, New Jersey. This is one of the closest points to New Hope.

fronts and coastal low pressures systems are frequent. Prevailing winds are from the west-northwest and average 10 to 12 miles per hour.[182]

Taking into account building shape and orientations the north and east walls are largely protected from sunlight, either by their position or the surrounding trees, the evaporative drying rate being slower that in the other orientations. This is exacerbated during humid periods. As described earlier, the Arts Building and Cloister was built in a wooded area on a downslope in New Hope, Bucks County, Pennsylvania.[183] Most of the surface water is managed by the water disposal system installed below grade and pertaining to the building. Additionally, in this area, building foundations are constructed below grade and the difference between the interior exhibition space and the exterior is obvious.

Changes in use have not been significant. The Arts Building continues its role as an exhibition space and occasionally houses music concerts and events related to its actual function as George Nakashima's Foundation for Peace headquarters. Additionally, the building is included in the guided tours that take place every month from spring to early fall. The Cloister hosts temporary visitors and scholars and contains the business archives.

5.3 Findings

5.3.1 Roofs, Terrace, and Skylights

Water penetration, associated with failures or damages in the waterproofing, the roof design, and the water disposal system, is a persistent problem. Addressing these issues in the past has required different intervention campaigns that have affected the integrity of the

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182 Edward A. Tompkins. Soil Survey of Bucks and Philadelphia Counties, Pennsylvania (Washington, D.C:US Department of Agriculture,), 124-127

183 40°20'25.0"N, 74°57'20.2"W

building. For example, the gutter design was changed as one alteration to address the problem, large areas of the eaves in the east and north walls were repaired, and the fireplace mantel beam was replaced as described in the previous chapter.

Surrounding trees must be considered as a contributing cause in the case of roof puncture,[184] particularly when the ballast has been washed out and the asphalt lining is exposed. In addition, soil and debris accumulation provides a suitable substrate for biological colonization, which might exacerbate the problems noticed in the roof; while at the same time suggest the presence of excess water.

The consequences of melting snow must be also considered where icicles and ice dams form at roof eaves and clog the gutters. Water that is retained behind the ice dams could ultimately penetrate through failures in the waterproof coating or may rise above the flashings, therefore causing leaks in the future. Excess moisture in the roofing system can weaken and eventually rot wood elements underneath.

Concerning the waterproof coatings, service performance of roofing asphalts depends upon their chemical and mechanical characteristics. Chemical changes resulting from exposure to light, heat, and oxygen facilitates oxidation and produces progressive embrittlement. Therefore, service stresses, which include the gravity loads depending on the inclination, and thermal expansion and contraction can cause cracking and eventually failures where the moisture can migrate.

Brown and Sparks offer an explanation to this phenomenon. Essentially,

> As a roofing asphalt ages in service, oxidation reactions result in composition changes reflected in an increase in asphaltenes and a decrease in resins as defined by the analysis types reported here. Oil content decreases slightly but probably more as

[184] The most recent episode was an active leak close to the roof skylight because fallen branches probably punctured the waterproofing system. It has been patched on July 2015.

> a result of evaporation than by conversion to resins or asphaltenes. As the asphaltenes content or its ratio to resin content increases, there is increased tendency for the highly polar asphaltenes to agglomerate into a gel or skeleton structure of appreciable rigidity. This is reflected in less plasticity and more brittleness in the product. In the earlier life of the asphalt, viscous flow properties consistent with higher dispersion of a lesser asphaltenes content permit dissipation of normal service-encountered stresses before a critical level is attained.[185]

Embedded aggregate or loose stone ballast disposed upon the asphalt lining slow down their rate of aging, however there are noticeable areas where the marble chips on the roof have been partly washed out or completely removed because of rainwater and snowmelt disposal. However, the recent removal of the ballast covering the lower area of the roof revealed that seemingly the asphalt lining remains in good condition. Although in located areas, asphalt appears to be cracked. In this case, if the asphalt membrane is original it can be inferred that it has reached or is close to reach the end of its service life in those areas.

As described in Chapter 3, roof flashing accomplishes a variety of functions: gravel stops, eave flashings, connections at roof penetrations, such as the chimney masonry intersects with the roof, and edge protection, as in the eaves on the covered pathway. Flashing should receive particular attention in building design, construction, and maintenance, since a failure in its performance causes undesired moisture infiltrations that compromises overall performance of elements and building systems.

Although cooper is a durable material and it is rigid enough to form the different flashing shapes employed in the Arts Building and Cloister, the inability of the cooper to withstand mechanical impacts, the lack of adhesion, and corrosion in connections are

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185 A. B. Brown, J. W. Sparks. "Composition and Rheology of Roofing Asphalts" in *Symposium on Bituminous Waterproofing and Roofing Materials* (Philadelphia, PA: ASTM, 1960), 6

causing failures and may deepen the magnitude of the moisture-related conditions in the future.

The copper elements show different rates of weathering, accordingly with the amount of time passed since they were installed. When exposed to atmospheric conditions, a conversion film turns the initial light reddish-brown copper from light brown to darker colors and then to greenish turquoise over the years. This patina makes copper resist further corrosion. The patina can be copper oxide or sulfides when the products are red or black, and copper carbonate hydroxides (basic copper carbonates) or copper chloride hydroxides polymorphs when the products color range from blue to green. Other corrosion chemical compounds include copper hydroxide nitrate (basic copper nitrates), copper acetate monohydrate (neutral verdigris), and copper acetate hydroxide (basic verdigris).[186] A greenish patina covers the eaves, while the more recently installed flashing and gutters remain dull brown with green staining because water carried the corrosion products of both eaves and earlier elements.

In addition, the copper gutters show crevice corrosion and galvanic corrosion in all the junctures because of direct contact between dissimilar metals: the steel nails and the cooper sheet. If this type of corrosion continues, current leakage in the junctures will be expedited. Also there is noticeable deterioration from impact damage in the gutter edges, the section being deformed probably by fallen branches, and at the base, which is abraded by marble chips carried off by the snowmelt and rainwater.

The fact that marble chips remain in the base facilitates the accumulation of debris including fallen leaves that clog the gutters, allowing the rainwater to overflow directly to the

[186] Lyndsie Selwyn, 60

ground by one side and on the eaves' edges on the other side. This worsens the moisture-related problems on the north and east walls, and contributes to faster decay of the wood strip protecting the roof eaves, as verified in the condition survey. An awl was used to probe suspected rot.

A section in the chimney flashing is also out of plane, which might cause water penetration above the head lap of the waterproofing coating, which the copper protects, and saturate the substrate.

In addition expansion and contraction from thermal movements may affect the overall performance of the copper flashing installed on the eaves. Sealing covering the flashing seams is unsightly and appears to be deteriorated. In the south elevation, the lower end of the flashing covering the edge is loose.

Regarding the roof deck, the plywood is exposed to interior and exterior conditions, therefore the rate of decay is different and the solutions applied in the maintenance campaigns diverse. Expected service life for plywood is one hundred years, but depends on the moisture conditions.

Overall, the plywood sheets show checks, which appear on the surface in the form of multiple hairline cracks or slightly open superficial parallel splits of different lengths. According to the technical guides, under severe moist and dry conditions, such as on unpainted, unprotected panels exposed to the weather, checks may in time become open cracks penetrating virtually the full thickness of the face. The main cause for this deterioration is moisture penetration and evaporation.

Causes of these checks are found in the chemical properties of the wood cells and the plywood characteristics as a composite material. On one hand, the wood cell wall is largely made up of cellulose and hemicellulose, and the hydroxyl groups on these chemicals make the cell wall hygroscopic.[187] Conversely, the differential moisture conditions to which ply faces are exposed create differential stresses that compromise plywood performance. In fact, under high humidity conditions, the outer face of the exposed veneer expands, while the inner face is relatively fixed because it is glued to the next ply, which is placed crosswise. Fibers in the exposed face then create compression stresses against one another. However, when the fibers dry out and shrink, they pull away from each other, creating checks of different intensity. This phenomenon can be more severe under rapid drying than under slow drying because wood has a plastic behavior.[188]

Regarding the concrete terrace, a fiberglass membrane was installed to solve leakage problems in the past. It appears that this solution was not enough, since water penetrated at the lap splices. A white epoxy coating was applied covering the entire surface and the vertical joint creating an impervious continuous film. Conditions before fiberglass installation are unknown, however the effects of the rainwater penetration are visible in the grid slab concrete soffits and the stucco covering some spaces.

Prefabricated plastic skydomes installed with an aluminum frame were thought to be a source of new leaks; consequently, new skylights with wood frames and methacrylate panes were manufactured to replace earlier skydomes. Nevertheless, some condensation has been noticed in the new system.

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187 *Wood Handbook: Wood as an Engineering Material* (Madison, Wisconsin: United States Department of Agriculture, 2010), 3-12

188 Nelson S. Perkins, Ed. Plywood: Properties, Design, and Construction. (Tacoma, WA: Douglas Fir Plywood Association, 1962), 91

5.3.2 Structural Elements and Materials

5.3.2.1 Concrete

Concrete conditions were recorded to describe possible causes as well as to estimate their possible effect upon the performance, service life, and safety of the structure as recommended by ASTM.[189]

As described in Chapter 3, the mezzanine area in the Art Building consists of a cast-in-place gridded slab supported by a combination of stone masonry and concrete walls and concrete ribs. Unfortunately, the only framing plan available differs from the as built state.

Overall, noticeable damage from inappropriate design and imperfections as a result of improper placing of concrete is visible. Flaws include honeycombing, bugholes, and uneven edges because of joints between the formwork panels. Surfaces also show impact damage, scratches, efflorescence, scour, soiling, and biological colonization. After visual examination and sounding with a hand-held hammer, no incipient spalling and blind delamination was observed.

It is possible that long-term loading and insufficient support has caused deflection of the gridded slab and visible cracking.[190] It is necessary to point out that the slab is not uniformly loaded. The pole supporting the tapered beams rests upon a concrete beam that is monolithic with the grid slab. In addition, on the south elevation, loads from the interplay of wood and glazing directly set on a joist that has the same section as the rest.

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[189] ASTM C823/C823M Standard Practice for Examination and Sampling of Hardened Concrete in Constructions

[190] The deformation of a concrete structure under sustained load over time is known as creep of concrete. Final creep strain may be larger than the initial elastic strain and it represent an important factor affecting the concrete deformation behavior.

This deflection was corrected with the addition of a wooden column, which was installed at the intersection of two joists providing additional support. Rust staining indicates that moisture infiltration through the cracks has affected the rebar.

Good quality concrete usually guarantees that the steel rebar remains in passive condition delaying corrosion. However, past cracking on the upper face facilitated the infiltration of carbon dioxide of the air and rainwater that could have contributed to the carbonation in concrete. In this context, the calcium present in concrete reacts with the carbon dioxide and is converted to calcium carbonate, modifying the concrete's alkalinity toward basic. A more neutral environment replaces the normal alkalinity and provides the factors for a rapid corrosion of the rebars. Concrete carbonation is potentially hazardous, since it can compromise the overall performance of the building. Consequently, evaluation of concrete becomes necessary and may include pH, strength,[191] and determination of composition by petrographic analysis.[192] This information is basic to further understand causes of deterioration and to identify active mechanisms of deterioration.

There is no visual evidence to conclude the existence of active corrosion in the embedded rebars, which could ultimately cause further cracking. Corrosion measurements can be taken using copper-copper sulfate half-cell tests or linear polarization techniques to determine the probability or rate of active corrosion of the reinforcing steel.[193]

In the interior of the building, various hairline cracks are visible on the gridded slab spans. Cracks are primarily random, with a variable length and a width around 1/16" or less. Generally, whitish leaching deposits fill in the cracks and a brown stain can be observed surrounding some cracks. These deposits are a consequence of water-soluble compounds

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[191] ACI 364.1 R-94 *Guide for Evaluation of Concrete Structures Prior to Rehabilitation*, 10

[192] ASTM C856 *Standard Practice for Petrographic Examination of Hardened Concrete*

[193] Paul Gaudette and Deborah Slaton. Preservation Brief 15: Preservation of Historic Concrete

leached out of the concrete by infiltrated water and precipitated by reactions such as carbonation or crystallization by evaporation. Carbonation occurs because the calcium hydroxide present in the concrete has combined with carbon dioxide once it reaches the exterior surface of the concrete. In the areas where moisture interacts with the rebar, corrosion products accompany the deposits.

Regarding surface defects, bugholes are small irregular cavities, usually not exceeding 5/8 inch in diameter which result from entrapment of air bubbles of formed concrete during pouring and hardening.[194] This defect is observable in some surfaces in the exterior, and in the interior in the soffits, and lower faces of the joists together with entrapped fallen leaves, which were not removed before pouring the concrete.

Honeycombing, also known as rock pockets, are areas of voids because of failure of the paste to effectively fill the spaces among the gravel. It can be produced by poor mixing, segregation during pouring, or leaching out of the mortar at a leak in the form.[195] Vibration during concrete placing might have prevented both honeycombing and trapped air bubbles, however the relative small section of the described elements probably made vibration of the concrete mix difficult once poured.

Honeycombing was noticed in different locations in the interior and the exterior: in one of the concrete ribs, in soffits and joists, in the concrete rail of the stair landing, and in the lower section of the wall at an angle close to the access. Generally, honeycombing is a condition that ranges from moderate to severe problem in concrete structures because the affected areas are weaker and more permeable that sound areas. Technical literature recommends to patch these areas as early as the form is retired, the greener the concrete the

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194 ACI 201.1R *Guide for Conduction a Visual Inspection of Concrete in Service* (Farmington Hills, MI: American Concrete Institute, 2013), 10

195 Concrete Engineer Handbook, 2-45

better. However, now, the difficulty in achieving a good match may suggest accepting these flaws, particularly in the interior. Additionally, it confers a particular and more organic character to the hardened material, which might be desirable if performance is not compromised.

On the exterior surfaces, different rates of erosion or scour on the unprotected surfaces was observed due to loss of the outer layer of cement paste causing the exposure of the aggregate. In some areas inadequate drip grooves and drainage caused this deterioration that is generally accompanied by moisture stains, which are a minor problem. In addition, the elevations that remain most of the time in shade show biological colonization, mainly comprised of algae and lichens.

In the entrance area, noticeable hairline cracks with leaching deposits were observed on the soffit under the balcony. The rest of the concrete surfaces show good condition, with the exception of some areas that are abraded by mechanical action, and show chipped edges and impact damage.

5.3.2.2 Block Concrete Masonry

Overall, both north and east rendered walls display large localized areas of moisture. Moisture is even more intense on the north wall, which is largely protected from the sunlight; therefore the drying rate is slower. It appears that moisture chiefly migrates through the mortar joints, which may have higher permeability compared to the concrete blocks, making partly visible the joint pattern on the stucco. Hairline cracking on the stucco accompanies these moisture stains, particularly on the head joints underneath the stucco surface. Cracking may also contribute to increased water seepage into the concrete block backing allowing moisture infiltration through the cracks when the pressure gradient occurs from outside to inside.

Moisture migration through the wall masonry is likely due to an uncontrolled source of water and the absence of a waterproof membrane or through-wall flashing that facilitates moisture migration driven by a moisture gradient, adsorption, and capillary action. Moisture sources could be the water table below grade and the surface from rainfall and snowmelt. Mira Nakashima recalled that a French drain, which essentially is a system comprised of a perforated drain pipe installed in a trench filled with compact gravel, was installed. However, the current system is incapable of diverting the surface water and the ground water away from the structure.

Water has been carrying soluble salts to the wall surface, where it evaporates crystallizes. Salt sources could be the soil, the foundations, the concrete blocks, or the cement mortar. A large accretion of mineral matter, as a consequence of the evaporation, suggests the potential hazard that moisture infiltration represents for building performance. X-ray diffraction showed that this mineral accretion is composed by calcium and small traces of copper; the latter being suggesting that part of the water may come from the roof. Wetting and efflorescence also contributes to the disintegration of the stucco surface, which shows a coarse-grained surface instead of the original smooth finish.

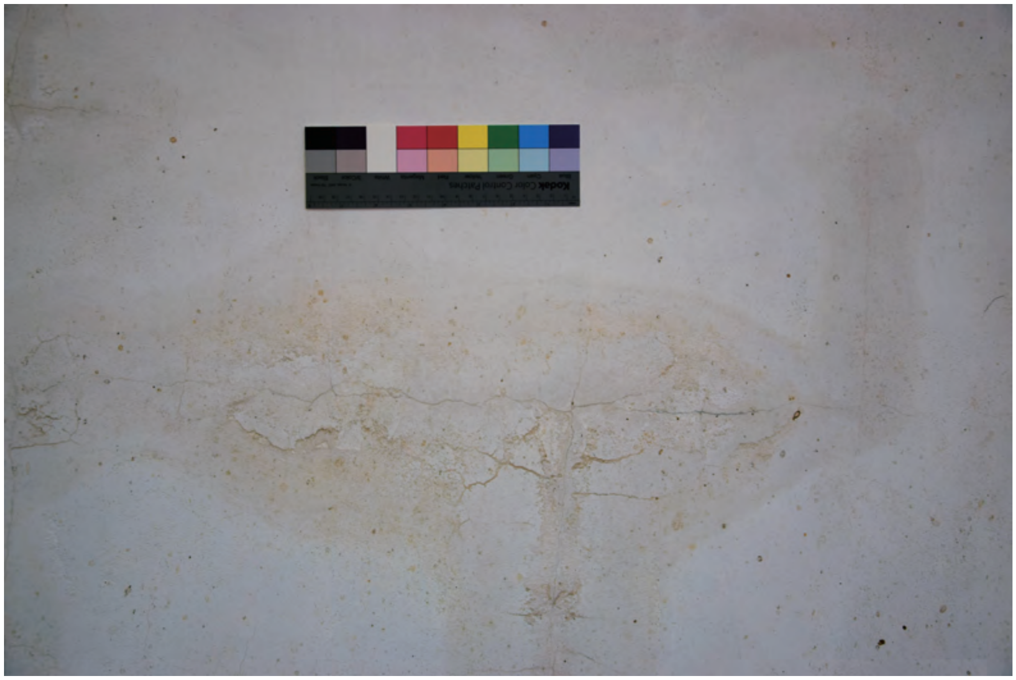

Fig. 5.1. This picture shows wet moisture stains along with hairline cracking map, efflorescence, superficial erosion, and light brown mineral deposits filling the cracks.

Larger cracking results from outside stress transferred to the stucco, which might be related to structural movements, such as stresses transferred through the bolts by the roof reacting to wind loads. The roof might also generate lateral stresses and horizontal movements affecting the concrete block masonry. In fact, the rigid wall connection does not allow translational movements. As a consequence, the northern wall has developed a series of longitudinal cracks parallel to the bed joints, particularly in the mid-upper section. Cracks range from 2 1/2 feet to approximately 18 feet with an approximate width of 1/32 to 1/16 inch are visible. Some cracks also show mineral accretions. The northeast corner is out of plumb at the level of the roof plate, which might involve the whole masonry section, and display hairline cracks. In the east side, the lower part of the wall shows a hairline crack. This area has been and repainted in the past, but now is open again, which might be indicative of a slight settlement.

Overall, the concrete block masonry in the Cloister is in good condition, with few minor to moderate problems such as dark moisture stains with efflorescence, biological colonization, located hairline cracks in joints and in concrete blocks, and dirt covering the lower section of the walls, particularly on the south and east elevations. In fact, on the porch elevation rainwater runs into a gravel path, while the south and east masonry is completely exposed to the rainwater splash transporting soil particles.

5.3.2.3 Stone Masonry

The various types of stones that comprise the stone masonry are causing an uneven rate of deterioration especially in the abutments. Superficial erosion, soiling, mechanical damage, blistering, flacking, hair cracks, and efflorescence are all visible. Overall, biological colonization is also present.

As explained in the previous section, efflorescence is due to the evaporation and crystallization of salts in solution transported by moisture infiltrated in porous materials. Since the presence of efflorescence is primarily limited to some units or areas, the sources of salts can be the stone units themselves too. In this case, laboratory testing would help to identify the type and sources of the salts.

Overall exposure to freeze/thaw cycling is causing superficial erosion and micro cracking expressed by hairline cracks of different orientation. In limited stone units, the surface has erupted into blisters and flacking. These conditions are primarily related to processes of granular disintegration because of moisture infiltration and salt crystallization.

Hair cracks and failing mortar joints, particularly in the chimney, and hairline separations from the stone due to shrinkage have been noticed. The extent of cracking affecting mortar joints is limited, thus a pattern has not been observed to support a hypothesis to explain possible causes.

Regarding biological colonization, algae, lichen, and mosses pervasively cover the stone in the areas exposed to rainwater or ground water splash. Biological activity varies across the seasons. During the fall moss covered large areas, which were reduced during the colder winter. Additionally, crusted areas varying in tone were observed where previously algae have grown in areas affected by temporary wetting episodes. Biological colonization contributes to moisture retention in the fabric slowing down evaporation and furthering greening thus. Although the decay mechanism is slow, some lichen species will disintegrate the substrate by chemical action.

5.3.2.4. Wood

Prolonged exposure to moisture and other environmental factors has caused discolorations, moisture stains, loss, and rot of wooden elements. Overall, exposed wood experiences natural weathering, which is the slow degradation of the material caused by various factors in combination including sunlight (UV radiation).

Of these, it is the UV portion of the solar spectrum that initiates weathering, which together with moisture advances the degradation process. UV radiation is limited to the range of 295 to 400nm and represents the 6.8% of the total radiation. It causes the photo oxidation and photochemical degradation of the wood surfaces. First, the exposure produces a color alteration, because of a chemical change in the wood extractives. Then, UV radiation degrades the lignin, which is the polymer that bonds cellulose and hemicellulose, therefore weakening the wood cellular structure and ultimately causing the slow erosion of the wood fibers from the surface. Eventually, colonization of microorganisms, commonly mildew, occurs. The rough and grey appearance of surface is a symptom of this degradation process.[196]

Moisture stains are the result of a single wetting or of periodic wetting and drying cycles; consequently, the cause can be active or inactive. Sources of moisture are water vapor that condensates, rainwater and snow through the open surface, and water below grade that infiltrates upwards trough the fabric by capillary action. Some leaks appear to be no longer active, however moisture stains are still present. Such stains are minor visual alterations that do not affect wood structurally. Otherwise, condensation or active leaks, which ultimately may lead to a major deterioration, need to be addressed. Therefore, it is important to determine whether a stain is the result of an isolated historic event or the result of an active problem. It is necessary to indicate that few windowpanes in the envelope exhibit simple glazing.

Water, along with heat and oxygen, causes fungus damage to wood. This condition is clearly recognizable in the exterior white oak posts. Fungus attacks either heartwood or sapwood in most wood species, when the moisture content of wood is above the fiber saturation point (average 30%). Although the lower end of the posts rests upon stone they are exposed to moisture in form of rainwater splash, wetting wood enough to allow the development of fungi.

Similar conditions were noticed in some sections of the wood strips used to protect the eaves edges and in the frame of the casement window in the mezzanine area. Failures in the flashing and gutters have been provided enough water to wet wood at a rate below the

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[196] R. Sam Williams. "Weathering of Wood" in *Handbook of Wood Chemistry and Composites*, 140-142

drying cycle. In located areas wood has changed color and is easily penetrable with an awl, suggesting its structural capabilities have been compromised.

Other types of biological activity include squirrels, birds, and insects. Squirrels have damaged wood surfaces by gnawing on elements, such as the grills installed on the elevations or on the plywood ceiling in the porch area. Woodpeckers have made holes looking for in-built insects and carpenter bees have drilled their characteristics holes in the wood elements. The holes have been repaired with a brown epoxy resin. The site is protected against subterranean termites by means of bite stations.

5.3.3. Ben Shahn's Mosaic

Damage and decay are present in Ben Shan's Mosaic. Main conditions recorded are color alteration, missing tesserae, granular disintegration, failing substrate, biological colonization, and superficial erosion. These conditions are limited, however the biological colonization by micro flora along the lower section of the mosaic is affecting various panels.

Observed discoloration is due to the use of epoxy resin to adhere the tesserae and hide the screw heads fastening the mosaic to a wood substructure as described in Chapter 3. This application has stained the tesserae covering the screw as well as also the surrounding tesserae altering their appearance. Discoloration has been also noticed on the joints between panels.

The presence of dark grey deposits covering the lower areas of the panels reveals the existence of micro flora probably associated with higher moisture content. Sources of moisture for this biological colonization are rainwater splash and accumulated snow in winter that is retained in the irregular interstices between tesserae, which are partly embedded in the bedding layer mortar.

Missing tesserae may be due weak assembly, since some tesserae have lost adhesion to the bedding layer or, occasionally, the epoxy. Fortunately, only few areas are affected by this problem and the mosaic shows a high level of physical integrity.

The granular disintegration, which appears to be active deterioration, occurs in various tesserae. This loss of stone is not uniform. Firstly, the original stone surface forms a hardened layer, while the subsurface experiences a process of granular disintegration. Ultimately, there is a process of detachment that generates an eroded coarse uneven surface.

Finally, the wood frame surrounding the mosaic presents sign of damage from animal activity in association with epoxy repairs. Various sections of the mortar that fills the upper joint between the mosaic panels and the inclined soffit of the concrete eave are deteriorated. There are signs of mud daubers nests that have been removed. The condition of the wood support is unknown.

5.3.4. Windows and Doors

Generally, windows and doors are in good condition, although their shrinking and swelling seasonally reduce their operability. In addition, wood frames show moisture stains because of condensation and natural weathering, which was described above.

Moisture stains are probably produced by condensation. Windows and sliding doors have simple glazing. When the indoor air is humid and the outdoor air temperature is below the dew point temperature of the indoor air, condensation of the water vapor occurs in the glass panes, which are the colder surface in relation to the wooden frame. Water leaks and soaks the wood frame causing the moisture stains as it dries. This phenomenon possibly damaged the screens originally housed on the shelves in the mezzanine. Environmental monitoring should be implemented to execute a comprehensive study of the interior conditions to further understand when and where condensation occurs, and to engineer a solution.

Overall, weather stripping, which consists of cypress strips exteriorly mounted and nailed to the wood frame, show signs of wear. This phenomenon occurs on both glazing directly set into the wood structure and into a wood frame mounted within a structural opening. In addition, isolated conditions in the Arts Building include: a mechanical impact to one of the panes of the sliding window facing south and a lifted sliding door leaf, the gap between the door leaf and the window frame accumulating dirt. In the Cloister, the red door closing the heating room is damaged in their lower end because the core has swelled due to moisture infiltration.

5.3.5. Interior Finishes

Discontinuities between the stone masonry and the concrete block masonry, and between those systems and the opening framing have been causing moisture infiltration, which ultimately has caused interior wall deterioration evidenced by staining and efflorescence.

In the vestibule, efflorescence and color alteration are visible in the window jamb and the area below. Particularly in the right corner, it is recognizable as an area that ranges from light ochre to light pink. Some of the plastered soffits in the gridded slab, which stands directly below the terrace area, are perforated and stained from hidden leaks that appear to be no longer active.

The walls plastered with Structolite™ show moisture stains and rust spots. In the northeast corner, the staining runs vertically and is related to an earlier leak in the area. In the fireplace area, wet moisture stains and whitish deposits are recognizable. Moisture infiltration causes for the latter can be discontinuities between the concrete block wall and the fireplace stone masonry, insufficient chimney cap, failures in the roof waterproofing system, and rising damp. The circular rust stains visible in the Structolite™ may be related to the oxidation of the metallic constituents contained in the aggregate or to an unknown chemical reaction between constituents.

5.3.6. Floorings Materials

Overall the vinyl tile flooring system is in moderate good condition; however the Arts Building tile floor shows sign of wear from visitation and direct sunlight after approximately fifty years in place. Conversely shoji screens protect the tiles in the Cloister and their use is minimum.

In the exhibition area, the Amtico™ travertine flooring has lost adhesion to the subfloor and present loose areas. As the technical literature indicates, if moisture migration can permeate the underlying concrete slab at a higher rate that it can permeate the vinyl tile flooring system, failures will occur.[197] In fact, the moisture infiltration is causing lifting of the vinyl tile system. This failure can occur between the adhesive and the subfloor or between

[197] Kimberly A. Konrad and Paul D. Kofoed, 243

the tiles and the adhesive. Moisture source is likely to be water below grade. This fact leads to question if a convenient vapor barrier was installed regarding the boundary conditions.

The tiles present a contraction in comparison to their original dimensions. This shrinkage is probably related to the sunlight (infrared radiation) exposure, which has caused uneven joints, discoloration, and ultimately can also cause embrittlement. Besides, it is observable fire damage on the fireplace hearth limits.

On the stone slabs used in the vestibule, moisture stains and scaling in some units are noticeable. The latter being a problem in the slabs used for the fireplace hearth, which is probably related to the temperatures that the stone has to resist when the firebox is used. Mortar joint failure is also observable.

5.4. Conclusion

As seen in this chapter, moisture infiltration is the main cause of deterioration in the Arts Building and Cloister. The water disposal system requires special attention, as well as the current condition of the roof and walls. Further identification of moisture sources and the proper repair of the systems become crucial for controlling conditions, which ultimately can compromise the long-term durability of the materials and assemblies.

In devising a conservation program, further recommendations will be done in final chapter in terms of urgent repairs and particularly additional research required by for long-term stewardship of the both fabric and artifacts housed in the Arts Building and Cloister.

6. Lessons in Preserving the Recent Past

Case studies and scholarly discussions in preserving the recent past are plentiful; nonetheless, methodologies and philosophical approaches require broader attention. This literature review attempts to examine how scholars and professionals have addressed the preservation of twentieth century modern architecture and specifically the philosophical challenges for professional practice. The chapter includes a short history of preserving modern architecture, then addresses the underlying debate common to all conservation practice: the preservation and reconciliation of historic fabric and the original design intent, which is linked to the notion of heritage values, and finishes with the definition of a suitable and balanced approach for modern heritage.

6.1. The Rise of Preserving the Modern

In 1960, the architectural historian Reyner Banham (1922-1988) described *modernization* as the era that emerged from industrialization producing a transformation in social, political, and environmental spheres; *modernity* as the subjective experience of each individual in this sociocultural context; and *modernism* as the cultural practices that both mediate and produced this transformation, as witnessed in painting, sculpture, architecture, and music. Architecture displayed a multiplicity of modernisms, from the earliest examples embracing the machine aesthetic rather than the machine itself, to the full incorporation of industrialized processes in construction, and exploring also the reconciliation between tradition and technology.

The choice of Banham to introduce this section is critical for it was he who supported those voices claiming the failure of the Modern Movement in the late 1950s. In so doing, he placed himself apart from other architectural historians, such as Siegfried Gideon, Nikolas Pevsner, and Henry-Russell Hitchcock, who theoretically and critically framed the Modern Movement through the identification of specific modernist architects and specific works.[198] Modernism and modern architecture, which had become the preferred choice of corporations, institutions, and government in the mid-20th century postwar era, became unpopular by the end of the 1960s and were gradually replaced by postmodern ideas, which subsequently contributed to the devaluation and vulnerability of modernist works.

Nonetheless, recognition of the need to preserve the most iconic works began at the same tine, first in Europe as early as the 1950s and 1960s, as a professional reaction to insensitive changes and a lack of maintenance for many important buildings of the period. This was followed by broader preservation efforts during the 1960s and the 1970s[199], at the same time that the Modern Movement came under increasing attack during the ascendency of Post Modernism. Examples of this initial preservation advocacy are Le Corbusier's built manifesto: Villa Savoye (1929), in Poissy, France, and the Frank Lloyd Wright's Robbie House (1910), in Chicago, Illinois.[200] Historians acknowledge the influence of American preservation advocacy in the efforts to save European modernist heritage, but it was predominantly professional specialists and the government, rather than the public, who led the charge. In the case of Villa Savoye, the architect author played a key role. Thus the preservation of modernist buildings was diametrically opposite to the public supported advocacy for preserving traditional buildings and sites. Lack of widespread public support

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[198] Banham's thesis was far beyond canonical writings that, according to the historiography, praised the trends and architectures that shaped the Modern Movement itself. Readers interested in the historiography of modernism in architecture may explore Anthony Vidler's book *Histories of the Immediate Present: Inventing Architectural Modernism* and Panayotis Tournikiotis' book *The Historiography of Modern Architecture*.

[199] Theodore H.M. Prudon. *Preservation of Modern Architecture* (Hoboken, NJ: John Wiley and Sons, 2008), ix

[200] Françoise Hamon, "Histoire de la protection du patrimoine du XXe siècle" in *Cahiers de l'École Nationale du Patrimoine* 1 (1998), 47-54

for preserving modernist works was based on a lack of recognition of their contributive values, on the misinterpretation of the Modern Movement itself, and on the association of such structures with post war urban renewal that gutted many cities in America.[201]

Despite this context, the preservation of the recent past in general gained attention during the 1980s and 1990s. Furthermore, by the end of the 1980s, Postmodernism was increasingly loosing interest, and professionals looked at modernist works again, through national and international networks for the exchange of information, documentation, conservation and advocacy. On September 14, 1990, DoCoMoMo[202] International's Constitution was approved in Eindhoven in order to protect and conserve the legacy of the Modern Movement. DoCoMoMo was more specific in its definition of modernism and embraced all significant structures, districts, and sites built from the mid-1920s to the mid-1970s that reflected the values embedded in social, political, technological, aesthetical, and spatial changes associated with early twentieth century notions of innovation and the creation of art works for the future[203]. The founding of this organization revealed the need for the promotion of the architectural heritage of the Modern Movement in the face of the critical voices that diminished and misinterpreted its contributions. Historian Richard Longstreth witnessed how there was limited interest to connect the future to the past using those resources as documents of our age due to its recentness; most people still perceived

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201 Nigel Whiteley, "Modern Architecture, Heritage and Englishness" in *Architectural History* 38 (1995), 220

202 Hubert-Jan Henket, architect and professor, and Wessel de Jonge, architect and research fellow, at the School of Architecture at the Technical University in Eindhoven, the Netherlands, initiated the efforts for founding Documentation Conservation of Modern Movement (DoCoMoMo) in 1988.

203 This definition is based on the published DoCoMoMo's criteria for evaluating modern building and sites. The three main qualifiers are:

- The Modern Movement was an artistic and architectural movement that embodied the unique early twentieth century notion that artistic works must look forward to the future without overt references to historical precedent.
- Modern design emphasized expression of functional, technical or spatial properties rather than reliance on decoration.
- Modern design was conscious of being modern: it purposefully expressed the principles of modern design.

DoCoMoMo US "How to Evaluate Modern Buildings and Sites. Selection Qualifiers." Accessed January 20, 2014. http://www.docomomo-us.org/register/how_to_evaluate.

modern architecture as part of their contemporary lives. Longstreth warned of the risk in considering age and rarity as the only imperatives to save creative works as certain examples of modern architecture were "... intrinsically more significant from a historic perspective" than buildings from early periods.[204]

In the early years of preserving these works from 'the recent past', efforts focused on the creation of a distinct set of principles different from those for the conservation of traditional architecture. Essentially the established principles of conservation, advocated in national and international charters, such as minimum intervention, maximum retention of historic fabric, conserving as found (preservation), reversibility, and avoidance of any reconstruction- were radically questioned.[205]Accordingly, from the beginning, authors identified several specific challenges when dealing with modern architecture,[206]which are outlined below and supplemented in Appendix 1 in quoting a table created by Susan MacDonald.[207]

1.New manufactured materials and assemblies that emerged in the twentieth century are no longer available or their reproduction is technically and economically unfeasible (Mike Jackson, 1991).[208] The introduction of new materials in the construction process was uneven: traditional building techniques continued and coexisted with new techniques in the early stages and throughout all the period. Therefore, at the beginning, being modern relied just as

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204 Richard Longstreth, "The Significance of the Recent Past" in *APT Bulletin*, Vol. 23, No. 2 (1991), 12-24

205 Martín Capeluto and María Turull, "The Evolution of Intervention Criteria in Modern Movement Restoration: Essential Problems and Circumstancial Problems" in *Proceedings of the 10th International Docomomo Conference: The Challenge of Change, Dealing with the Legacy of the Modern Movement* (Amsterdam, The Netherdlands: IOS Press, 2008), 37-42

206 Susan MacDonald made a useful and interesting summary of all the difficulties in modern buildings ranging from material failure to other cultural circumstance. The reader can find it in Susan MacDonald, "Authenticity Is More than Skin Deep: Conserving Britain's Postwar Concrete Architecture" in *APT Bulletin*, Vol. 28, No. 4 (1997), 38

207 Susan MacDonald, "Authenticity is More than Skin Deep: Conserving Britain's Postwar Concrete Architecture" in *APT Bulletin* 28 (1997), 37-44

208 Mike Jackson, "Preserving What's New" in *APT Bulletin*, 23, 2 (1991), 7-11

much on conceiving new forms and spatial relationships with traditional building materials and systems as it did with utilizing new fabricated materials and constructions methods.

2. Application of experimental and innovative building techniques and assemblies pushed architecture and construction limits. Consequently, earlier preservation efforts did not prepare restoration architects and preservationists to deal with these materials and methods (H.Ward Jandl, 1991).[209]

3. Written and graphic documentation is commonly available and the original designer may still be living and have legal say in what happens to the structure.

4. Planned obsolescence: In some cases, the technology was designed to be replaced after a limited lifespan.

5. New or untried materials aged poorly (François Cox Duperroy, 1989). This is mostly a problem of reception and the lack of aesthetic considerations for the aging of modernist works.

6. Rapid redundancy of the buildings' functional programs because of the tight relationship between form and function resulting in difficult adaptive reuse (Martín Capeluto and María Turull, 2008)[210]

Professional interest also materialized in conferences and in publications. *APT Bulletin* published two special issues in the 1990s: *Preserving What's New* (1991) and *Mending the Modern* (1997) [211]. Both publications contained articles that provided an overview of contemporary philosophical challenges, as well as technical challenges, and revealed one

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209 H. Ward Jandl, "With Heritage So Shiny: America's First All-Aluminum House" in *APT Bulletin*, 23, 2 (1991), 38-43
210 Martín Capeluto and María Turull, 37
211 *Preserving What's New* was the 1989 APT conference's name that was held in Chicago, some papers of which were included in the 1991 APT"s special issue.

main theme of the underlying professional discussion when preserving modernist works: authenticity.

6.2. Significance and Authenticity's Ambiguity in Preserving Modern Architecture

Authenticity is a difficult concept even for traditional heritage, the interpretation of which still attracts scholarly attention and fosters doctrinal debate. Authenticity is a manifold notion, universally considered but culturally relevant in its application and ultimately informing the conservation, interpretation, and value of any intervention. Its contemporary interpretation has evolved within the established criteria in historic preservation: from the 1964 Venice Charter introducing the term of authenticity based on design, materials, workmanship, and setting, to a broader and more inclusive nature involving use, function, traditions, language, spirit, and feeling, as presented in the 1994 Nara Document on Authenticity.[212] For the Nara Document, authenticity is rooted in judgments about values, which are ultimately cultural and context dependent, thus it is not appropriate to use fixed criteria to assess both values and authenticity. As Professor Emeritus David Lowenthal has stated "authenticity is in practice is never absolute, but always relative."[213] The Himeji Recommendation and the Nara+20[214], a text published in celebrating the 20th anniversary of the Nara Document, still identify the manifold nature of authenticity and furthers its

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212 Pamela Jerome made a quick summary of this aspects in Pamela Jerome, "An Introduction to Authenticity in Preservation" in *APT Bulletin* Vol. 39, No. 2/3 (2008), 3-7

213 David Lowenthal, "Changing Criteria of Authenticity" in *Nara Conference on Authenticity Proceedings*, ed. Knut Einar Larsen (Japan: Unesco World Heritage Centre, ICCROM, ICOMOS, 1995), 123

214 Nara+20 was adopted by the participants at the Meeting on the 20th Anniversary of the Nara Document on Autehnticity, held at Nara, Japan, from 22-24 October 2014, at the invitation of the Agency of Cultural Affairs (Government of Japan), Nara Prefecture and Nara City.

meaning to a more perceptual approach as authenticity becomes linked to the social and emotional resonance of group identity among individuals.

The original material-related meaning of authenticity was also defied in preserving modern architecture. The professional discussion early on included a new aspect: the privileging of the initial design intent over the historical reality of its actual realization. The latter aims to retain the maximum amount of historical fabric based on traditional conservation practices, while the former stresses the import of the design concept, realized or not.

In supporting the first point of view, Dutch architects H.A.J Henket and N. Tummers argued, "the authenticity of the concept of the original design and realization forms the most important aspect of the preservation of 20th century architecture and urban planning"[215] in the preparatory conference for the 1994 Nara Document. Similar thoughts populated the decade. Yet, this discussion continued undeterred when John Allan (2007) stated that "the significance of modern architecture may not reside so much in its materiality as in its intellectual achievements, and that it is 'essence' rather than 'substance' which should underpin any consideration of its future at times of change"[216]or when Tore Tallqvist (2000) declared "Modernism is to a great extent architecture of concept."[217]

Theodore H. M. Prudon also capitalizes on aspects related to the intangible qualities of modern architecture and appears to consider material conservation essentially accessory.[218]

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215 H. A. J Henket and N. Tummers, "Authenticity of the Modern Movement" in *Nara Conference on Authenticity Proceedings*, ed. Knut Einar Larsen (Japan: Unesco World Heritage Centre, ICCROM, ICOMOS, 1995), 327

216 John Allan, "Points of Balance: Patterns of Practice in the Conservation of Modern Architecture" in Susan Macdonald, Kyle Normandin, and Bob Kindred, Ed. *Conservation of Modern Architecture* (United Kingdom: Donhead Publishing, 2007), 13-46

217 Tore Tallqvist, "Understanding and Interpreting the Spirit is a Necessity for Restoration: Timeless Patterns in Alvar Aalto's Use of Wood" in *DoCoMoMo Wood and Modern Movement* (2000), 23-31

218 The APT Association conferred the 2008 Lee Nelson Award to the book *Preservation of Modern Architecture*, written by Theodore H. M Prudon. *APT Bulletin* Vol. 40, No. 2 (2009) relates this fact and publishes and excerpt of his book.

In this way, Prudon argues that modern architecture's significance lies upon the architect's intent and states "the consideration of the original idea as a representation of the creative role of the designer is directly connected to the paramount importance of the visual integrity of the entire building." [219] What is original intent for Prudon? It is "a visual and conceptual expression of the designer's creativity and therefore informs every aspect of both the building and its construction."[220] Prudon bases this thinking upon the supremacy of authorship, the industrial nature of the materials, and the preeminence of design upon craftsmanship in the building process. It is palpable that Prudon's discourse is based on a canonical and sometimes unilinear discourse of the history of architecture, which lacks nuances, diminishes other possible modernisms in the twentieth century, and forgets the limitations of the construction process that also has an unexpected impact on the final product, as happened on the exterior finish of the concrete at Frank LLoyd Wright's Guggenheim Museum.[221] Consequently, Prudon focuses on the problem of visual perception and on searching for a state that could never exist originally, only in available graphical documentation, which can also provide a frame for replacement or reconstruction.

The Yale University Art Gallery (1953), expanded and renovated in 2012, symbolizes an example based on visual perception and replacement. In this project, thermal expansion issues and condensation problems compromised Louis Khan's window wall design performance. The retention of the original material defied the new program requirements and the installation of new mechanical systems. Eventually, a new curtain wall recaptured Khan's intention, in accurately matching the original detail while solving the modern

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219 Theodore H.M. Prudon, 25
220 Ibid., 35
221 Frank G. Matero and Robert FitzGerald, "The Fallacies of Intent: Finishing Frank Lloyd Wright's Guggenheim Museum" in *APT Bulletin*, Vol. 38, No.1 (2007), 3-12

museum environment needs.[222] Mies Van der Rohe's German Pavilion for the 1929 Barcelona International Exhibition illustrates an example based on reconstruction of the original intent. This seminal masterpiece was demolished in 1930 and was reconstructed on the original site during the 1980s. The reconstruction followed contradictory and incomplete documentation and few remaining materials, essentially highlighting Mies' original intent based on the visual qualities of the project identified through graphic documentation. Simultaneously, known historical variations related to the original construction process that detracted from the original intent were excluded from the reconstruction, prioritizing a specific new interpretation.[223] Intriguingly, in this case, authenticity relied on the realization of a 'faithful' replica in terms of intent.

Whether reconstruction or replacement, authors like Prudon tend to agree that the defining attributes of modern architecture, enumerated in the first section, challenge traditional conservation methodologies and practices, especially those derived from 19th century English theory and its association with preservation policies. It leads to a dilemma that pits the retention of historic fabric against the re-establishment of the original appearance considering the designer's intent.[224] This debate echoes the earlier Scrape and Anti-scrape debates: Viollet-le-Duc and the French school of restoration vs. Ruskin, Morris, and the manifesto of the Society for the Protection of Ancient Building (SPAB). Preserving modernist works brings the late nineteenth century impassioned discussion to the present, expanding the meaning of authenticity in the Western tradition, in which the value of conserving tangible features (the original fabric) prevails.

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[222] LLoyd L. DesBrisay, "Yale University Art Gallery, Louis I. Khan. Challenges for the Rehabilitation of Modern Museum Buildings" in Conservation of Modern Architecture, ed. Susan Macdonald, Special issue of the *Journal of Architectural Conservation*, v. 13, n. 2 (2007), 17

[223] Theodore H.M. Prudon, 185-193

[224] Accordingly, Henket and Tummers argue that Modern Movement genuine works -monuments- should be restored to their original state, as Violet-le-Duc upheld.

6.3. Age Value and Newness

In preserving modern architecture, replacement is based on the idea that the age value in modern manufactured materials, recognized through an acceptable level of alteration that enables the visual perception of the passage of time on the material, may conflict with the original design intent and the values of newness and machine age (Mike Jackson, 1991).[225] Newness value would support the authenticity in modernist heritage especially when the value of Modernity was strongly tied to innovation and conflicted tradition. In his paper of 1903 on the values of monuments, the art historian Alois Riegl already preceded this discussion and argued that the newness character of modern works could only be preserved by means that oppose the cult of age value, therefore, keeping patina, which reinforces age value, would make modern works less valuables. Prudon exemplifies this antagonism with the Seagram Building's bronze curtain wall maintenance. The author argues that the regular treatment applied to avoid oxidation maintains the newness value and Mies Van der Rohe's design intent, which conveys the building's importance towards commercial grandeur.[226]

Nevertheless, is newness always the most appropriate prevailing value in preserving modernist works? David N. Fixler refutes this reasoning when affirming that there are many aged industrial products "...capable of engendering powerful emotional response", thereby contributing to heritage value.[227] In fact, age value for modern materials becomes a problem of reception: how the fabric is relatively assessed and interpreted according to the viewer's perception. As Fixler reminds us in the aging of materials there is a "latent cultural

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225 Mike Jackson, "What's New" in *APT Bulletin* 23 (1991), p. 7-11
226 Theodore H.M. Prudon, 43
227 David N. Fixler, "Appropriate Means to an Appropriate End: Industry, Modernism, and Preservation" in *APT Bulletin*, Vol. 39, No. 4 (2008), 31-36

meaning"[228] that transports us to the original state, allows interpretation, and informs us of the social and cultural aspirations of architects and clients and the technical limitations for achieving these aspirations. Previously, in the British context, in recalling Ruskin and Morris' spirit, the director of the Centre for Conservation Studies at the University of York, Peter Burman, dedicated a full book chapter to support the idea of the passage of time as meaningful and contributing to the understanding of modernist works. Burman deepened this approach and extoled the connection between present and past through perceptions about use of the space, changes, human activity, weathering, and even soiling.[229] Furthermore, Burman challenged the idea of "machine age" value arguing that the craftsman had a role in the construction process. As aforementioned, it would be represented by technical limitations in translating the design to the reality, or the fact that modern ideas were reflected with traditional building techniques. Besides, Burman stated, "machines also exist in time and space",[230] thereby the material imprint produced by an evolving technology represents a specific period, the essence of which may be especially difficult to replicate, and consequently its preservation becomes a major concern. As explained later, this issue arose in dealing with the poured and sprayed concrete surface in Frank Lloyd Wright's Guggenheim Museum in New York.

6.4. A Matter of Balance

Opposite from the earlier narrative focused on original intent as the driving force for any preservation effort, other authors have urged the need to preserve material authenticity

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[228] Ibid.
[229] Peter Burman, "Towards a Philosophy for Conserving Twentieth Century Buildings" in Michael Stratton, ed. *Structure and Style: Conserving 20th Century Buildings* (London: E&FN Spon, 1997), 15-33
[230] Ibid.

while at the same time recognizing the same specifics for modern architecture. As early as the 1980s, Bernard Furrer expressed that "new materials deserve the same preservation approach as traditional materials: original fabric should be preserved as built with all the imperfections."[231] This idea probably relates to the fact that most of the efforts in the material culture preservation sphere stem from architectural conservators' practices such as the Billiet House's (1927) color scheme reconstruction, in Bruges, Belgium, or the Eames House's (1949) conservation management plan. In the former, the Belgian architect Huib Hoste designed an impressive group of interconnected abstract paintings for the walls and ceiling of the living room. This artwork became significant in the socio-historical context of post-war modernism in Belgium. Aspects of authenticity and wholeness were considered for a proposal that contemplates an eventual exposure of selected areas while other areas will remain uncovered and protected by the coats of paint applied over time telling the whole story of the site. In the Eames House case, which goes beyond its domestic nature to a design monument of the twentieth century, comprehensive research has been conducted encompassing an investigation of interior and exterior climatic conditions and materials analysis.

Andrew Saint would represent the most radical approach when he criticized the conceptualist attitude based on original intent and image-lead conservation. Saint stated that no matter what the intentions of the original authors were, they only could be acceptable in conservation practice as a last resort, where the gap between design and execution is extreme.[232]

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[231] Bernhard Furrer, *Inventarisation, législation et réalisation en Suisse in Patrimoine Architecturale du XXe siècle: stratétiges de conservation et mise en valeur, Proceedings* (1989)
[232] Andrew Saint, "Philosophical Principles of Modern Conservation" in Susan Macdonald, ed. *Modern Matters: Principles & Practice in Conserving Recent Architecture* (London: English Heritage, 1996)

Nevertheless, is there room for a position of balance? As Susan MacDonald states "arguments concerning authenticity will subside as less intrusive repair methods are developed and the acceptance that loss of material authenticity, may, in some instances, be unavoidable."[233] It means that earlier positions merely focused on original intent would be misguided, since they are essentially based on a lack of experience and on conservation technologies not developed enough. Consequently, the integration of different points of view in a designed solution, thereby balanced, will lead to a more satisfactory solution that preserves the major amount of historical fabric and at the same time increases the performance of systems.

This manner was also supported by the guest editors of the 1997 special *APT Bulletin* on the preservation of modern architecture, Susan D. Bronson and Thomas C. Jester: balance, collaboration, and dialogue answer ongoing philosophical and technical questions associated with the preservation of the recent past. Both authors agreed with a flexible interpretation of authenticity that informs the decisions that have to be taken case-by-case underpinned by a comprehensive analysis of the socio-economic, ecological, cultural, and historical context.[234]

More recently, the restoration of Frank Lloyd Wright's Solomon R. Guggenheim Museum (1956-59) in New York has also required a balanced approach in its exterior treatment. According to Angel Ayón, Wright's final intent and detail caused decay soon due to the absence of expansion joints in a continuous exterior exposed surface. Architects were constrained by the construction industry's limitations when building their ideas. Ayón points

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[233] Susan Macdonald, "Long Live Modern Architecture: A Technical Appraisal of Conservation Work to Three 1930 Houses" in *Twentieth Century Architecture* 2 (1996), 102-110

[234] D. Bronson and Thomas C. Jester, "Conserving the Built Heritage of the Modern Era: Recent Developments and Ongoing Challenges" in *APT Bulletin*, Vol. 28, No. 4 (1997), 4-12

out that the exterior formwork marks were "culturally significant, not only as evidence of authenticity of fabrication, but also as an indication that Wright's vision for the Guggenheim was ahead of the construction means and methods available at the time."[235] According to Frank Matero and Robert Fitzgerald, the Guggenheim's restoration brought the current debates over the appropriate manner to treat modernist works to a head: whether to recreate a new continuous surface according to Wright's original intent and never realized or to preserve the current surface texture as-built applying only a new paint coat finish. According to them, to conserve the inconsistencies between idea and production is the responsibility of conservation.[236]

6.5. An Outlook Across Established Guidelines and Policies

What makes a modernist building distinctive does not necessarily define a unique approach to its conservation. Current international principles of architectural conservation, and the methodology of analyzing, diagnosing, and treating deterioration to prolong and interpret the historic resource, can be applied to structures of the twentieth century as they are to those of an earlier period and design ethos. Although without connotations for modern architecture, there are numerous national and international charters and declarations that address shared universal issues in the preservation of all cultural heritage that are suitable for preserving the recent past: specifically the Venice Charter (1964), the Australia ICOMOS Burra Charter (1979, last revision approved in 2013)[237], and the United States

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235 Angel Ayón, "Historic Fabric vs. Design Intent: Authenticity and Preservation of Modern Architecture at Frank Lloyd Wright's Guggenheim Museum" in *Journal of Architectural Conservation*, 15:3, (2009), 41-58

236 Frank G. Matero and Robert FitzGerald, "The Fallacies of Intent: Finishing Frank Lloyd Wright's Guggenheim Museum" in *APT Bulletin*, Vol. 38, No.1 (2007), 3-12

237 The Burra Charter was first adopted in 1979 at the historic South Australian mining town of Burra. Minor revisions were made in 1981 and 1988, with more substantial changes in 1999. Following a review, Australia ICOMOS adopted a last

Secretary of the Interior's Standards for the Treatment of Historic Properties. The Madrid Document (ICOMOS, 2011)[238] is also useful, it was created as specific guide that has resulted particularly useful for those countries that do not apply the values-centered approach in preserving heritage.[239] These documents focus their recommendations on a property's cultural significance and propose a values-centered approach. However, the fact of this multiplicity of charters, documents, and guidelines reveals the relativity of their postulates and the continuous need of adjusting preservation principles following the evolution of the discipline and what contributes to heritage value.

The 1964 Venice Charter drew upon the 1931 Athens Charter and benefited from the 20th century Italian restoration philosophy and theories supported by Cesare Brandi's conservation theory and Gustavo Giovannoni's *restauro scientifico*, echoing the integration of conservation and planning, the respect for the different historical layers, the need to avoid historical confusions, and the reversibility of interventions. The document emphasized the context, while at the same time broadened the conservation scope to include the vernacular. There is no good reason to suppose that signatories of the Venice Charter had preservation of modern architecture and sites in mind, words such as ‘ancient building’ or ‘age-old traditions’ opening the document refute any approach in this way. In fact, the Venice Chapter directly challenges design intent stating "restoration must stop at the point where conjecture begins." TheVenice Charter provided a framework for expansion and revision as seen in the Burra Charter. Useful attitudes in the former are: buildings are historical documents and their fabric witnesses time and space, and thus must be conserved; an

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version in October 2013. *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013*. Australia ICOMOS Incorporated International Council on Monuments and Sites.

238 This document titled *Approaches for the Conservation of Twentieth-Century Architectural Heritage* was adopted in the international conference hosted by ICOMOS International Scientific Committee for Twentieth Century Heritage in Madrid, June 2011.

239 As Susan Macdonald highlighted in its lecture 'Somewhere Between History and Current Events: Conserving Modern Heritage' that took place on February 26, 2015 in the School of Design at the University of Pennsylvania.

acceptance of what is modern, whether meaning modern techniques for conservation and construction, where the preferred traditional techniques prove inadequate, or "contemporary" interventions to differentiate new from old; and the introduction of some flexibility regarding change of function, which became essential to make preserving modern building and sites possible as Prudon argues.[240]

Later, the Burra Charter represented a qualitative leap in conceptual approach to preservation, moving the focus from the physical appearance to the cultural significance of places in a value-centered approach, a notion that also expands the earlier Venice Charter's scope as well. While place is a geographically defined area, it is not restrained by time, only to its significance and cultural heritage value. Place goes beyond monuments, and may include elements, objects, spaces, and views, therefore also modernist works. Like the Venice Charter, the Burra Charter focuses on traditional techniques and materials as the preferred ones for the conservation of significant fabric. This narrative needs to be adjusted regarding the experimentalist use of new materials in modernist works, thus mention to replacements in-kind would be more appropriate. Whether traditional or modernist materials, innovative techniques and materials, which offer substantial conservation benefits, may be appropriate.

To better accomplish the conservation of modernist works and sites, specific guidelines were defined and gathered in the ICOMOS ISC20C Madrid Document 2011, which also draws upon previous documents.[241] This adaptation confirms the original idea published in the Venice Charter about the relativity of the doctrinal framework and the need for its adjustment to specific cultures and contexts.

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240 Theodore H.M. Prudon, 59-60

241 The Madrid Document 2011 particularly quotes: the Venice Charter (1964), the Florence Charter (1981), the Washington Charter (1987), the Eindhoven Statement (DoCoMoMo, 1990), the Nara Document on Authenticity (1994), the Burra Charter (1999), the Principles for the Analysis, Conservation, and Structural Restoration of Architectural Heritage (2003), the Nizhny Tagil Charter for the Industrial Heritage (2003), Xi'an Declaration on the Conservation of the Setting of Heritage Structures, Sites and Areas (2005), World Heritage Convention: Operational Guidelines (2008)

To identify and assess cultural significance, the Madrid Document explicitly involves interiors, fittings, associated furniture and art works, together with the doctrinal fabric, use, and context. Although most of the conservation and nomination processes of American policy are mirrored in the articles, the Madrid Document shows a discrepancy between international doctrine concerns and national policy, since historic interiors are one of the facets that do not have enough protection within the United States. Additionally, the Madrid Document does explicitly include the creative genius as contributing intangible value to the cultural significance, and for applying an appropriate conservation planning methodology "the input of the original designer or builder should always be sought, where relevant."[242]

It is clear that the Madrid Document defines a reasonable and suitable methodology for devising conservation plans, particularly in those countries unfamiliar with the values-based approach or do not have policies on protection of modern architecture. The document largely supports the notion of beginning all conservation decision making with the collection of information about the design, construction, use and condition of any historic resource over time. In addition, it recommends the establishment of acceptable changes, the use of interdisciplinary expertise, maintenance planning, and the elaboration of records and documentation of the entire process.

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[242] In the Article 1: Identify and assess cultural significance the Madrid Document includes a mention to the creative genius as an intangible value. *Madrid Document 2011*, 1

6.6 Case Studies

6.6.1. The Sydney Opera House: Managing Significance

Although the Sydney Opera House construction finished in 1973, it soon gained heritage value and professional recognition. During the 2000s, it was listed at local, national, and world levels, which provided statutory heritage protection.[243] However, conservation planning efforts began early with the issue of a conservation plan in 1993 and the subsequent creation of the Conservation Council in 1996. Overall, the purpose of the conservation plan, which has been already revised four times, is to guide and manage works and alterations, and to provide a tool to assess the success of those interventions.[244] The third conservation plan already has as a distinctive feature, namely the engagement of the original designer in defining the values of the place, the conservation approach, and how change, necessary in a venue still in use, should be managed.

This case study examines the original architect's role and the integration of a series of approved design guidelines in the conservation process that guide both the day-to-day building stewardship, as well as the proposals for large-scale work. It also includes the study of professional practices in assessing significance, as well as levels of significance, for defining the preservation policy that will establish the framework for every conservation process. In so doing, a new concept called "sensitivity to change" or "tolerance for change" will be introduced.

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[243] State Heritage Register on December 3rd, 2003, National Heritage List on July 12th, 2005, and UNESCO's World Heritage List on June 28th, 2007.

[244] In Australia a conservation plan, based on the Burra Charter, is similar to the historic structure reports used in the U.S. The impact of intervention and changes are measured against the identified valued of the place as reflected in the statement of cultural significance. Sheridan Burke and Susan Macdonald. "Creativity and Conservation: Managing Significance at the Sydney Opera House" in in *APT Bulletin* vol. 45 no. 2/3 (2014), 32

With some adjustment, the lessons of this case study could be integrated in the process of devising a conservation program for the Arts Building and Cloister, with the purpose of achieving a balance between the need to improve details that have failed and the need to conserve the original fabric as much as possible, while at the same time offering tools that eventually could be adaptable to managing the whole site.

The Sidney Opera House stands at the tip of a peninsula projecting into Sydney Harbor, constituting the focal point of an impressive waterscape. It was the winning design of the combined efforts of the Danish architect Jørn Utzon, who won the international competition set in January 1956, and the engineering firm of Ove Arup and Partners of London. The building represents an inspired design solution in response to the site and the combination of both architectural and structural innovations, as well as a model of public space integration with the city.[245]

The ribbed shell roof based on the geometry of a sphere together with the reinterpretation of the platform as an architectural element gained early recognition in professional circles in the early 1960s, but at the same time, the controversy surrounding its time and cost of construction raised and spread to almost all levels of society.[246] In fact, the Opera House opened six years later than the estimated date, eventually costing AUS$102 million, ten times its original budget.

Unlike the earlier political climate, which influenced the initial construction process before the shells and supports were correctly resolved in the mid-1960s, the new elected government disagreed with the Utzon's work methodology. Utzon worked in close collaboration with technical experts and artisans by a process of trial an error to improve the

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[245] Based on the statement of significance. James Semple Kerr. Sydney Opera House: A Plan for the Conservation of the Sydney Opera House and its Site. (Sydney, Australia: Sydney Opera House Trust, 2003), 32

[246] James Semple Kerr, 18

design and to incorporate a better solution to the Opera House. This required a financial effort, then not considered appropriate, that ultimately triggered Utzon's resignation.[247]

After Utzon's departure, a panel of Sydney architects was appointed to complete the project in 1966. The new group included Peter Hall from Public Works; Lionel Todd of Hanson, Todd and Partners; and David Littlemore of Rudder, Littlemore and Rudder, who, under the name of Hall Todd and Littlemore led the conclusion of the job.[248] The first public performance took on September 28th, 1973.

However, in 1999 Utzon became involved again in the Sydney Opera House, in this occasion to assist the Sydney Opera House Trust. The process, with the aid of his architect son, Jan, included the documentation of Utzon's original design intentions and to advise on future work through the formulation of a statement of design principles. In collaboration with the Australian architect Richard Johnson and his firm Johnson Pilton Walker, the Utzon Design Principles (UDP) were prepared and ultimately approved by Utzon.

Utzon and Johnson's collaboration produced two documents: the Sydney Opera House, Strategic Building Plan (December 2001) and the Sydney Opera House, Venue Improvement Plan (May 2002). While the first documents proposed conceptual ideas for addressing functional and design deficiencies, the second document outlined a program of works to be done for the Sydney Opera House Trust. In fact, the Opera House is a living organism that needs constant adaptation and needs a conservation policy capable of establishing a sound framework for the management of the site and its long-term stewardship.

[247] Ibid, 19
[248] Ibid, 20

The text of the UDP consisted of quotations arranged by Richard Johnson originated in the writings of Utzon and in taped discussions between Johnson and Utzon.[249] In the third edition of the conservation plan published in 2003, the principles inform the policies that define acceptable options and constrains in preparing proposals for work. The proposed fourth edition[250], recognized the primacy of Utzon's vision, together with the Conservation Management Plan, constitute "the chief guiding documents on matters relating to the conservation and management of the significant values of the Sydney Opera House."[251]

Usually, the impact of any change in cultural heritage is measured in terms of the effect it has on the heritage values, as well as on the physical building fabric, which could ultimately diminish both its integrity and authenticity and consequently on the cultural significance of the place. As defined in the 2003 Conservation Plan, the general cultural significance statement relies "on an understanding of the physical attributes and use of the building in relationship with the setting and of the associations with and attitudes to both building and site."

Determining what contributes or reinforces the statement of significance requires a careful evaluation of the various elements that comprise the site. This notion is particularly applicable to the Sydney Opera House because it has been altered in some areas and almost untouched in others. Ultimately, the introduction of the notion of levels of significance helps

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249 Ibid.

250 The fourth edition of the Conservation Management Plan is the charge of Alan Croker. The fourth revision answers the inscription of the Opera House in the UNESCO's World Heritage list in 2007 and updates the previous version, which was managed by James Semple Kerr as the two previous plans issued in 1993 and 1999., Sheridan Burke and Susan Macdonald examine the implications and particularities of the inscription in their article published in the *APT Bulletin* in 2014.. "Creativity and Conservation: Managing Significance at the Sydney Opera House" in *APT Bulletin* vol. 45 no. 2/3 (2014), 31-37

251 Alan Croker. *Sydney Opera House: Conservation Management Plan.* Final Draft, June 2015. At the time this thesis was being written, the Sydney Opera House website announced a period for public debate to take place in the summer 2015.

to justify a flexible approach to the treatment of the place, while at the same time clearly states which values and elements need to be protected.[252]

How can this notion be adjusted for the Arts Building and Cloister? The levels of significance rely on the degree to which a particular element tends to reinforce or reduce the significance of the whole. Ultimately, this implies "the greater the significance the greater the need for careful decision making. And that the lesser the significance the more free may be the treatment, always provided that aspects of greater significance remain undamaged."[253]

To manage this, the fourth revision includes an impact assessment tool to assist building managers and users for the conservation and adaptive reuse of the building within a series of limits. In fact, simple operational changes such as replacing the paving to ensure functional capacity, or to modify the lighting system to meet safety standards could adversely impact the heritage values as well as its physical building fabric, which ultimately embody the values.[254]

The tool was based on the notion of "sensitivity to change" (StC), which was developed by Sheridan Burke after the Burra Charter principles for Godden Mackay Logan, who adapted the tool for a wide range of conservation plans in Australia. "Sensitivity to change" is a "judgment about how sensitive to change are the attributes of the form, fabric, function, and location of each heritage component part, and consequently how tolerant they are to change without adverse impacts on heritage significance."[255]

For the Opera House, each element has been subdivided according to its component parts and articulated in a table that includes the above four attributes. Function involves the

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252 James Semple Kerr, 32
253 Ibid.
254 Sheridan Burke. "Sensitivity to Change: Conservation Management at the Sydney Opera House" in *Fourth International Utzon Symposium, Sydney, Australia: What Would Utzon do Now?*
255 Ibid.

current use and the role in function of element, activities and practices, either temporary or permanent. Form refers to the design, configuration, details, scale, and character. Fabric means the physical material, as well as contents, interiors, and artifacts. Finally, location includes the relationship between elements, physical and functional context, and views.[256]

Each attribute is rated from 1 to 3, 1 being highest sensitivity to change, or having least tolerance for change, and 3 being least sensitive and thus having highest tolerance for change. Attributes with highest sensitivity contribute most to the significance of the element, which has been previously assessed in terms of its level of significance.[257]

The StC tables inform the decision making process and supports the implementation of the policies, however, in case of conflict, policies have prevalence. While the policies answer the strategic questions, the StC table gives guidance about how to proceed.

In conclusion, the decision taken at the Opera House illustrates how conservation can address the need to adapt modifications for maintenance and public demands, while at the same time providing a framework for safeguarding the extant fabric. Within this perspective, the conservation plan is conceived as an evolving document that is retrofitted through the success and failures in managing the heritage values.

Two other fundamental learning outcomes of this case study are that both the establishment of a strategy and the development of conservation tools to assist the site management become necessary. Evidently, this conservation management plan was developed within a framework comprised of local and national regulations, such as heritage guidelines, planning, building control and codes that together with the stakeholders involved in the Sidney Opera House constitute the enabling environment.

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[256]Alan Croker, Section 5. Conservation Policy.
[257] Ibid.

6.6.2. Applying Accepted Practices in Preserving a Modernist Icon: The Eames House and Studio

Starting in 2012 under its Conserving Modern Architecture Initiative (CMAI), the Getty Conservation Institute (GCI) and the Charles and Ray Eames House Preservation Foundation (Eames Foundation) partnered to analyze and assess the conditions of the Charles and Ray Eames House and Studio (1949), as well as to develop a conservation management plan for its long-term stewardship. While the current efforts are focused on devising a conservation management and maintenance plan, the results of the investigation have already informed the implementation of conservation measures. The Eames House and Studio conservation case study is an opportunity to understand why the accepted practices in analyzing and conserving traditional materials, such as architectural finishes or wood, should also be applied to iconic modern buildings built with manufactured industrial materials of the 20th century. The scale of the project, along with the idea that the house embodies how the Eames lived and worked, make this case study suitable for comparison to Nakashima's Arts Building and Cloister, which is the main focus of this thesis.

The Eames House and Studio or Case Study House nº8 was designed by Charles (1907-1978) and Ray Eames (1912-1988) and built in 1949 on a plot in Pacific Palisades, California, after the invitation of John Enteza, editor of *Arts and Architecture* magazine, and his celebrated Case Study Program. Considering the needs of the average American, this program was designed to showcase eight examples of affordable and mass-producible houses that embodied ideas of good living for the postwar era while thoughtfully using new materials and new techniques.[258]

According to the National Historic Landmark (NHL) nomination, the house and studio are significant because it is the property most closely related with the prolific and nationally significant husband-and-wife design team of Charles and Ray Eames. Both gained international reputations through careers that comprised furniture design, filmmaking, photography, exhibitions, and graphic design. Additionally, the house and studio is a rare example of the few buildings designed by Charles Eames that became the most influential of all built case study houses and satisfied the requirements of using industrial and standardized materials. The designers used the house as their private residence and working studio until their respective deaths in 1978 and 1988. The house contains their furnishings, works of art and a myriad of objects they collected throughout their lives.[259] Summing up, , "the site, house, studio, and interior collections tell a remarkable story about the architecture of this period, including the role of California modernism within an international context, and provide an intimate view into the life of its occupants, opening a new understanding about the human side of modernism."[260]

Taking advantage of the fact that the living room contents were temporarily relocated to an exhibition at the Angeles County Museum of Art (LACMA), the Eames Foundation partnered with the GCI to address the study and conservation of the house in both the immediate and the long term. To date, the research has involved architectural finishes analysis, wood identification, flooring replacement, and environmental monitoring

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[258] John Entenza, "Announcement: The Case Study House Program" in *Arts and Architecture* 62 (1) (January, 1945): 37-41.
[259] Historic Resources Group, *National Historic Landmark Nomination: Eames House* (2005).
[260] "Eames Conservation Project," last modified on January 2015 www.getty.edu/consevation/our_projects/field_projects/eameshouse/index.html, accessed March, 17 2015.

and climate control. Currently, the efforts focus on devising a conservation management plan for the stewardship of the site in the long term.

Aiming to understand the use of color and paint at the Eames House, the GCI implemented an architectural finishes analysis on the exterior metalwork, which was supplemented with archival documentation research, such as trade catalogs, and physical evidence examination. As part of this work, optical microscopy and chemical analysis were conducted to determine the pigment composition of the paint layers. Multiple samples were collected in order to get consistency in the results. In recording the multiple layers corresponding to different painting campaigns, the paint stratigraphy provided information about color change over time. Supplementing and confirming the results obtained by the scientific analysis, in-situ exposure windows or scrape tests, which consist of exposing each paint layer showing the stratigraphy in situ, were also carried out.[261] This judicious combined application of different techniques ensures better results than if they are separately implemented. As the Winterthur Museum scientist Catherine R. Matsen argues, the scrape test can show a variety of errors if solely applied. For example, it can be difficult to distinguish between successive layers of similarly colored coatings.[262] Consequently, to the extent possible, architectural finishes analysis must be implemented using the analytical techniques that provide as much objective data as possible, first to eventually move to more manual techniques, which may help to a better understanding of the site.

With the results of the finishes analysis, the research group created a timeline of paint layers. This timeline offers an example of how the scientific research expanded, and

261 Getty Conservation Institute, "Conserving the Eames House: A Case Study in Conservation," (January 2015) http://www.youtube.com/watch?v=P4lS53FjsJU, accessed on March 19, 2015.
262 Catherine R. Masten, "Hue's Clues: Inside Historic Paint Research" in *Old House Journal*, http://www.oldhousejournal.com/historic-paint-research/magazine/1637, accessed March, 18 2015.

also confirmed, the information contained in archival documentation, which is often incomplete. It is worth mentioning that the results can have an impact on the cultural significance of the place. In fact, the paint analysis revealed that the exterior metalwork was repainted when Charles and Ray Eames still lived in the house changing the original appearance of the house and the studio. In this way, the original warm gray paint layer, the intention of which might be to replicate the bark of the surrounding eucalyptus trees, was eventually covered with a black coating.[263] This change during the period of significance might arouse conflicts in how to conserve the house that should be elucidated on the conservation management plan, establishing levels of significance and devising a preservation philosophy that also includes issues such as this fact.

As with the paint coatings, records about other materials might be erroneous and incomplete. In the case of the Eames House, wood sampling and microscopic identification was considered the most suitable technique to identify species of wood, which is one of the common procedures in conserving traditional architecture and a necessary step in selecting appropriate treatments. The examination of microscopic features, such as the cellular structure, provided accurate results in determining the species of wood of the aged paneling covering the living room, in addition to conditions such as the presence of fungus. The results supported new theories to describe the designer's original intent and became thus a new source to assess the significance of the site. According to the conservator, the fact that the Eames chose eucalyptus for the wooden boards in the living room is clearly related to the subtle ways that the designers used the architectural elements to integrate architecture

[263] Getty Conservation Institute, "Conserving the Eames House: A Case Study in Conservation."

and nature, establishing in this case a dialogue between the interior of the house and the row of eucalyptus trees on the exterior.[264]

The wood identification was complemented with further investigation of the protective coatings. This analysis was based on the fact that not only the substrate should be conserved, also the finishes where possible. Finishes are the expression of a particular technology and design intention as discussed in the literature review. This case study offers an example of a sensitive approach that intends to conserve the age value as well, which is the product of the material aging. For identifying the coatings, Fourier-Transform Infrared Spectroscopy (FTIR) was used.[265]

Furthermore, interior and exterior environmental monitoring was conducted with the goal of designing and implementing a suitable and minimally intrusive system to secure the collection of furnishings and objects in the long term. The research was based on the installation of a weather station to monitor temperature and relative humidity as well as light and ultraviolet exposure, and to investigate how to use the existing ducts to install a system of climate control.[266] This study is still in process and the results not yet analyzed.

This insight into the building physics was accompanied by the study of various failures in the building assemblies due to moisture migration, such as the roof, the vinyl flooring, the wood paneling, and the envelope metalwork. The proposed action with the greatest impact will be the complete replacement of the deteriorated vinyl flooring, which was originally installed two years after the construction of the house. Because the tiles contain asbestos and had accomplished the end of their life, replacement was carried out

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[264] Arlen Heginbotham, "What's in a Wood? How Science Helps to Reveal the Eames' Vision" in *The Getty Iris: the Online Magazine of the Getty* (October, 2013), accessed March 18, 2015.
[265] Getty Conservation Institute, "Conserving the Eames House: A Case Study in Conservation."
[266] Ibid.

because of the problems derived from moisture penetration, which did not guarantee tile adhesion and its long-term maintenance, as revealed by Oddy Test. The discussion preceding the replacement included different variables, such as the potential material for replacement, the color, the new assembly, and the original design intent.[267] This action implies that whenever possible culturally significant materials have to be preserved. Otherwise, if overall performance is compromised, sensitive replacement should be compatible with the significance of the house, while improving the performance.

The final step of the collaboration between the Eames Foundation and the GCI included the development of a conservation management plan. This plan defines to what extent the significance of the Eames House will be impacted in the future, policies to secure it in the long term, a maintenance plan for its stewardship, and everyday issues like how to manage visitors. Essentially, the Eames House and Studio case study shows how accepted and tested techniques in traditional conservation practice, such as the paint analysis, wood identification, and environmental monitoring, provide objective data to better understand the materiality of the house and inform the decision-making for this conservation plan. However, although the analyses executed at the Eames House and Studio provided baseline data to understand mechanisms of deterioration, and consequently the recommendation and implementation of treatments, the conservation program ought to include the philosophical framework to intervene based on the goals established in reference to the significance of the house and the adjacent landscape. In addition, the conservation management plan has to be sufficiently flexible to incorporate new data that may be revealed throughout new investigations. Susan Macdonald, head of projects at the GCI, confirmed this in the

[267] Ibid.

presentation of the case study at the GCI early in 2015.[268] Undoubtedly, this approach, which is more holistic than an Historic Structure Report, is applicable to the Arts Building and Cloister adjusting to its own levels of significance and George Nakashima's philosophy; notions that will be considered in the next case study.

6.7. Defining a methodological approach to George Nakashima's House, Studio and Workshop Complex and Specially the Arts Building and Cloister

Modernist architecture requires the same documentation and recording as any heritage property and recognition of all the values embedded in the place on the basis of a case-by-case analysis, taking into account its complexities and contradictions, the understanding and assessment of its cultural significance, and the devising of policies prior to intervention. This thesis attempts to go beyond in adding the identification and elaboration of a conservation philosophy that constitutes the frame of reference in defining preservation objectives and recommendations, and establishes a model to develop sound policies for ongoing management of the site.

In the case of George Nakashima's house, studio, and workshop, the cultural significance is clearly outlined in the recent National Historic Landmark (NHL) nomination[269] (April 2014), extended now with oral history, archival, and physical investigation. The site is culturally significant under NHL criteria 2 and 4. Additionally, being significant between 1946 and 1982, the complex required the application of exception 8.

Criterion 2 embraces "properties that are notably associated with the lives of persons nationally significant in the history of the United States". Criterion 4 involves "properties

[268] Ibid.
[269] The form was prepared by David Kimmerly and Catherine C. Lavoie and presented in February 7, 2013.

that embody the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style, or method of construction, or that represent a significant, distinctive and exceptional entity whose components may lack individual distinction."[270]

Exception 8 recognizes those properties that gain national significance during the last fifty years or achieved it more than fifty years before the nomination but continued to be significant longer. In fact, the NHL registration criteria establish fifty years as the time needed to develop historical perspective and to evaluate national significance. Evidently, this criterion has become challenging for modernist works and needs adjusting as the NHL criteria recognizes in introducing the exception 8. In fact, dealing with works from the recent past requires a different approach, which also includes challenging traditional notions of beauty that are not applicable to understand and interpret them.[271]

The NHL nomination identifies the Nakashima house, studio and workshop as a total complex, a cultural landscape of significance at the local and national levels. The Arts Building and Cloister is particularly important as a highly refined example of George Nakashima's philosophical ideas, of the fusion of traditional Japanese and American craftsmanship with modernist ideas materializing a new way of expression as happened with his furniture. This is an architecture that blends traditional materials such as wood and stone, with new manufactured materials such as plywood, concrete and structural gypsum block, and poured concrete, and their application in monumental expression such as the building's soaring plywood hyperbolic paraboloid roof. There is a clear connection between furniture and architecture through the use of similar details and principles: the cantilevered steps of

[270] *How to Prepare National Historic Landmark Nominations*, U.S. Department of Interior, National Park Services 1999
[271] Scott Adrian Fine, "Top 13 Challenges for Saving Modernism and the Recent Past" in *Forum News* 16, No. 11 (2010)

the stairs leading to the second story, the fireplace lintel, and the balcony and the support posts along the exterior pathway. The building also embodies the interrelationship with the arts; ties with Japan materialized in the use of Japanese volcanic stone, the friendship with the artist Ben Shahn, which is overtly manifested through the mosaic tile mural designed by the latter and installed in the west facade in 1972; spiritual values that are especially evident in cloister-garden design and the isolated location on a slope at the edge of the property.

The preservation philosophy and significance, which is covered in the following chapter, is informed by George Nakashima's ideas, the building's larger architectural historical context, and its physical integrity and condition. The physical investigation has required consideration of the as-built condition, and as Bronson and Jester has stated, "understanding the evolution of construction technology in response to new building materials and assemblies."[272] George Nakashima directly participated in the construction process and few project drawings were produced in advance. The analysis of patterns, detailing, and material in the building has also helped to reveal Nakashima's intent in the absence of much documentary evidence and to bring this into the debate about how to approach the conservation process. . Consequently, an approach that exclusively emphasizes the architect's original intent rather than the actual as built structure is not convenient. Moreover, his design intent was an evolving body of ideas; thus later repairs and maintenance works have to be analyzed and interpreted in order to device the conservation program.

The Burra Charter suggests us that "conservation of a place should identify and take into consideration all aspects of cultural and natural significance without unwarranted

[272] Susan D. Bronson and Thomas C. Jester, "Mending the Modern" in *APT Bulletin*, Vol. 28, No. 4 (1997), 3

emphasis on any one value at the expense of others."[273] Pursuing this balance means that the original architect's intent should inform the preservation efforts without compromising the authentic fabric conservation, since values are embedded in the architectural fabric. Within the frame or reference of the Australian document, the conservation plan of the iconic Sydney Opera House offers us a lesson that has been translated to this thesis. The plan integrates the dialogue with the original architect, Jørn Utzon (1918-2008), as well as the World Heritage process for assessing significance and devises the management strategies. [274] Utzon contributed to and approved a series of design principles to provide a permanent reference for managing change and to inform building stewardship. The case study teaches about what will lead decision-making in the conservations plan: sensitivity to change of the cultural significance of the site, which can have an impact on the attributed values, and consideration of the engagement of Utzon and other architects who were implied in the construction process. These notions, together with the constitution of a panel of experts, are certainly suitable for the case of the Arts Building and Cloister.

Additionally, the idea of managing change to preserve cultural significance, as considered and built upon in the narrative of the NHL Designation, becomes relevant. As the Burra Charter suggests, "the amount of change to a place and its use should be guided by the cultural significance of the place and its appropriate interpretation." The Madrid Document recommends "a conservation plan should define the significant parts of the heritage site, the areas where interventions are possible, the optimum usage of the site and the conservation measure to be taken." As Sheridan Burke and Susan MacDonald quote,

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273 Article 5. "Values" in *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Last revision in 1999)
274 Sheridan Burke and Susan MacDonald, "Creativity and Conservation: Managing Significance at the Sydney Opera House" in *APT Bulletin*, Vol. 45, No. 2/3 (2014), 31-37

"the conservation process relies on developing a good understanding of why a place is significant, identifying the attributes that embody specific heritage values, and establishing an understanding of the relative levels of significance."[275] Thus, priorities are established. In the case of George Nakashima's complex, what is the best approach to conserve both its authenticity and integrity? Does the Arts Building meet contemporary energy and use performance? Is a change of use expected now or in the future based on current or new programming? The conservation of the place requires the retention of an appropriate visual setting. Thus, what about the evolution of the complex? To a certain extent, sustainability can compromise authenticity. Angel Ayón states that a sustainable approach requires that, "when intervening on critical components of Modern building envelopes, upgrades be aimed at preserving the integrity of the historic building character, instead of limiting the interventions to saving historic fabric alone."[276]If a conditions assessment shows that the envelope performs well, is it environmentally responsible? Should the conservation program contemplate the replacement to meet sustainability? Are retrofitting measures appropriate? These questions show further difficulties in devising a conservation program for the Arts Building and Cloister that the development of this thesis should answer, taking into account that the impact of any planned change shall be measured against the identified valued of the place as reflected in the statement of cultural significance, and keeping in mind that it is good practice to review conservation plans when new elements of cultural significance are revealed and when major change is proposed.

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[275] Ibid.
[276] Angel Ayón, 56

7. Mending the Arts Building and Cloister

In the United States, one critical document required for the preservation of a historic structure is the Historic Structure Report (HSR). Essentially, an HSR assembles all documentary sources on the property and its occupants, graphic and physical information describing the site and structures, and existing conditions. The HSR is the basic document that allows informed decisions to be made about a culturally or historically significant property, typically a building and its associated site;[277] areas that have been addressed in this thesis.

Also often a series of recommendations are included, which guide planned interventions whether for immediate stabilization or long term interpretation and reuse.

First, a statement of significance summarizes the importance of the site as a cultural resource including its architectural, social and cultural context. Secondly, a preservation philosophy guides intervention decisions informed by current condition and integrity. Thirdly, prioritized recommendations are provided including recommendations for further research, which are a necessary step prior to strategic planning.

7.1. Summary of the Statement of Significance

Designed and built by renowned American-Japanese George Nakashima, the Arts Building and Cloister occupy a privileged position as the most iconic and architecturally significant of his built works and possess high integrity in design, setting, materials,

[277] Deborah Slaton, Preservation Brief 43: The Preparation and Use of Historic Structure Reports. (Washington, D.C: US Government Print Office, 2004), 1

craftsmanship, and feeling.[278] Completed in 1967, the building is of national significance because it is associated with George Nakashima, "one of America's most eminent furniture designer-craftsmen and a significant force within the American Craft movement of the mid-twentieth century, a seminal period for woodworking in the United States."[279] The compound represents a fusion of modernist ideas with traditional Japanese and American vernacular building techniques, uses an experimental hyperbolic paraboloid plywood roof, and houses a mosaic mural executed by the Gabriel Loire stained glass studio in Paris after Ben Shahn's designs.

Stemming from Nakashima's apprenticeship and earlier experiences, particularly with Antonin Raymond, his widely recognized interpretation and combination of modernist and traditional ideas generated a personal style of design unique to him and is intimately bound up with the social values, sense of community, and personal identity that Nakashima nurtured in New Hope.

These intangible qualities are substantially embedded in the Arts Building and Cloister. We must not ignore that the compound was conceived as an exhibition space and as a place of universal exchange in relation to both craftsmanship and the arts. Shortly after construction, the building was called the Minguren Museum, which culminated Nakashima's constant interest in transcending his woodworking activity in New Hope, and deepening its association with the arts and crafts.

The use of the hyperbolic paraboloid roof closely relates with the rise of warped roofs in post war America and exemplifies a rare example in its use of structural plywood

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[278] The National Register recognizes a property's integrity based on the above aspects or qualities. For a detailed description it is recommended to visit the following website: National Park Services. *National Register Bulletin: How to Apply the National Register Criteria for Evaluation.* http://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_8.htm (accessed on July 2015).
[279] David Kimmerly and Catherine C. Lavoie. George Nakashima Woodworker Complex. National Historic Landmark Nomination (November 2007 (NR documentation);October 2012; Designation April 2014), 14

marrying craft and engineering efforts, while at the same time representing an evolution of experimental architecture practiced at Nakashima's property.

This significant sense of transcendence and spirituality resulted in Nakashima's Altar of Peace Project, initiated in 1984 and now continues with the Foundation for Peace, which manages and uses the Arts Building and Cloister.

7.2. Levels of Significance

Of particular importance in defining the character and significance of the overall design of the Arts Building and Cloister is the form, fabric, and interior configuration of the space, its context, setting and interrelationship between exterior and interior,, its function as an exhibition space and temporary lodging for visiting craftsmen and scholars respectively, and the original concept of sequential experiences in approaching the building.

Important physical elements are the tilted hyperbolic paraboloid plywood roof, interior woodwork, the cast-in-place concrete elements, stonework, block masonry, and the immediate landscaped features. Elements in the interior include paving, plasters, stone and concrete elements, cantilevered steps, rails, built-in shelves and settees, and whatsoever crafted wood elements originally conceived by George Nakashima.

7.3. Preservation Philosophy

How should the Arts Building and Cloister be preserved? The Secretary of Interior's Standards for the Treatment of Historic Properties suggest four distinct approaches for dealing with heritage: preservation, rehabilitation, restoration, and reconstruction; in order to assist professionals in decision-making.

Secretary of Interior's Standards for the Treatment of Historic Properties[280]

Preservation	The maintenance and repair of exiting historic materials and retention of a property's form as it has evolved over time.
Rehabilitation	The need to alter or add to a historic property to meet continuing or changing uses while retaining the property's historic character.
Restoration	To depict a property at a particular period of time in its history, while removing evidence of other periods.
Reconstruction	To recreate vanished or non-surviving portions of a property for interpretive purposes.

Accordingly, the Standards provide philosophical consistency for each treatment, however when dealing with modernist architecture difficulties arise. Due to the high integrity of the Arts Building and Cloister, a suitable approach would be preservation. However, while traditional materials often do not present a conflict, stabilizing, consolidating, and conserving experimental, innovative assemblies and materials that have reached the end of their service life may suggest a more aggressive approach of replacement.

Additionally, considering the diverse range of tangible and intangible qualities, determining a unique conservation approach may fail in sustaining the values and significance of the place, whereas synthesizing different philosophies of conservation can offer a balanced solution to the problem. This solution encompasses preserving the constructed realities and the as-built conditions, thus preserving the original fabric including

280 This table directly quotes the definitions from National Park Services. *Secretary of Interior's Standards for the Treatment of Historic Properties* http://www.nps.gov/tps/standards.htm (accessed on July 2015)

its age value, the continuity of the craft when replacement becomes necessary, and most importantly the invocation of conscious design as the source of all decisions.

Is preserving the constructed realities and the as-built conditions of particular relevance? Cost of repair versus replacement can be argued, however ensuring value age supports an affirmative response and echoes George Nakashima's ideas. Let us use a parallel with furniture. In quoting his father, Mira Nakashima indicated that George Nakashima "extolled the virtues of the wear and tear left by everyday living on furniture."[281] Mira Nakashima also reminds us that as furniture ages, it becomes a tangible repository of the user's memories and the passage of time, which are regarded as qualities of age value.[282]

As in aged furniture, these memories are also perceived in architecture. Age value is revealed in imperfections, fading colors, scratches, and other types of burdens that connect visitors to Nakashima's legacy through the positive perception of the passage of time. Additionally, value age stresses the building quality as an historical document that evidences Nakashima's craftsmanship as well as the tactile and texture qualities of age and use cannot be reproduced and must be conveyed to visitors.

However, when replacement is necessary, investment in the same craft tradition as espoused by Nakashima should be invoked. Craft can be defined as creating objects by hand through the skilled use of tools. The quality of the result is undetermined, but depends on the judgement, dexterity, and care which the craftsman exercises as he works. [283]As George Nakashima suggested for wood, craft requires one to explore the wonder and beauty of its potentialities. According to him, the concept of creativity is linked to the crafts. Through the

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[281] Mira Nakashima, 116

[282] Earlier in this thesis the notion of age value was confronted to the notion of newness. Riegl defined age value as "rooted purely in its value as memory… [which] springs from our appreciation of the time which has elapsed since [the work] was made and which has burdened it with traces of age." Alan Colquhoun, "Newness and Age Value in Alois Riegl" in *Modernity and the Classical Tradition: Architectural Essays 1980-1987* (Cambridge, Mass: MIT Press, 1989), 213

[283] Lucy Donkin. Crafts and Conservation: Synthesis Report for ICCROM (ICCROM, 2001),5

craft, materiality embodies value and spirit. Truth in making things, the path is taking materials and techniques from the past (traditional Japanese carpentry and vernacular American building techniques) to synthesize with the present.

In view of this, it is necessary to perpetuate the continuity of the craft as means of ensuring proper repair or replacement while Nakashima's approach reflects the guiding philosophy. The use of appropriate techniques and the particular nature of crafting wood and other materials entail specialization of professionals whose task is to study and preserve the Arts Building and Cloister, as well as other buildings in the property. Therefore following ICCROM recommendations, know-how involved in practicing craft must itself be the object of conservation either through apprenticeship or other forms of training, which must be incorporated in the building conservation process. The training process should be documented and recorded.

Nevertheless, it is necessary to ensure enough flexibility to intervene without compromising the cultural significance. When assemblies or materials require replacement because they have exhausted their life span or serious processes of decay pose difficulties, it is important to establish design principles that stem from Nakashima's sensitive approach but are also respectful of the extant fabric in being compatible, reversible, and non-intrusive. Any change needs to be evaluated and recorded for the use of other professionals or future research.

7.5. Recommendations for Conservation

Further Research

Structure	1-Structural assessment of the hyperbolic paraboloid roof and the effects of the transferred loads to other structural elements. 2-Analysis of active corrosion in the reinforced concrete elements. If structural assessment is needed, it is recommended to identify the number, the location, spacing, and approximate depth of the embedded reinforcing steel elements in the section. For this purpose, a pachometer or eddy current device can be used.
Environment	1-Design and implement an environmental monitoring program for conducting a comprehensive study of the interior and exterior environment in order to further understand deterioration processes and optimize energy consumption and protection of the interior contents. This program may include assessment of thermal value, and UV value of the glass spans in order to protect the interior collection.
Material	1-Perform additional material characterization and documentation to assess life span, chemical composition, and understand patterns of deterioration in relation to physical and chemical properties of the materials. This recommendation includes mosaic tesserae, stone masonry wood, plywood, pavements, and plasters. 2-Laboratory testing to identify type and sources of salts noticed during the visual survey.

The following recommendations are prioritized in immediate, short, and long term phasing. Additionally, because of the limitations of the developed study, it is strongly recommended to conduct further research to understand the potential for future deterioration of original materials and assemblies to prevent the need for replacement.

All interventions should be monitored regularly to evaluate their success. In addition, it is recommended that all work be documented before, during, and after repairs. Significant elements that were removed must be recorded and stored properly.

Priority	**Recommendation**
Immediate priority	1-Roof and water disposal system 2-North wall and drainage system below grade
Short-term priority	1-Envelope and deteriorated wooden members 2-Ben Shahn's mosaic 3- Examination of bio-growth and study of removal
Long-term priority	1-Stone and concrete masonry 2-Remove intrusive added elements

Recommendation	**Action**
Roof and water disposal system	Ensure building tightness by repairing active leaks, investigating further points of water seepage, and seek the advice of a structural engineer. Evaluation of the roofing system and especially the plywood shell and study of its replacement depending on the level of deterioration.
North wall and drainage system below grade	Identify accurately the causes of rising damp and evaluate and test different methods before deciding, either installation of through-wall flashing, water repellent coatings, or French drain repair.
Envelope and decayed wood members	Determine the soundness of structural wood members to identify hidden rot or decay. Evaluate repair or replacement before deciding. Investigation of the environmental factors that produce condensation, and evaluate alternatives to prevent related deterioration processes.
Mosaic	Characterization of materials and study of the process of fabrication and deterioration through a conditions survey. Do not replace missing elements.
Bio-growth	Study of the processes of deterioration possibly associated with biological colonization. Otherwise, if decay is not supported by evidence, biogrowth can be aesthetically pleasing, contributing to generate value age at least in the masonry.
Masonry	Study of the decay processes (see further research), efflorescence removal, and material consolidation, particularly in selected stone elements

Intrusive alterations	Study and evaluate alterations. Consider replacement which returns the architectural design to George Nakashima's original intent unless he himself advocated for and/or made subsequent alterations.

7.6. Further Recommendations

This thesis and the recommendations herein contained aim to support the necessary planning for the long-term stewardship of this important property through the development of a conservation management plan. A conservation management plan is a document and a process, which explains why a place is significant and how significance is sustained in any new use, alteration, repair, or management. To such a degree, it is also a policy document, which articulates the mission and the strategy to assist in implementing that main goal.

The preparation of a conservation management plan is a multidisciplinary task and needs to involve all the stakeholders in order to create a useful tool. A more detailed work program should include maintenance, management, access, interpretation, use, and other specific issues that could arise in relation to the future use and interpretation of the buildings and their context. The case study examined in this thesis argues for a policy-oriented conservation management plan centered on active and continued use while ensuring the protection and enjoyment of the place.

Unlike the Sydney Opera House, a smaller scale and a less intensive use characterize the Arts Building and Cloister. However, the conservation management plan may include the idea of devising conservation tools for assessing the success of repairs, replacement, and other interventions in retaining significance and may explore the engagement of Nakashima's philosophy as specified above.

It is also necessary to specify use, which may involve the reactivation of the site as space for the interchange of ideas regarding craftsmanship, arts, and training, and how this use can impact significance and the extant architecture.

In terms of strategic planning, further research should:

- Record and evaluate the landscape features

- Create an inventory of furniture and artwork in the interior and exterior of the Arts Building and Cloister.

- Examine and evaluate the building codes and other regulatory policies affecting site management efforts that might need to be addressed in project planning or preservation works.

- Explore the interpretation and possible uses of the site, which may involve current use and the reactivation of the site as space to reunite craftsmanship, arts, and training, and assessing how this use can impact significance.

Additionally, prior to devising the conservation management plan it is recommended that the enabling environment be studied to help assess the vulnerabilities, the strengths, and external factors that may represent or limit the opportunities for preserving the Arts Building and Cloister.

Although the conservation management plan proposed focuses on one specific building and by extension, the entire complex, it represents an opportunity to provide a case study that contributes to the growing need to clarify how to preserve modern heritage of similar scale and qualities.

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APPENDIX A. Terminology

Modernism: the cultural practices that both mediate and produced a transformation in social, political, and environmental spheres as consequence of the industrialization and the machine. (Banham, 1960)

Modernity: is the subjective experience of each individual in the sociocultural context of modernization, which aims to make the present different from the past and paves the way for the future, being a break or a conflict with tradition. (Banham, 1960)

Modernist: this term is associated with modernism and conveys the functional, visual and perceptual characteristics of creative works.[284] (Prudon, 2008)

Modern Movement: an artistic and architectural movement that consciously embodied modernism, which began with new and rupturing social, technical and design theories in Europe in the early twentieth century. DoCoMoMo promotes a time-based definition that involves architecture that dates from the 1920s to the 1970s and states that such works look forward to the future without overt references to historical precedent. For DoCoMoMo, modern design emphasized expression of functional, technical or spatial properties rather than reliance on decoration.[285]

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284 Theodore H.M. Prudon... ix
285 DoCoMoMo US "How to Evaluate Modern Buildings and Sites. Selection Qualifiers."

Modern architecture: opposite to Modern Movement, this term involves a wide range of architectures, which is linked to a more temporal than stylistic meaning. It refers to all the architecture of the recent past.[286] (Prudon, 2008)

Levels of significance: the relative significance of the different elements contributing to the overall level of a property's cultural significance. The Sydney Opera House Conservation Management Plan includes the following definitions:[287]

Level of Significance		Definition
A	**Exceptional significance**	These elements are essential to the significance of the place. They play a crucial role in supporting this significance.
B	**High significance**	These elements play an important but not necessarily crucial role in supporting the significance of the place.
C	**Moderate significance**	These elements provide support to elements or functions of higher significance. They play a role in supporting the significance of the place, but may be inadequate in their current configuration or use.
D	**Low significance**	These elements play a minor role in supporting the significance of the place, or may have been compromised by later changes.
int.	**Intrusive**	These elements or components obscure or damage the significance of the place.

[286] Theodore H.M. Prudon, ix
[287] Alan Croker, Section 4 Summary of Significance

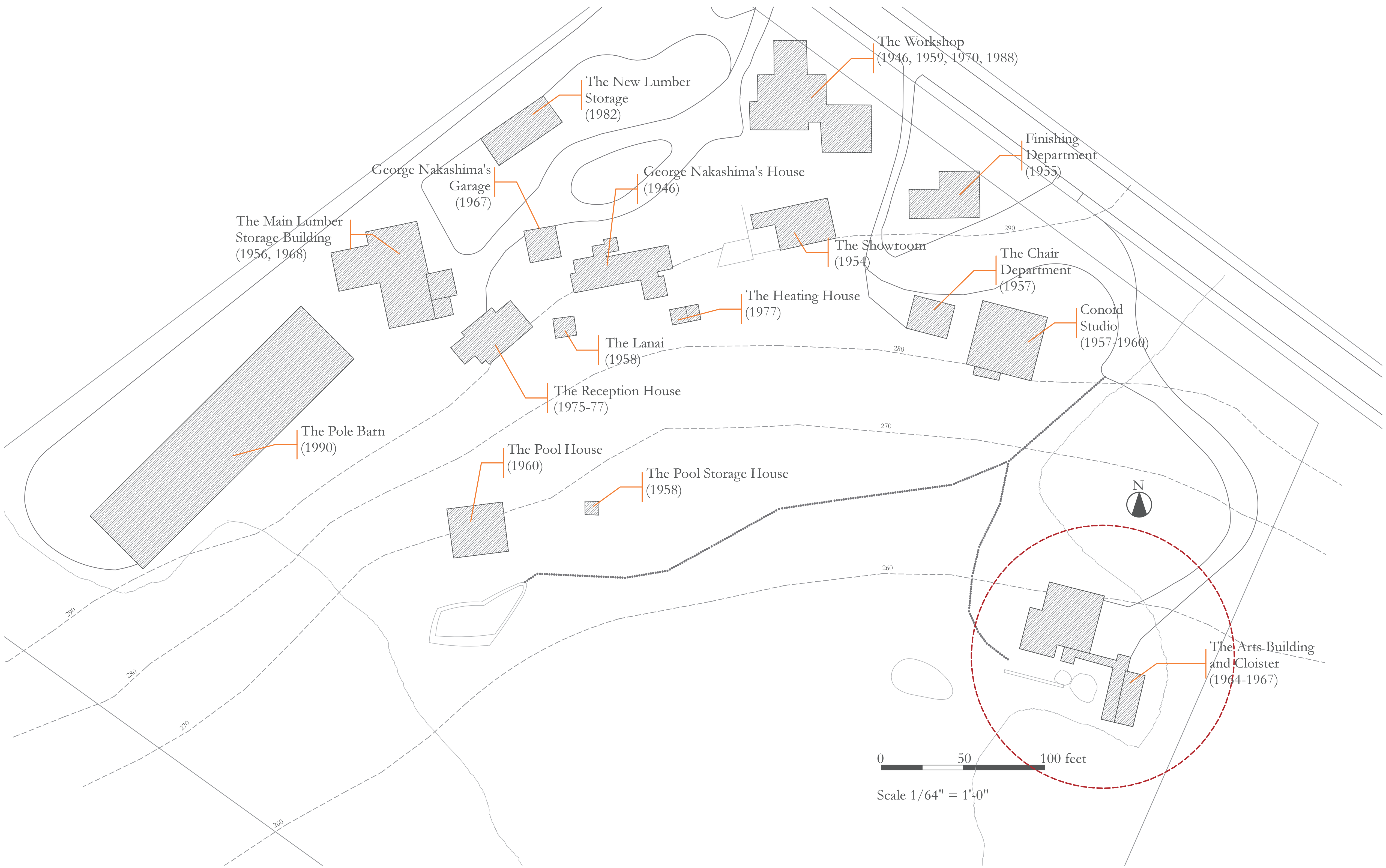
APPENDIX B

Table created by Susan MacDonald, which was published twice. Herein is presented the most complete version published in *APT Bulletin*, Vol. 28, No. 4 (1997), 38

Philosophical/Physical Problem	Cause of Difficulty
Material failure	• Use of new materials with unproven performance records • Use of new materials without knowledge of best practice methods for use • Use of traditional materials in new ways, or in combination with new materials • Poor workmanship and quality control (new materials chosen for reasons of economy)
Detailing failure	• Lack of knowledge for best methods of detailing new materials to ensure long-term survival • Adaptation of traditional materials to new detailing to achieve aesthetic
Outmoded production	• Rapid development of materials and equally rapid supersession of materials • Use of environmentally unfriendly materials now banned • Lack of salvage industry yet established for modern buildings
Maintenance failure	• Naiveté regarding maintenance requirements for new materials and building systems • Failure to implement maintenance recommendations
Patina of age	• Comparative accelerated aging of moderns architecture • Short-term performance of modern materials • Unrecognized nostalgia for aging modern buildings • Material problems for deteriorating modern buildings
Design and functionalism	• Adaptation for new spatial and planning requirements (open plan and glazing expanses) • Upgrading for modern environmental performance requirements (energy conservation)

	• Health and safety requirements • Large scale of some modern buildings
Life span	• "Throwaway architecture", intentionally designed for short lifespan • Poor technical performance of materials and systems • Economic viability • Recording as a valid form of conservation
Cultural circumstances/ position on the time line	• Lack of recognition/appreciation for modern buildings • Poor understanding of twentieth-century architecture (incomplete histories) • Lack of experience • Lack of knowledge of modern materials and their performance over time • Lack of knowledge of repair systems in the longer term • Undeveloped repair methods to meet conservation aims • Availability of resources (expertise, financial and salvage material) • Presence of the original architect (wish to restore and improve)

APPENDIX C. Architectural Drawings



The Arts Building and the Cloister

George Nakashima Woodworker, S.A. 1847 Aquetong Road New Hope, Pennsylvania

Graduate Program in Historic Preservation

School of Design University of Pennsylvania

Thesis advisors:
Frank G. Matero
William Whitaker

Prepared by:
César Bargues Ballester

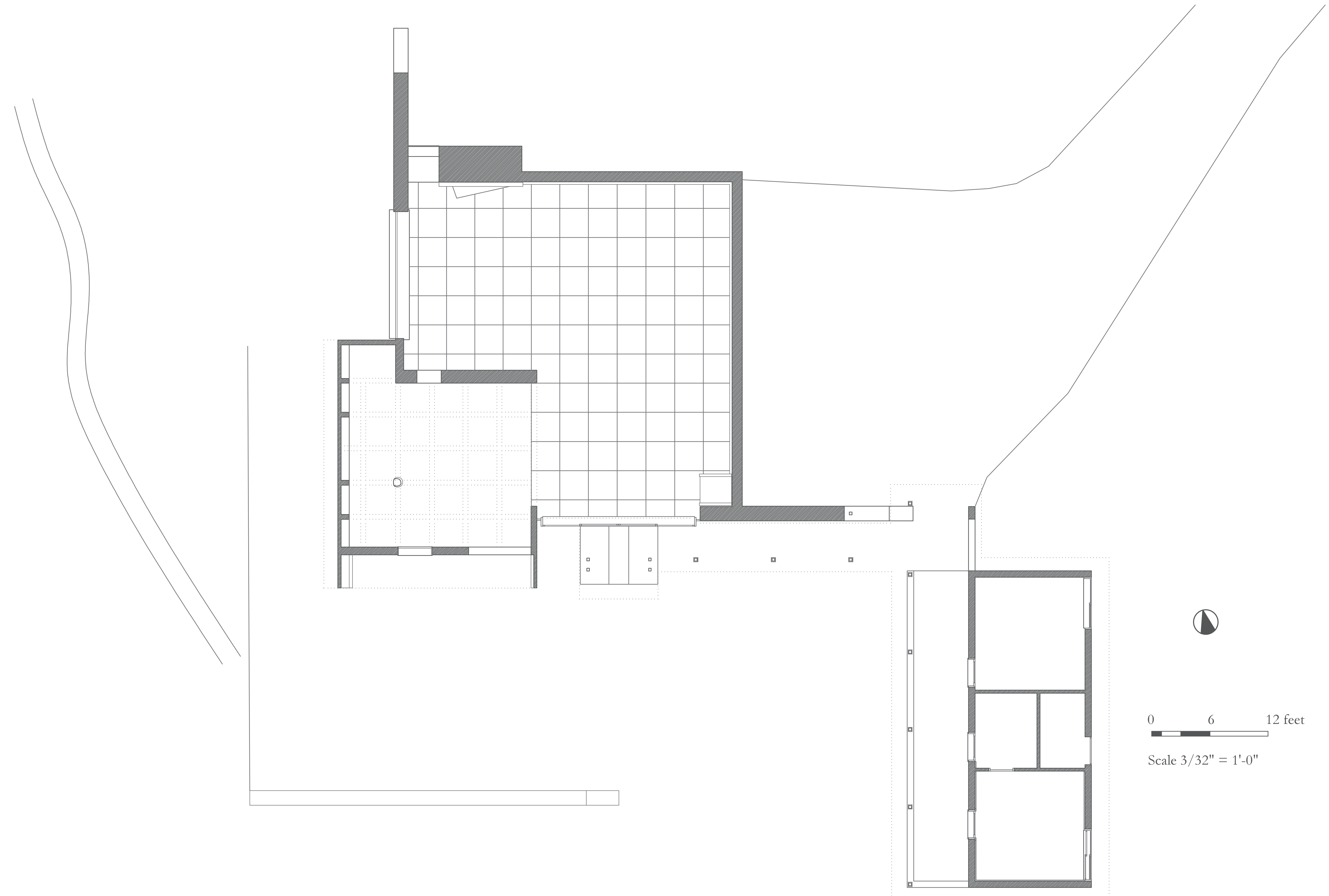
Plan ID

Architectural Drawings

Site Plan

Based on NHL Site Plan

Sheet No.
00



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William Whitaker

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Architectural Drawings

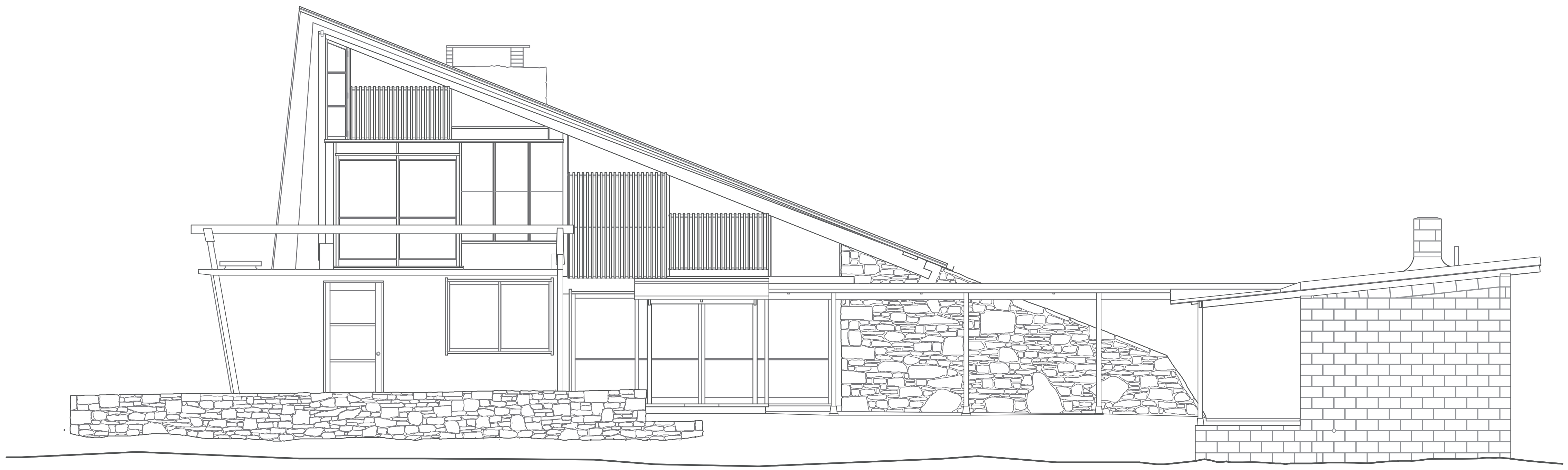
Plan ID

Floorplan

Site recording: Fall 2014

Sheet No.

01



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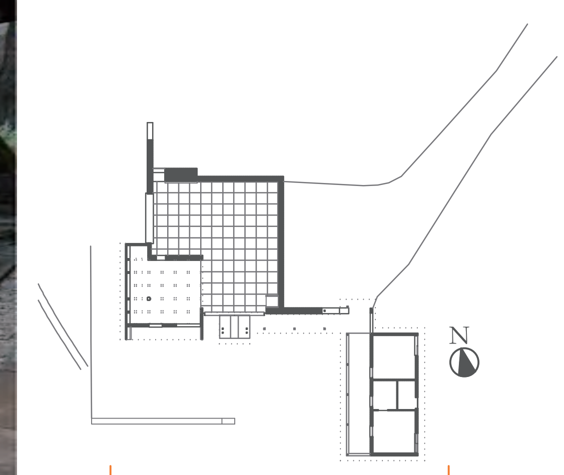

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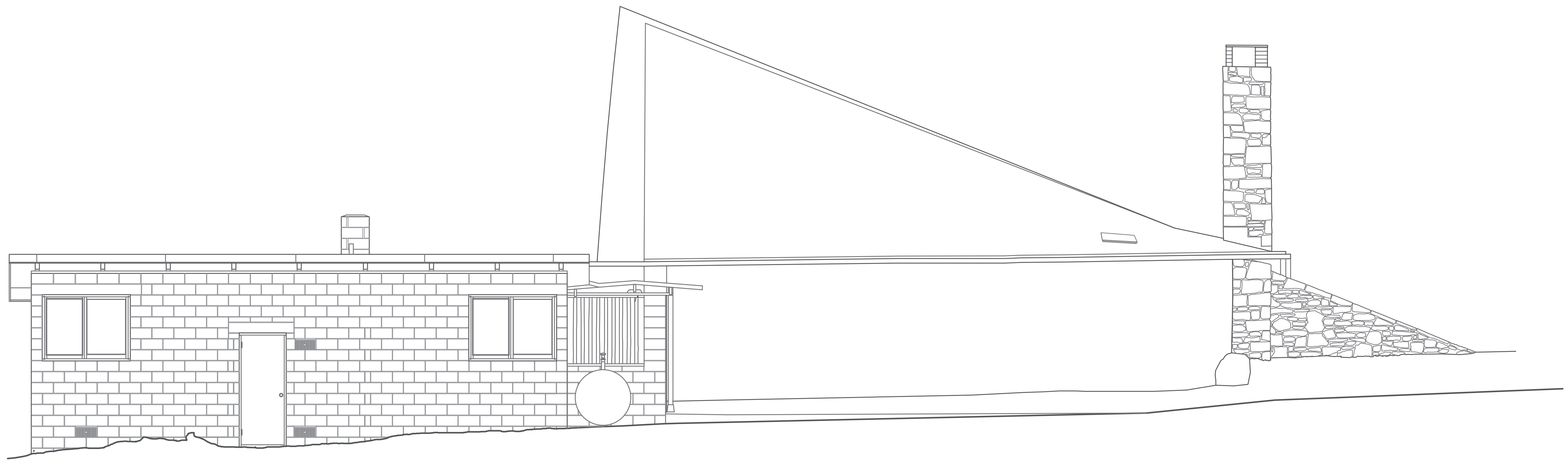
South Elevation

Site recording: Fall 2014

Architectural Drawings

Plan ID

Sheet No. 02



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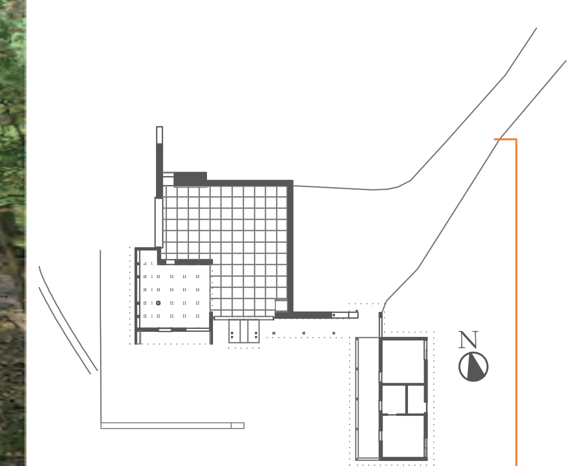

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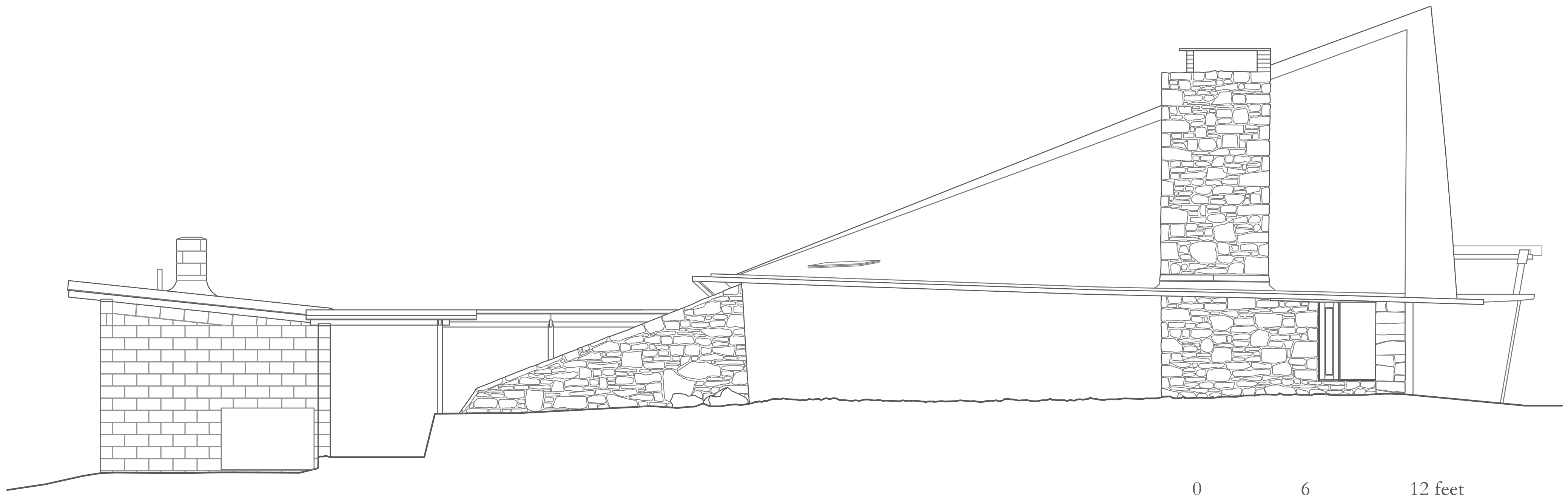
Architectural Drawings

East Elevation

Site recording: Fall 2014

Sheet No.
03



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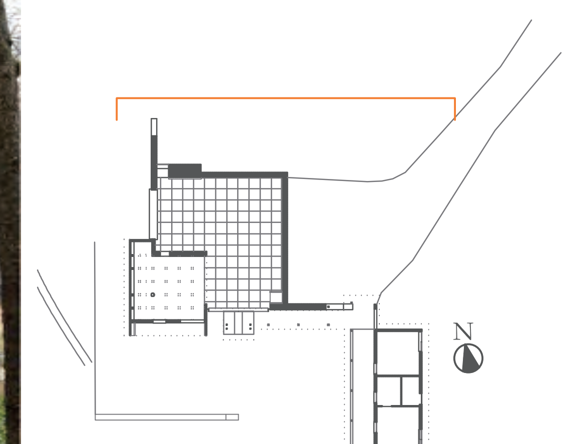

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North Elevation

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Architectural Drawings

Plan ID

Sheet No. 04

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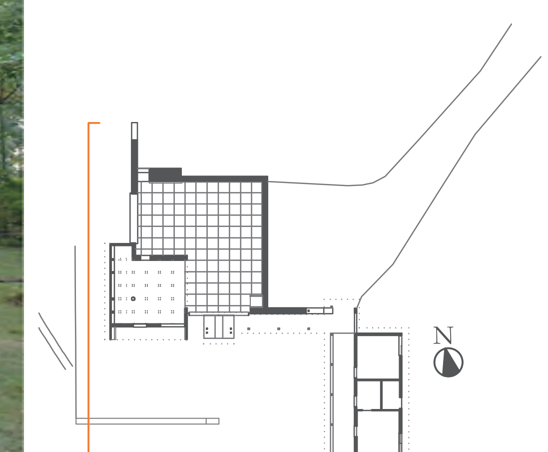
Scale 1/8" = 1'-0"



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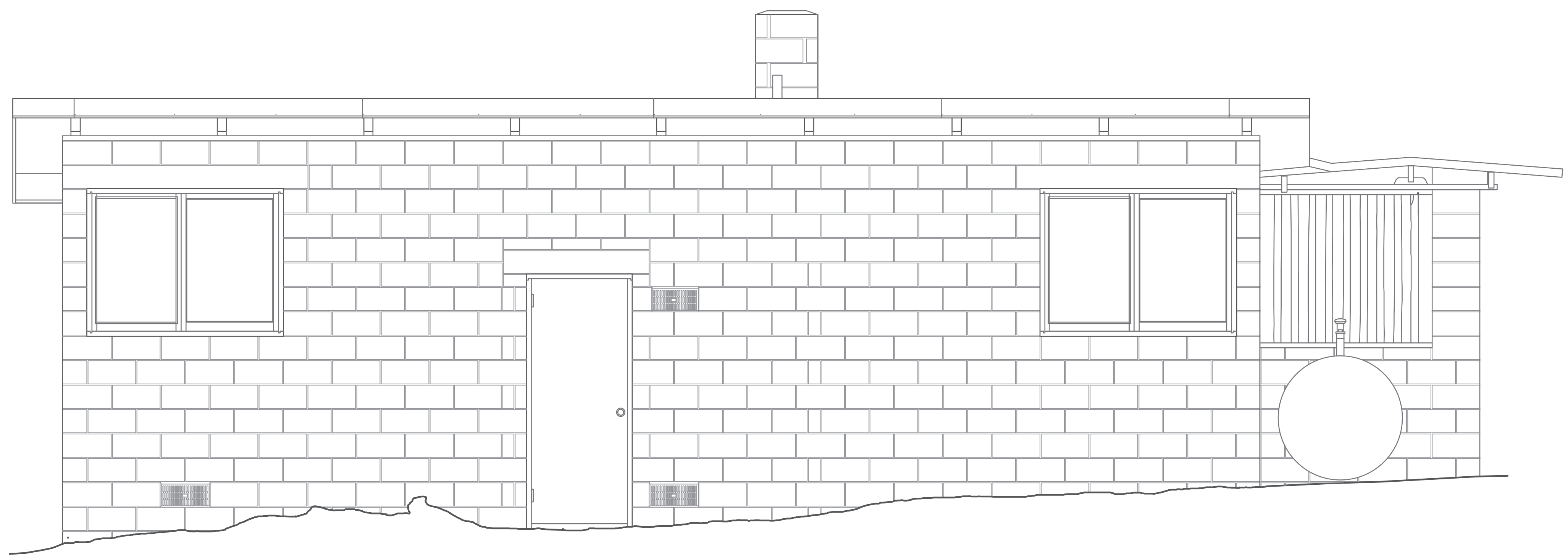
Architectural Drawings

West Elevation

Site recording: Fall 2014

Sheet No.
05



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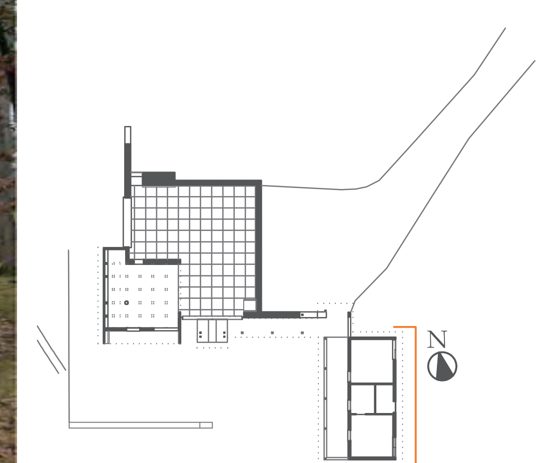

Plan ID

Architectural Drawings

Sheet No. 06

The Cloister - East Elevation

Site recording: Fall 2014

Recorded and prepared by:
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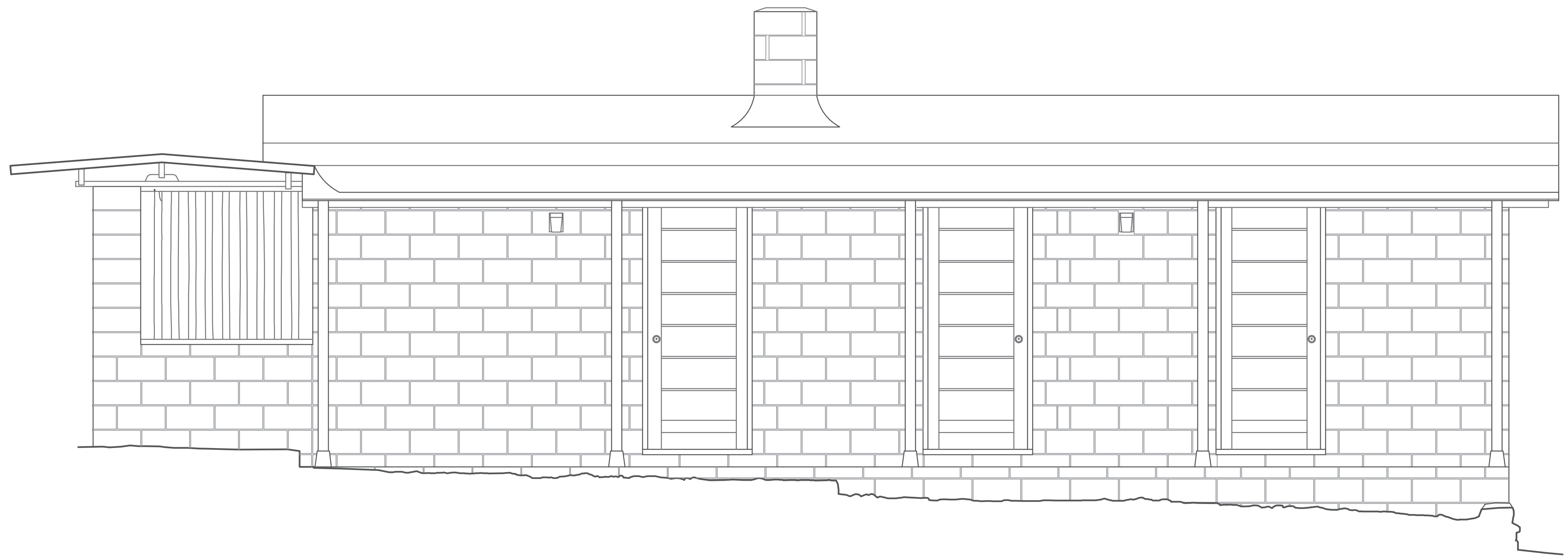

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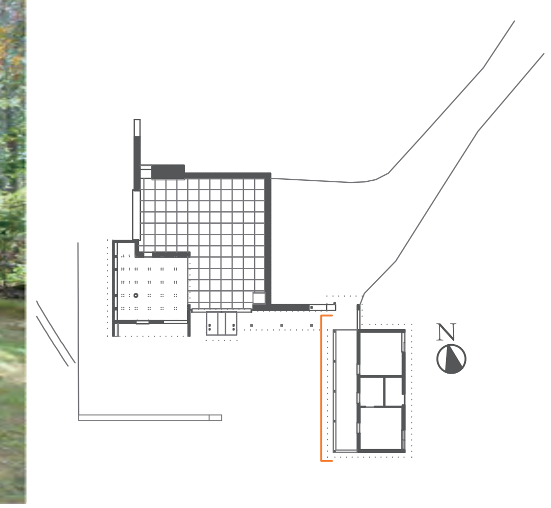

Plan ID

Architectural Drawings

Sheet No. 07

The Cloister - West Elevation

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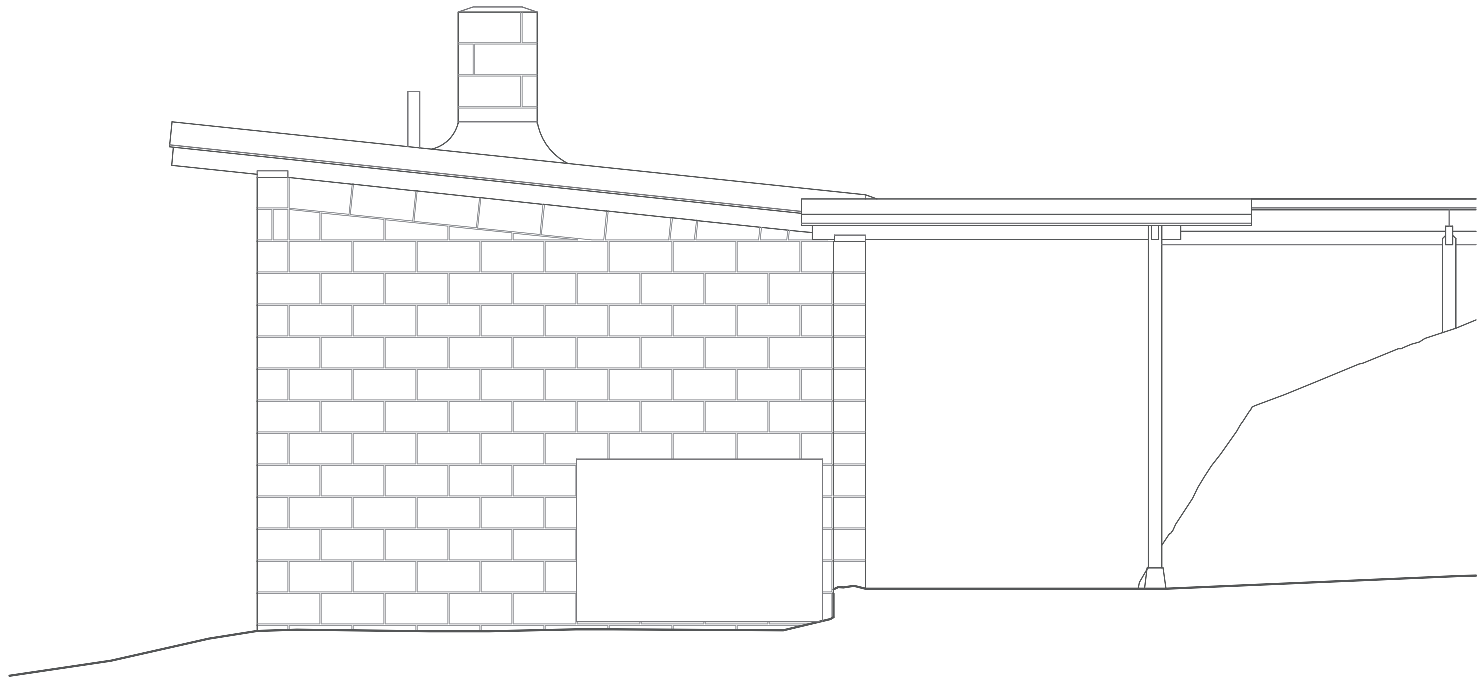

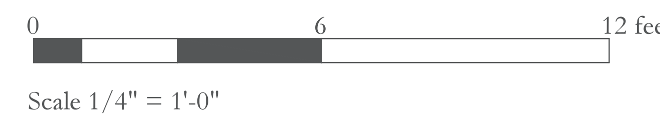

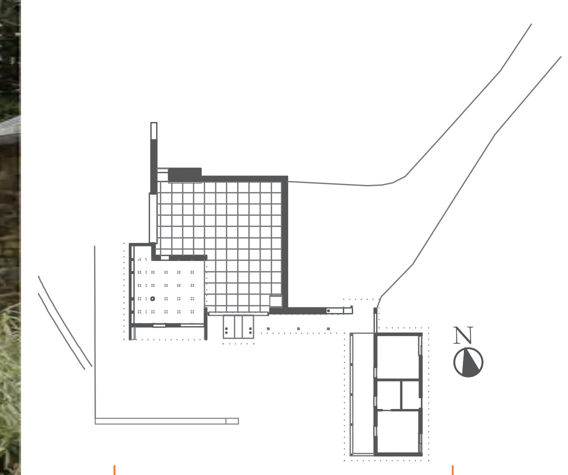

Plan ID

Architectural Drawings

Sheet No. 08

The Cloister - North Elevation

Site recording: Fall 2014

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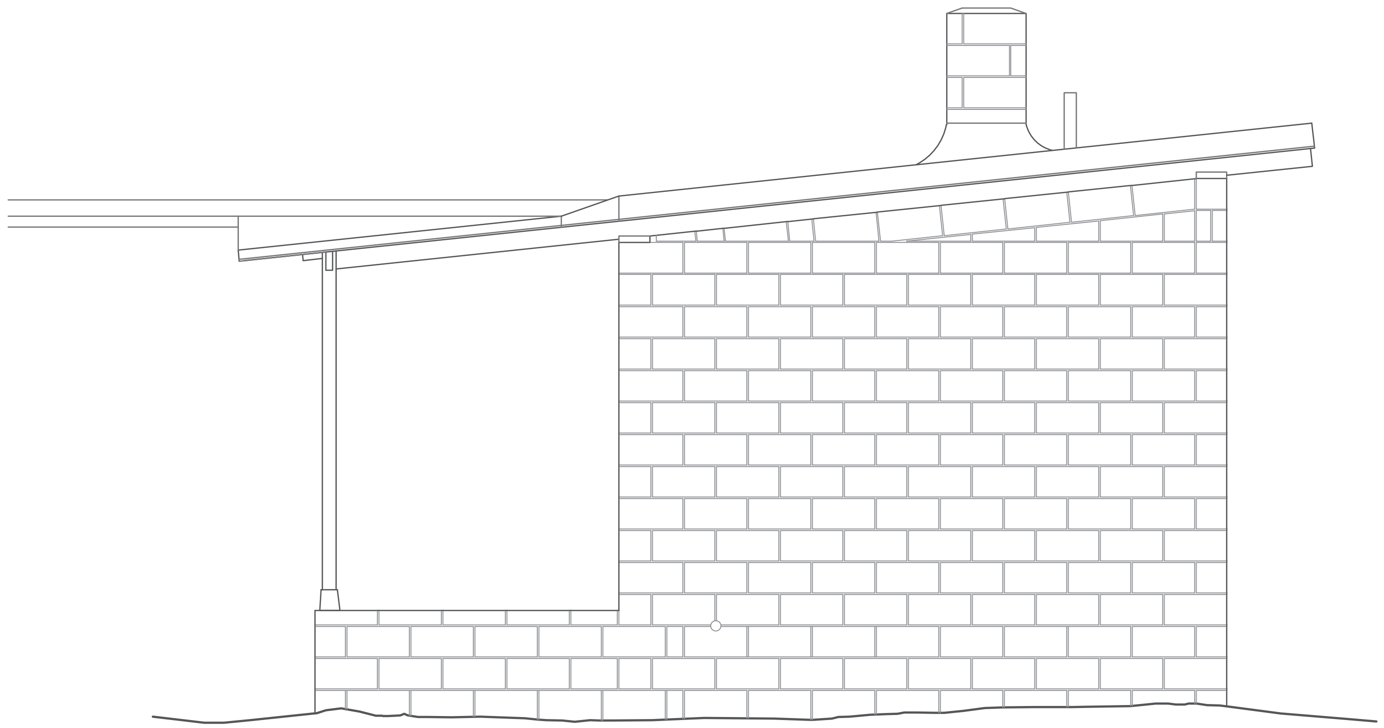

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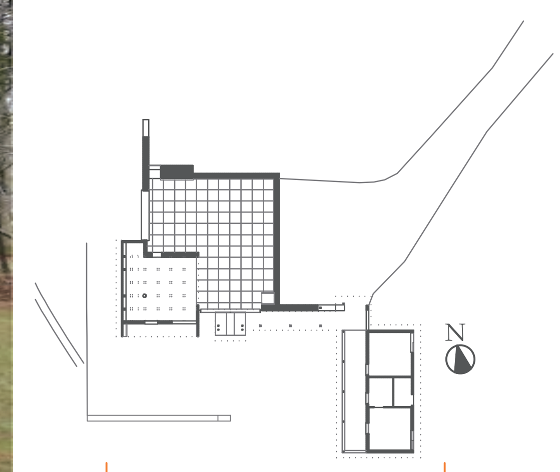

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Architectural Drawings

Sheet No. 09

The Cloister - South Elevation

Site recording: Fall 2014

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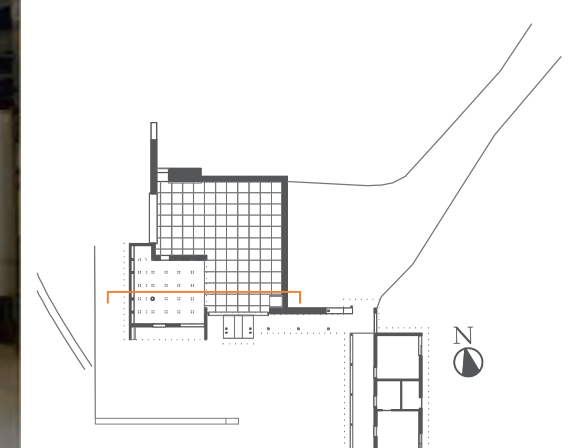

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Architectural Drawings

Sheet No.
10

Interior - Elevation A

Site recording: Fall 2014

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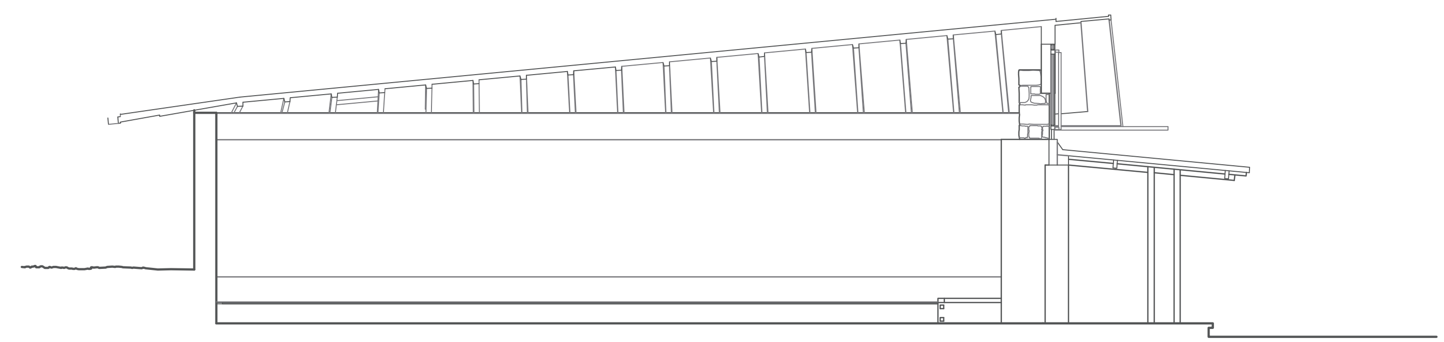

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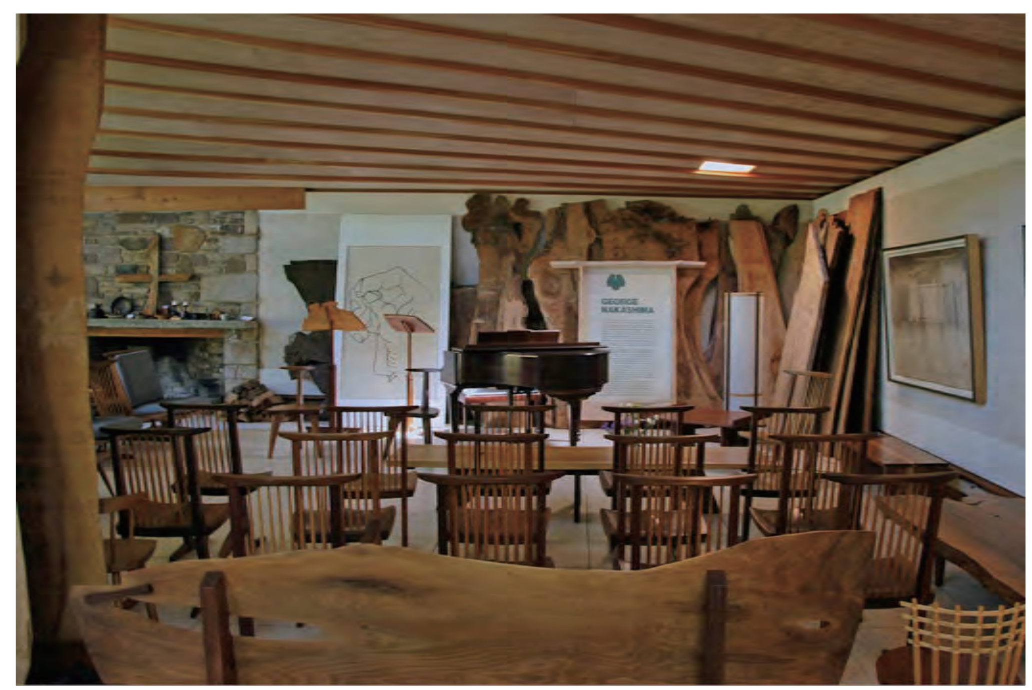

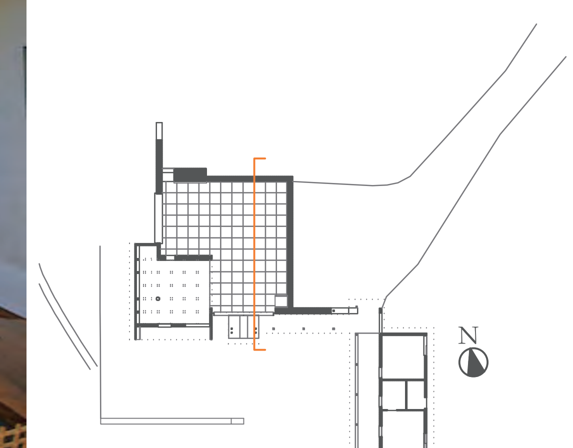

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Architectural Drawings

Interior - Elevation B

Sheet No. 11

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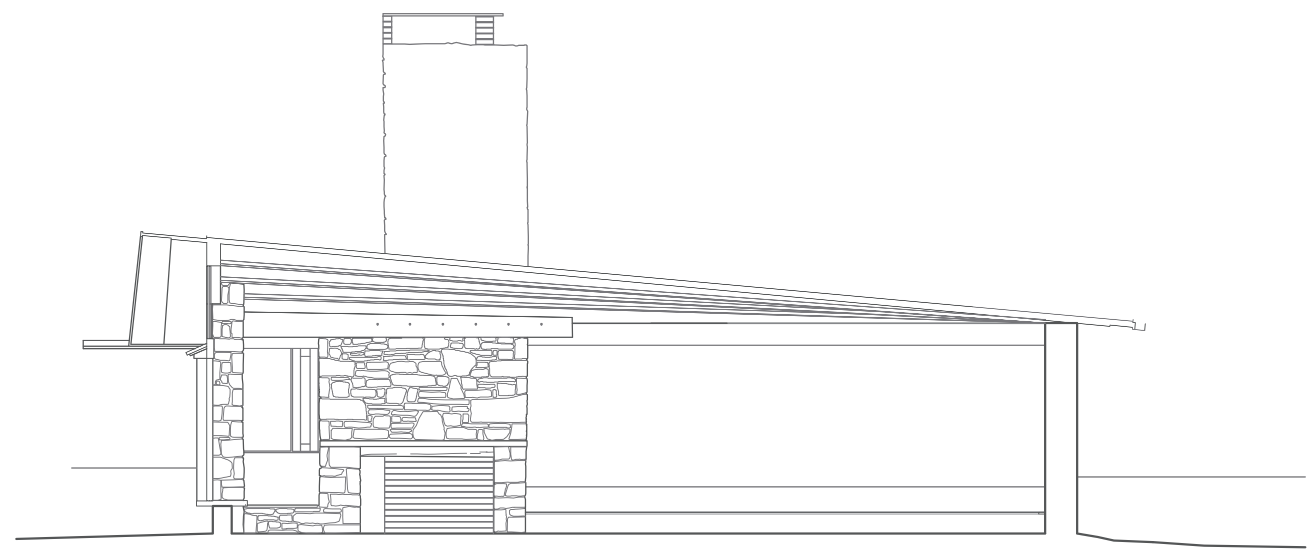

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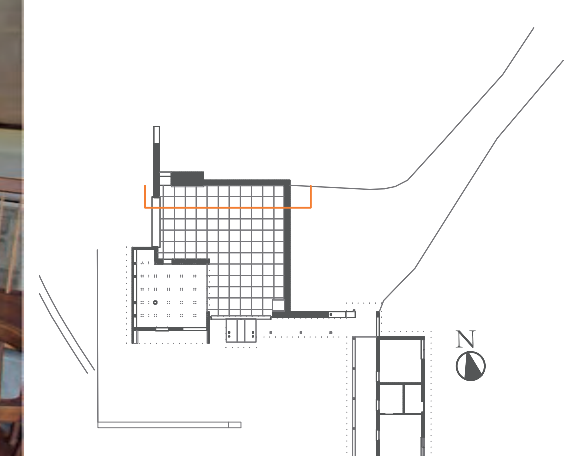

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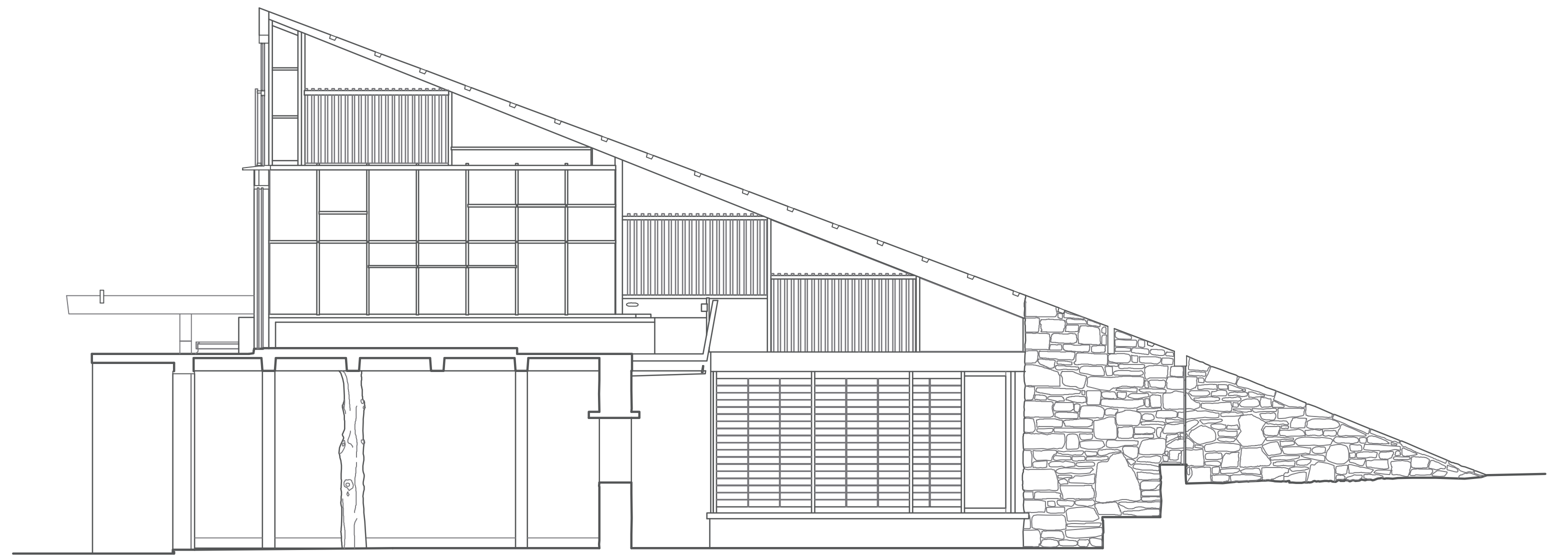
Architectural Drawings

Interior - Elevation C

Site recording: Fall 2014

Sheet No.
12



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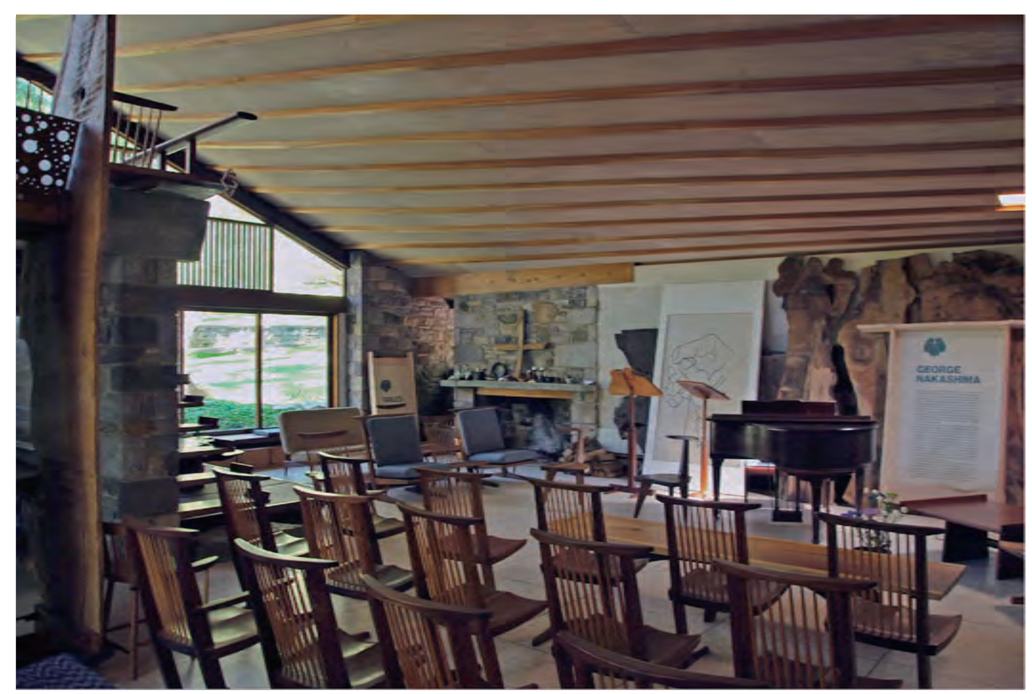

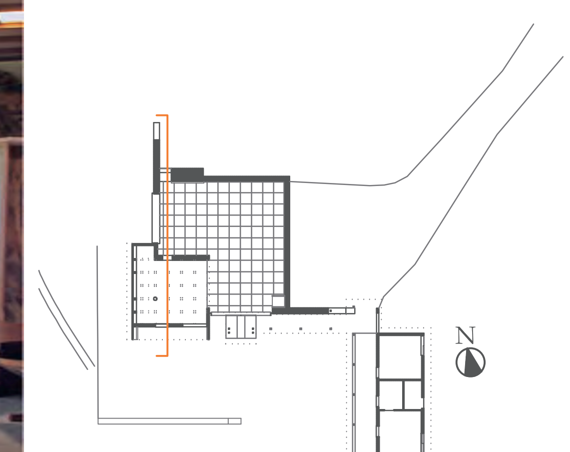

Plan ID

Architectural Drawings

Sheet No. 13

Interior - Elevation D

Site recording: Fall 2014

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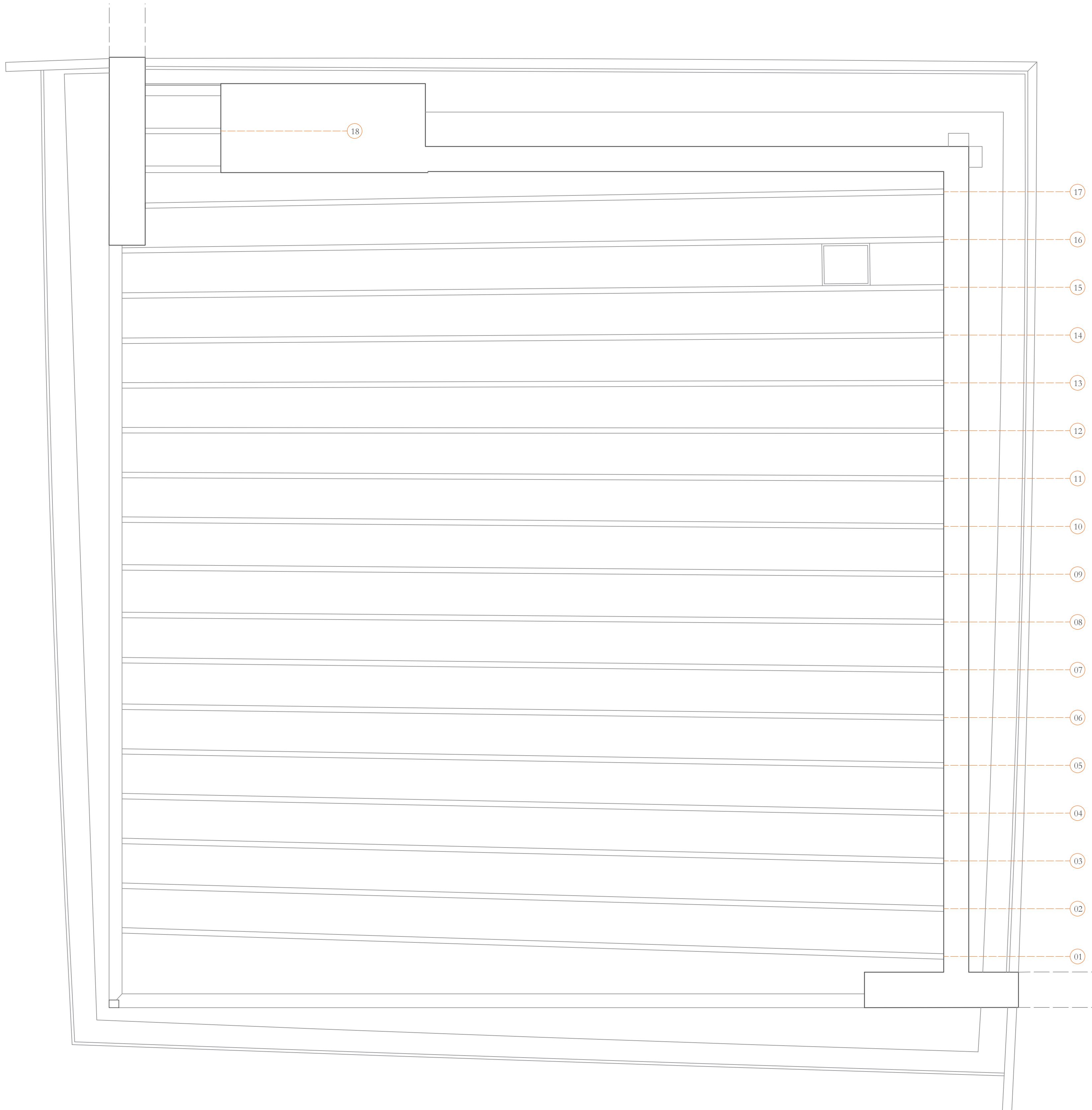

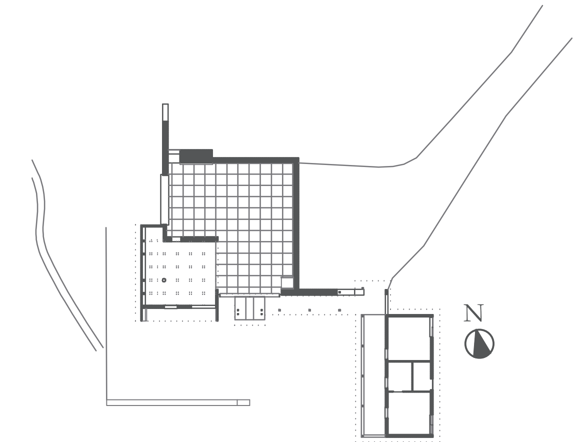

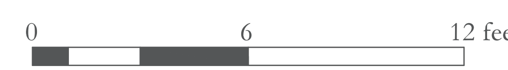

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The Arts Building and the Cloister

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Do not use this drawing for construction purposes.

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William Whitaker

Recorded and prepared by:
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Plan ID

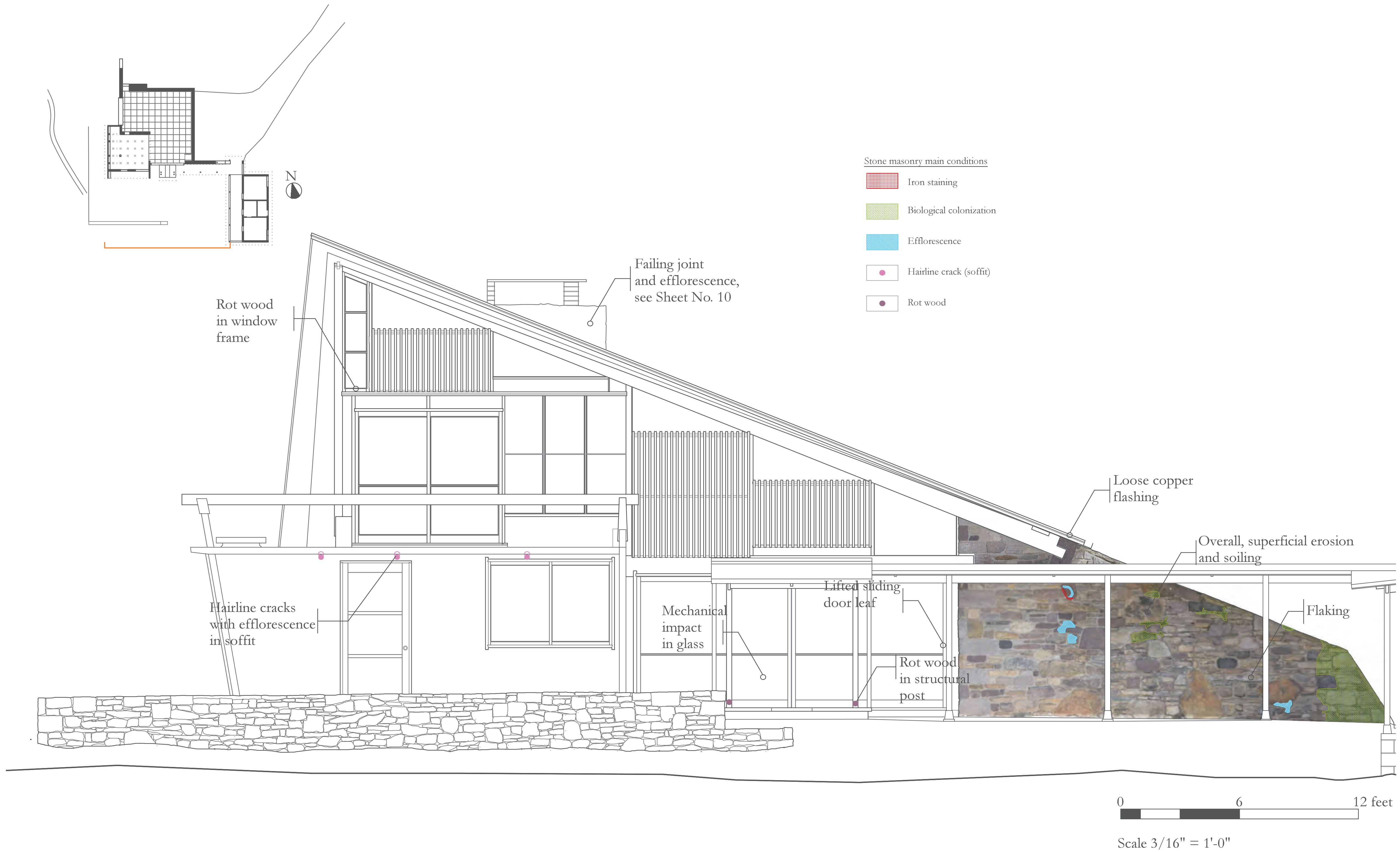
Conditions Assessment

Reflected Ceiling Plan

Site recording: Fall 2014

Sheet No. 14

APPENDIX D. Conditions Survey



Plan ID

Conditions Survey

Sheet No. 01

The Arts Building - South Elevation

Spring 2015

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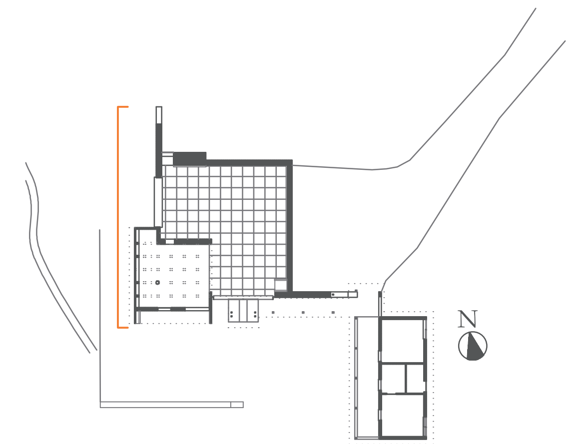

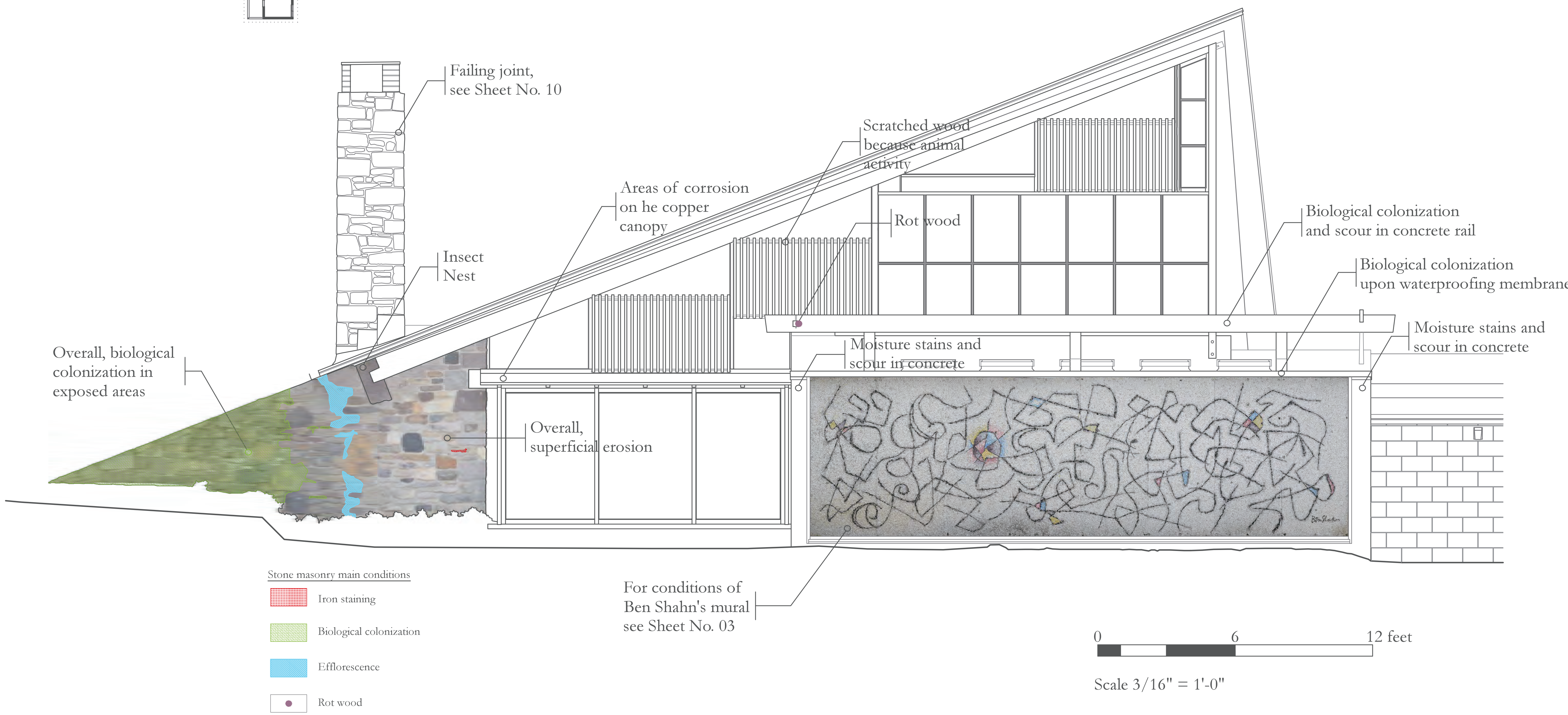

The Arts Building and the Cloister

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Plan ID

Conditions Survey

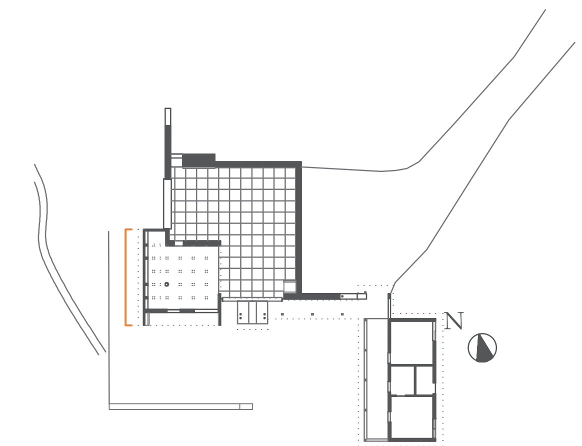
The Arts Building - West Elevation

Spring 2015

Sheet No. 02

Ben Shahn's Mosaic main conditions

- Soiling
- Missing tesserae
- Color alteration



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Scale 1/2" = 1'- 0"

Plan ID

Conditions Survey

Sheet No. 03

Ben Shahn's Mosaic Mural

Spring 2015

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Conditions Survey

Sheet No. 04

The Arts Building - North Elevation

Spring 2015

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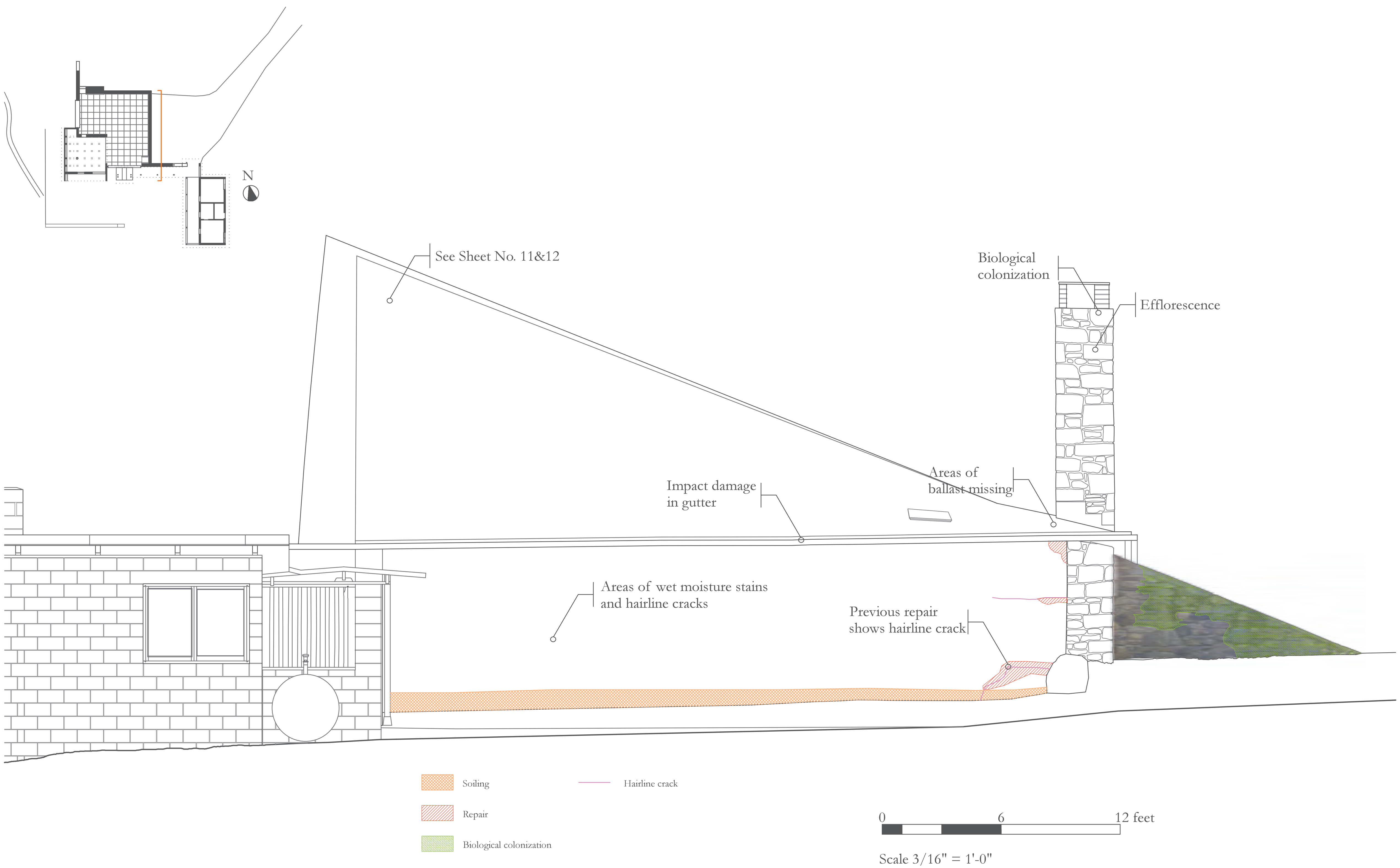

Plan ID

Conditions Survey

Sheet No. 05

The Arts Building - East Elevation

Condition Survey: Spring 2015

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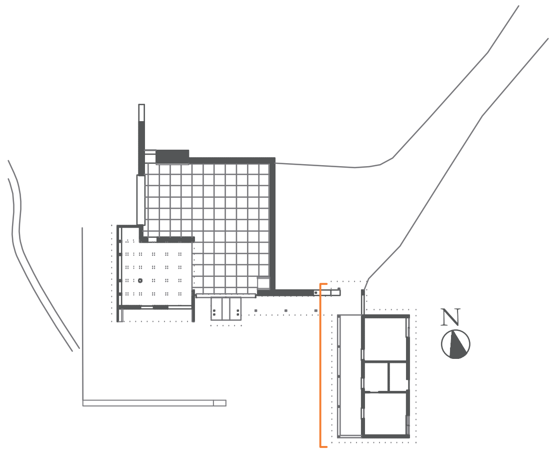
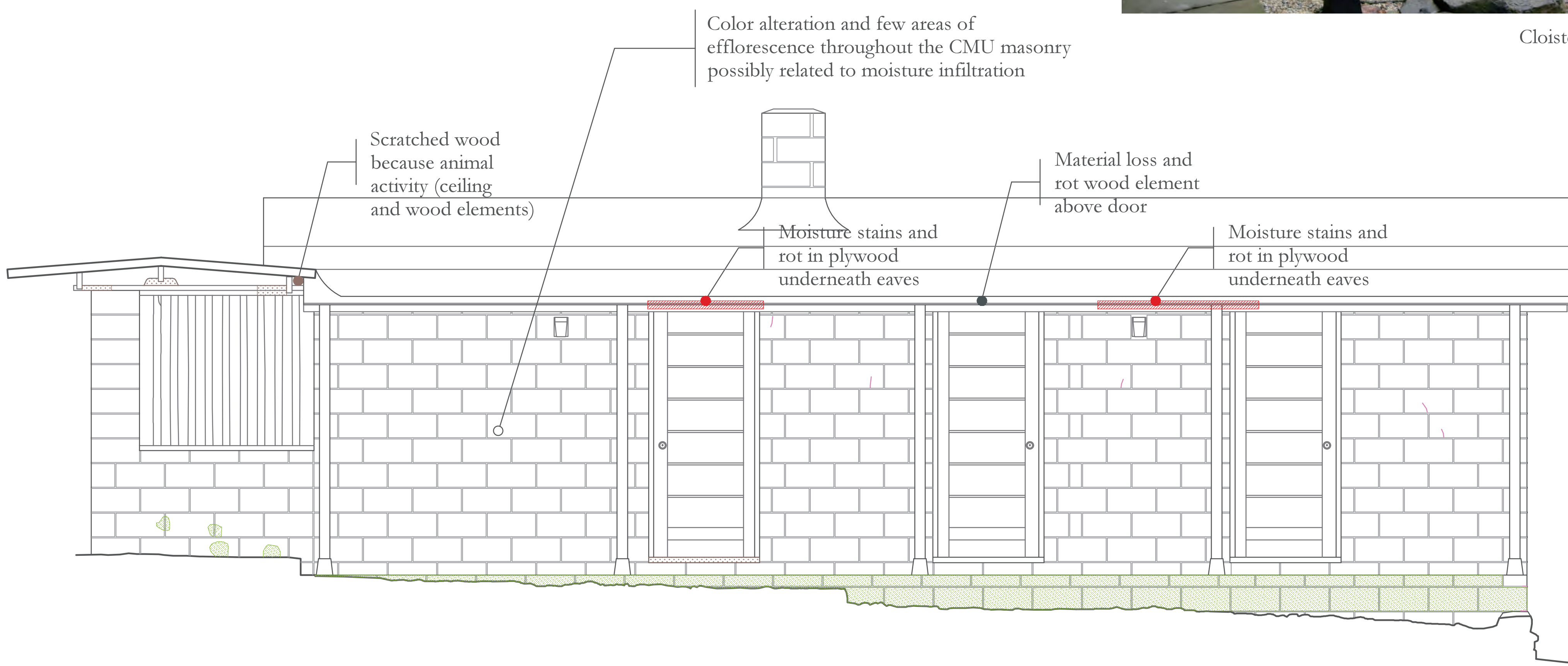


Cloister exterior view from the Arts Building



Scratched wood

Hairline crack

Biological Colonization

0 6 12 feet

Scale 1/4" = 1'-0"

Plan ID

Conditions Survey

Sheet No. 06

Cloister - West Elevation

Spring 2015

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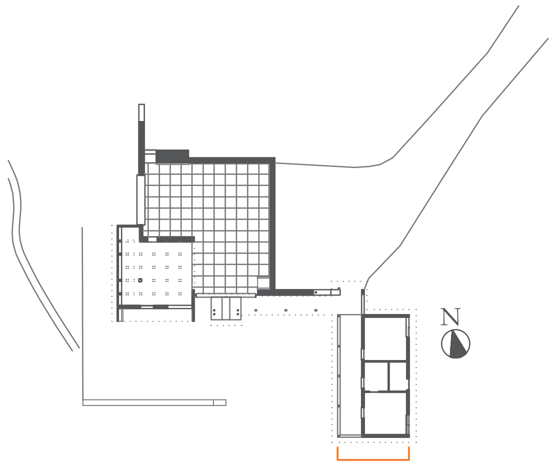
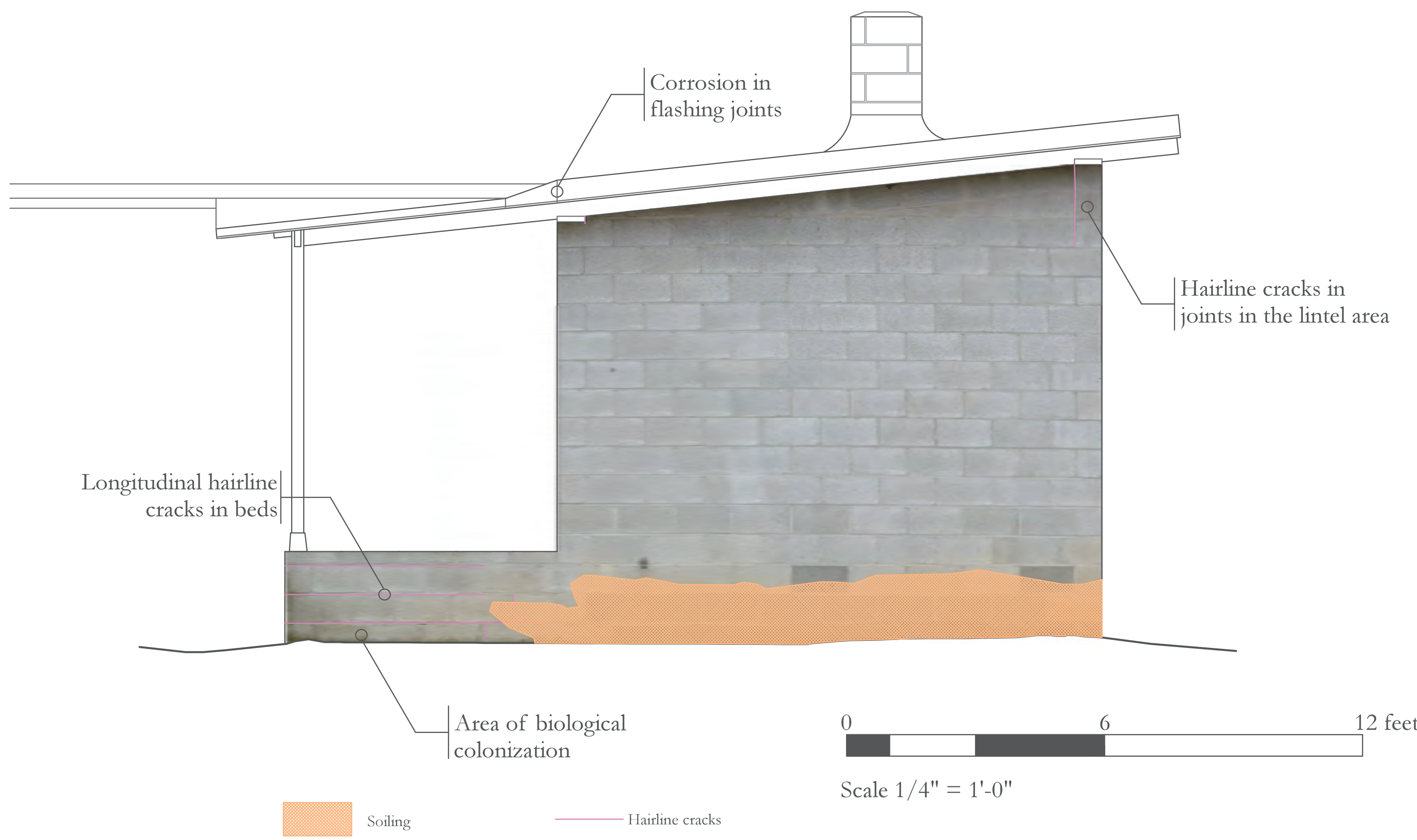


Cloister exterior view from the south



Plan ID

Conditions Survey

Sheet No. 07

The Cloister - South Elevation

Spring 2015

Recorded and prepared by:
César Bargues Ballester

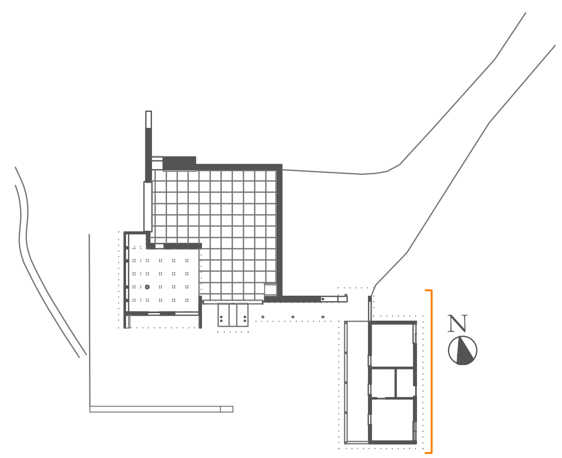
Thesis advisors:
Frank G. Matero
William Whitaker

The Arts Building and the Cloister

George Nakashima Woodworker, S.A. 1847 Aquetong Road New Hope, Pennsylvania

Graduate Program in Historic Preservation

School of Design University of Pennsylvania



Cloister exterior view from the northeast

Soiling

Hairline cracks

Scratched wood

Scale 1/4" = 1'-0"

Plan ID

Conditions Survey

North Masonry Wall

Sheet No. 08

Spring 2015

Recorded and prepared by:
César Bargues Ballester

Thesis advisors:
Frank G. Matero
William Whitaker

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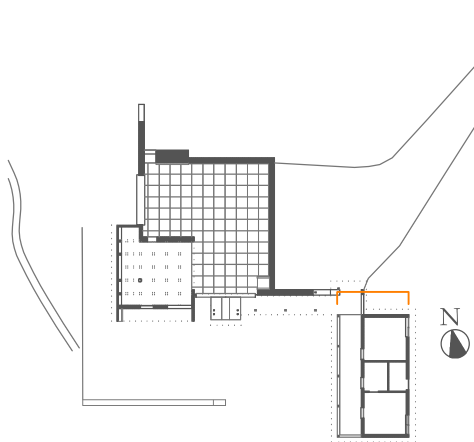
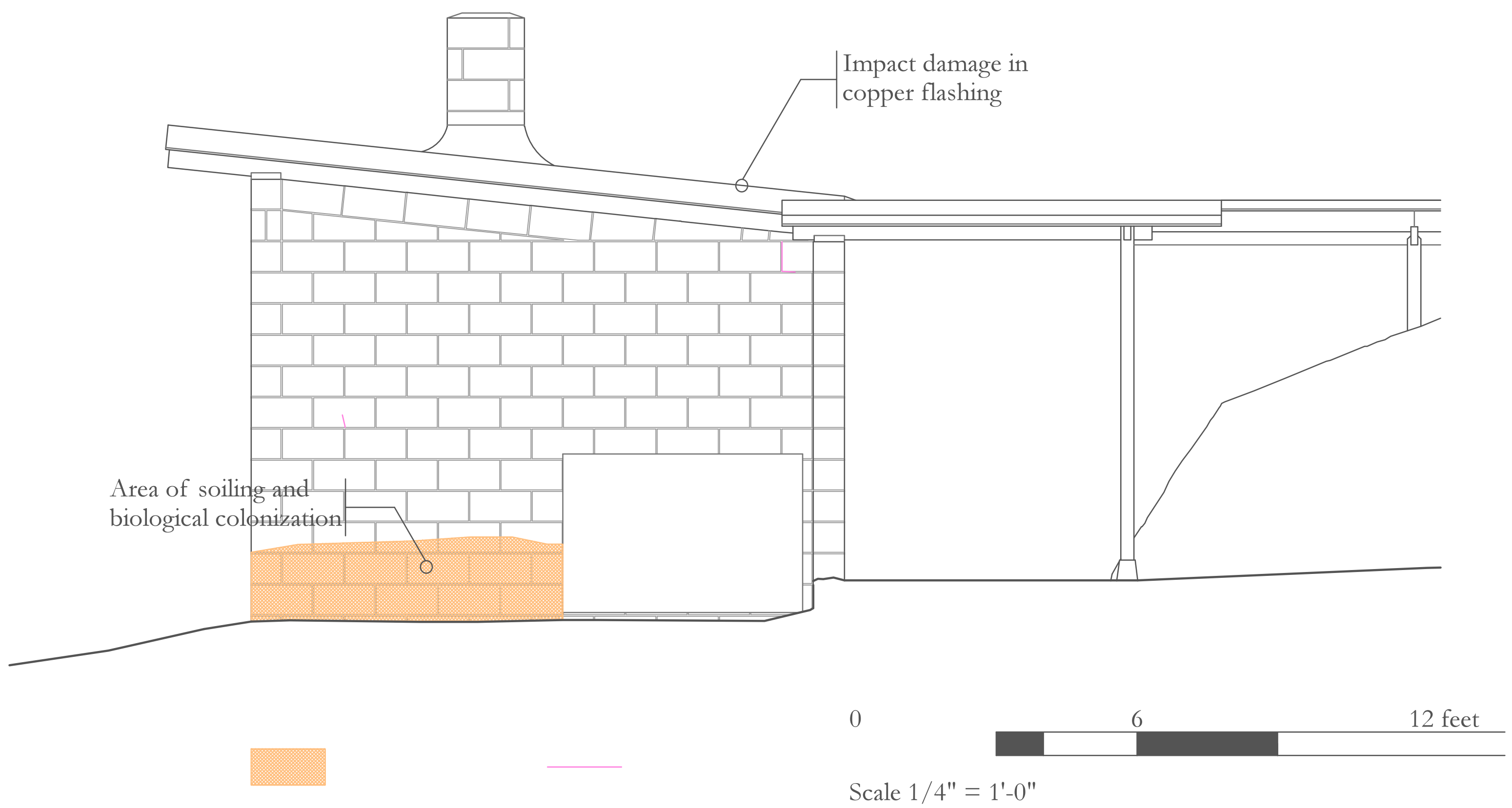


Cloister exterior view from the northeast



Plan ID

Conditions Survey

Sheet No.
09

North Masonry Wall

Spring 2015

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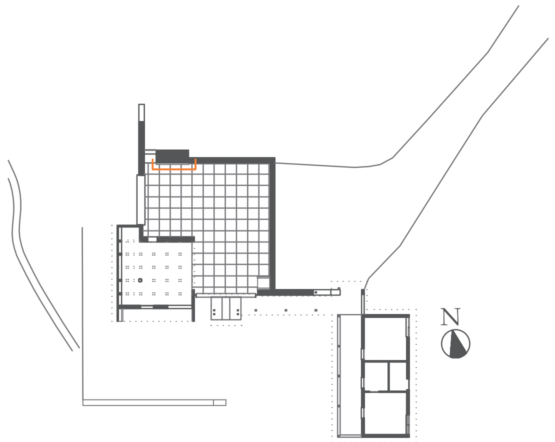
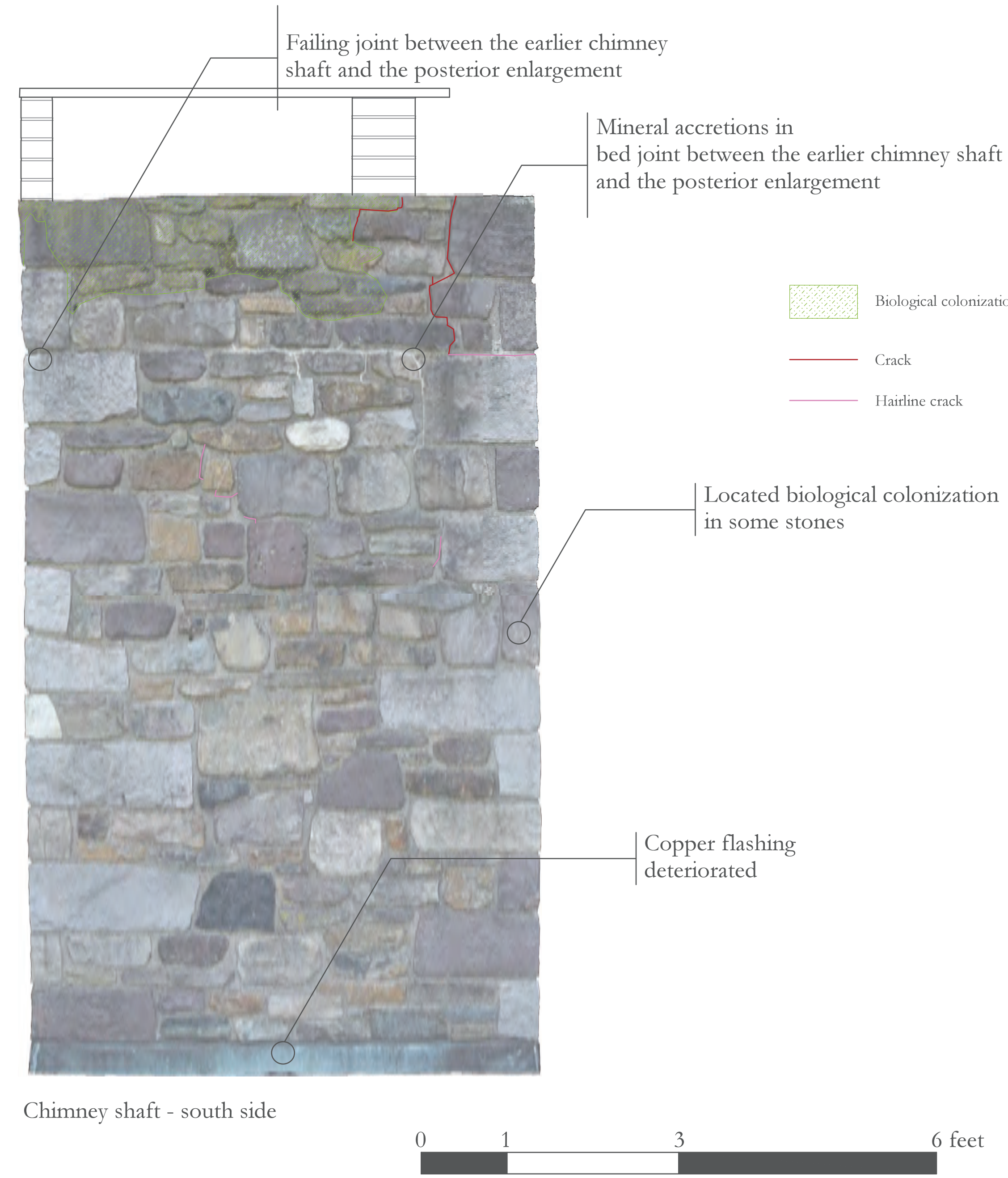


Left corner, closer view of deteriorated bed joint

Right corner, closer view of deteriorated bed joint, mineral accretions, and cracks



Chimney shaft - south side

Scale 1/2" = 1'- 0"

The Arts Building and the Cloister

George Nakashima Woodworker, S.A. 1847 Aquetong Road New Hope, Pennsylvania

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School of Design University of Pennsylvania

Thesis advisors:
Frank G. Matero
William Whitaker

Recorded and prepared by:
César Bargues Ballester

The Arts Building - Chimney

Condition Survey: Spring 2015

Plan ID

Conditions Survey

Sheet No.
10

Overall good condition of asphalt lining under ballast (removed on July 2015 for repairing active leak)

Deteriorated copper flashing in the chimney shaft base

Closer view of the upper section

Plan ID

Conditions Survey

Sheet No. 11

The Arts Building Roof

Spring 2015

Do not use this drawing for construction purposes.

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Thesis advisors:
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The Arts Building and the Cloister

George Nakashima Woodworker, S.A.
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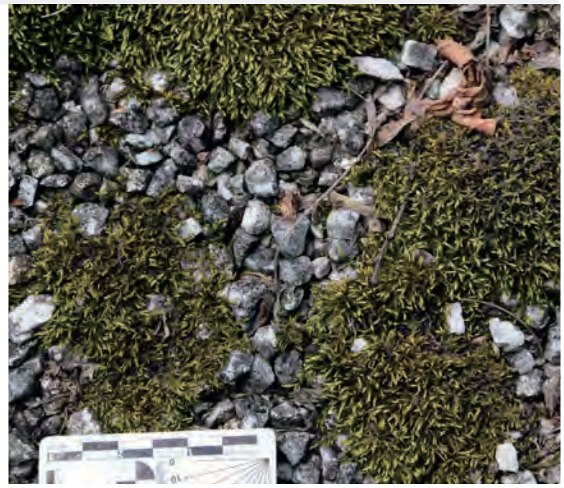
APPENDIX E. Conditions Glossary

Conditions

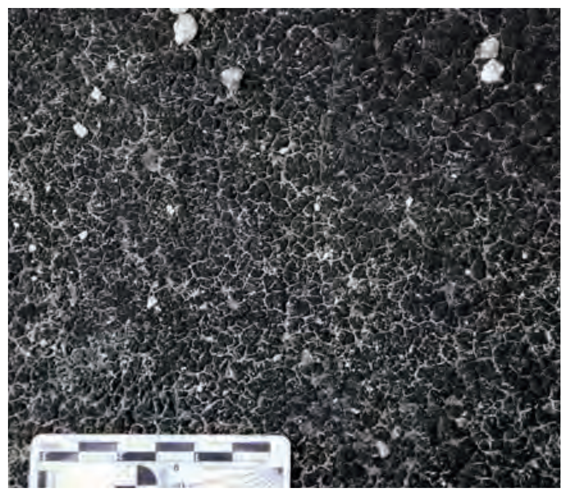
Biological Colonization

Presence of mosses, lichens, and related plants on the roof slope contributing to moisture retention.



Asphalt Cracking

Asphalt exposed layer is cracked due to weathering which results in loss of elasticity.



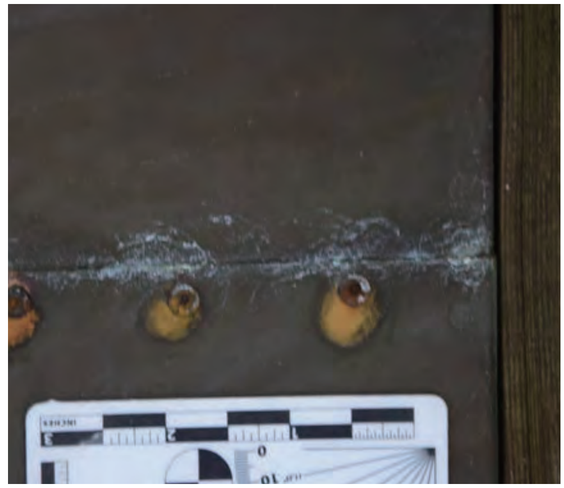
Clogged gutters

Presence of marble chips and leaves accumulated in the base of gutters contributing to poor drainage and water overflow.

Roofing system

Conditions

Corrosion

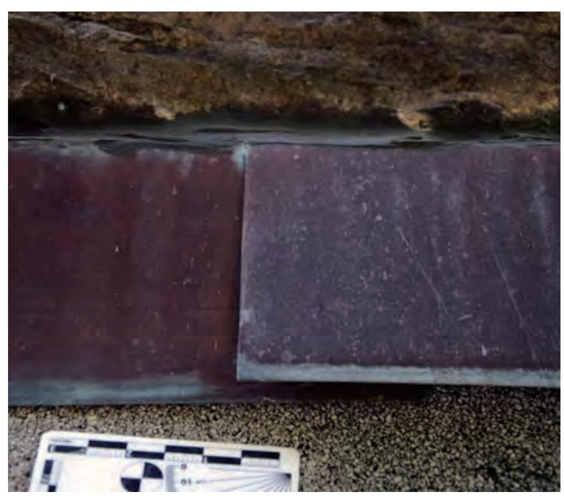


Greenish-blue corrosion occurs in the flashing joints due to water retentionand redox reactions.

Impact Damage

Bent sections of copper due to mechanical impact of fallen branches.

Open Flashing



Sections of copper sheets are out of plane because of lack of adhesion or insufficient adhesion.

Roofing system

Conditions

Active Leak

Moisture stains and wet surface from water seepage through the roofing system.

Plywood Deformation

Plywood board is bent and not flush with the contiguous boards.

Plywood Checking

Multiple hairline cracks or slightly open parallel splits of different length.

Conditions

Rib Crack

Single crack visible in rib joint.

Rib checks.

Checks limited to the lower middle section of the rib.

Moisture Stain

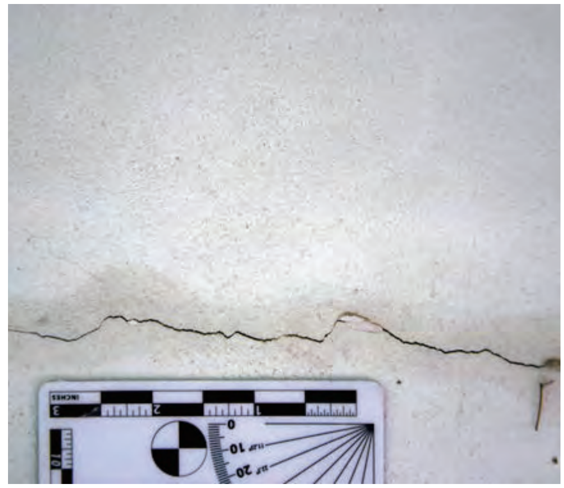
Color alteration in the ribs because of historic exposure to moisture.

Rendered Concrete Block Masonry Wall

Conditions

Crack

Cracks of variable lenght with a width between 1/32 and 1/16 inch, primarily longitudinal along the bedding joint.



Hairline Crack

Cracks in the stucco surface having widths so small as to be barely perceptible. Orientation may vary and they can intersect other cracks forming a pattern.

Mineral Accretion

Salts transported by water has evaporate and crystallized on the stucco surfaces forming mineral deposits in association with a reddish bronw stain.

Rendered Concrete Block Masonry Wall

Conditions

Soiling

Water splash deposited soil particles upon the rendered surfaces creating a thin brown film disrupting the aesthetics qualities of the white stucco.

Superficial Erosion

Increased surface roughness due to moisture infiltration and salt crystallization. Surfaces constrast with the smoother sourrounding surfaces.

Previous Repair

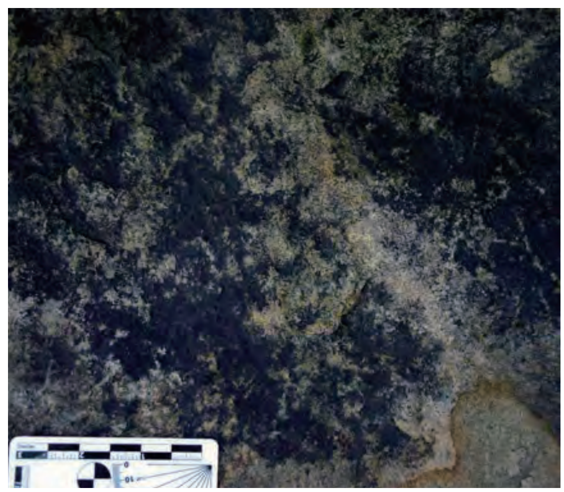
Repair of eroded and cracked surfaces with a white cementitious material that shows a coarse-grain texture.

Efflorescence

Generally whitish, powdery salts crystallized on the surface. Efflorescences are generally poorly cohesive and commonly soluble salt. This condition has been observed in the exterior and interior walls.

Soiling

Deposit of a very thin layer of particles giving a dirty appearance to the stone surface. It may be a direct effect of earlier biological colonization with algae.

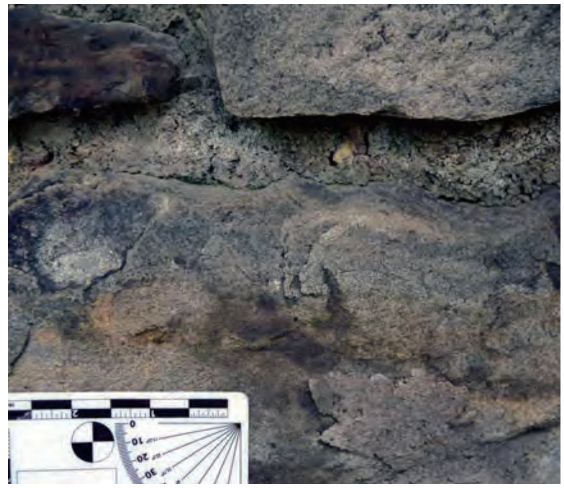


Insect Nest

Mud dauber wasps have constructed their nest on the stone surface. Nests are also localized on other substrates in the other areas of the building.

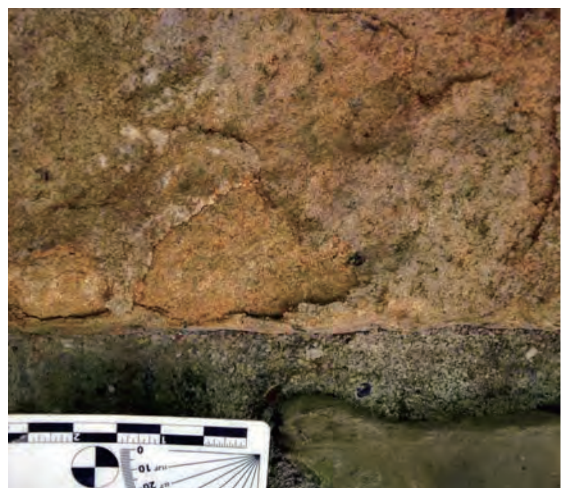
Flaking

Scaling in thin flat or curved scales. The detachment is located near to the stone surface.



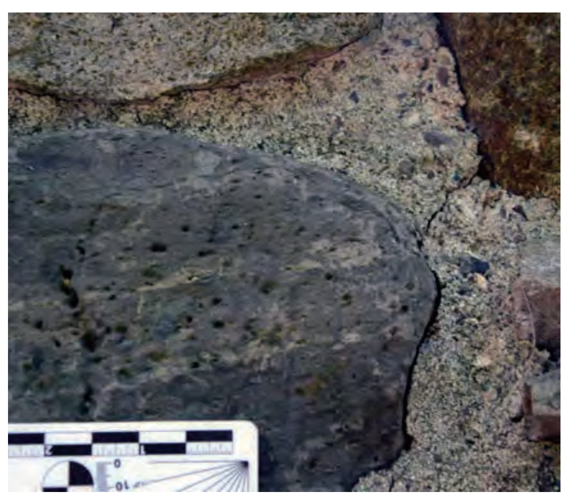
Blistering

Surface erupts into blisters and crumbles away leading to a loss of stone surface.



Hairline cracks

Thin cracks between mortar joints and stone units.



Biological Colonization

Presence of mosses, lichens, and related plants on stone masonry.

Hairline Crack

Cracks in the concrete elements having widths so small as to be barely perceptible. Hairline cracks show a variety of direction and can be accompanied by efflorescence or rust staining.

Rust Staining

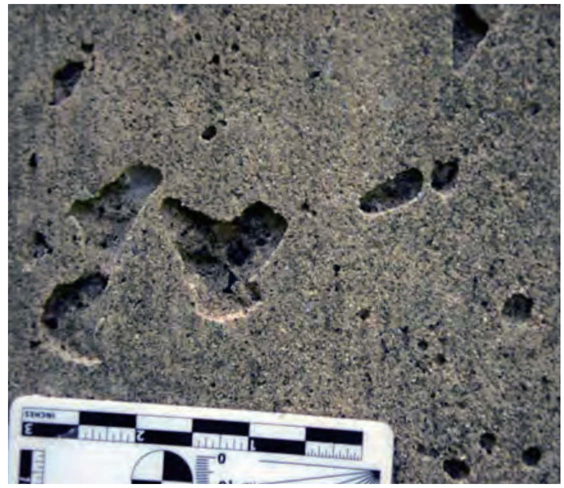
Rust brownish red stains in a limited area of the concrete surface as a consequence of moisture intrusion and rebar corrosion.

Honeycombing

Voids left in concrete due to poor mixing of the aggreagate and vibration during the placing process.

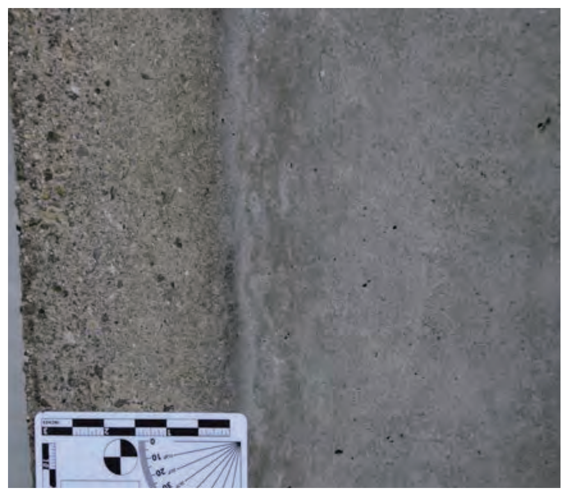
Bugholes

Small regular or irregular cavities as a result of entrapped bubbles during the placing process. Overall, they do not exceed 5/8 inch in diameter.



Scour

Overall rough surfaces due to exposure to rainwater, which has dissolved the outer layer of the cement paste leaving the aggregate particles exposed.

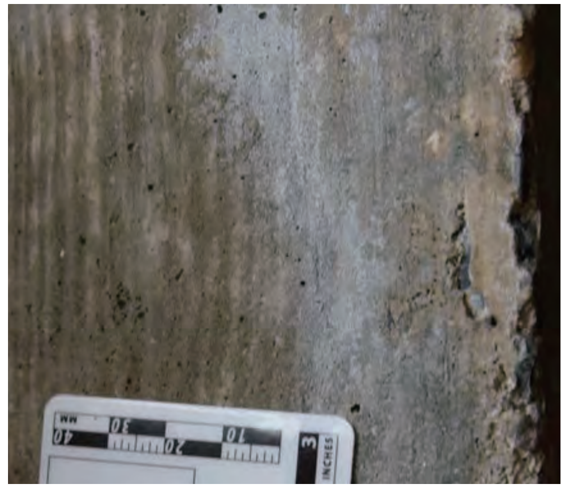


Moisture Stains

Discoloration of the concrete surface as a consquence of temporary wetting episodes.

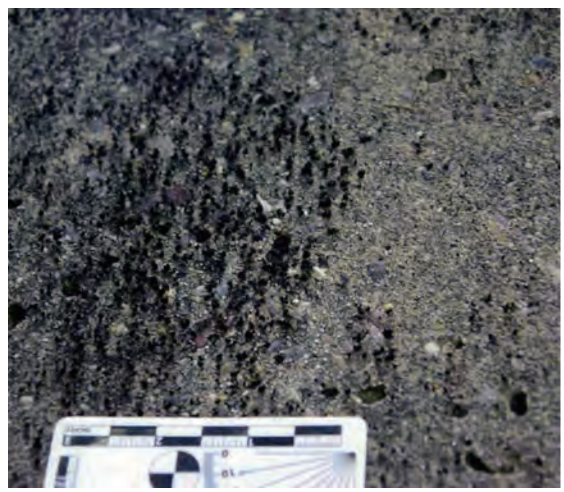
Efflorescence

A whitish deposit of salts crystallized on the concrete surface precipitated by carbonation or evaporation.



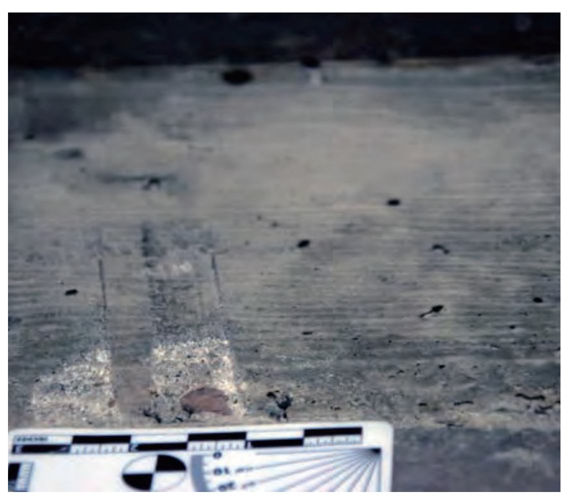
Biological Colonization

Presence of algae covering surfaces exposed to permanent moisture or regular wetting episodes.



Impact Damage

Mechanical damage on the outer surface of the concrete.



Ferrous materials

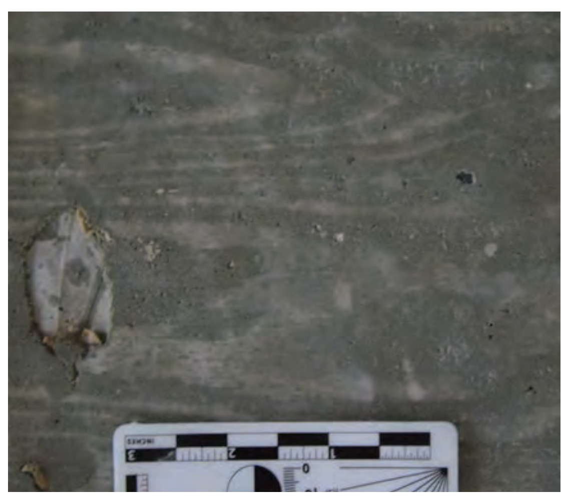
Installation of metallic elements by insertion in a concrete element.

Scratches

Mechanical damage to the outer surfaces of the concrete thus damaging the fragile woodprint pattern.

Entrapped Elements

Leaves and formwork wood chips entrapped in the concrete during the placing process.



Wood elements

Conditions

Rot

Areas of wood, showing color alteration, that have been attacked by fungus. These areas are soft and easily penetrable with an awl.

Checking

Longitudinal openings extending along the length of the wood member facitilitating moisture infiltration. Structural stability appears not to be comprosised though.

Moisture Stains

Uneven color alteration because of wetting episodes. Wood may be wet or dry.

Wood elements

Conditions

Natural Weathering

Wood surfaces showing the symptoms of slow degradation from a combination of natural factors: sunlight, moisture, temperature, chemicals, suspended particles carried by wind, and biological agents.

Animal Abrasion

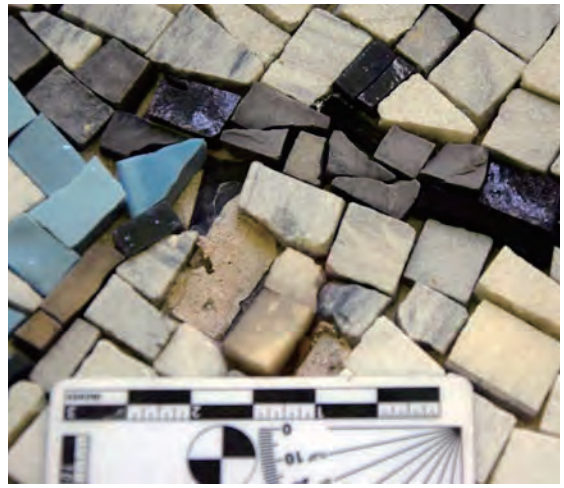
Damages from animal activity, probably squirrels.

Previous repair

Holes perforated by woodpeckers repaired with the use of a brown epoxy resin.

Missing Tessera

Single or multiple tesserae have detached because of lack of adhesion between the tesserae and the substrate.



Granular Disintegration

Eroded and detached surface of tesserae.

Color Alteration

Discoloration due to the use of epoxy resin to adhere the tesserae and hide the screw heads fastening the mosaic to a wood substructure.

Mosaic

Conditions

Detachment

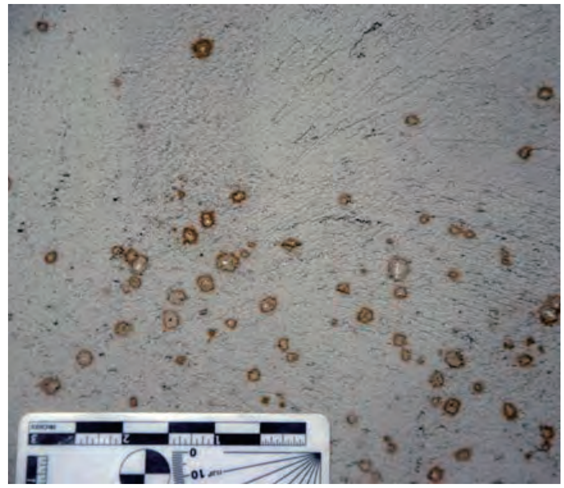
Adhesion failure causing individual tessera loss.

Biological Colonization

Microflora and soiling covering the lower section of the mosaic panels.

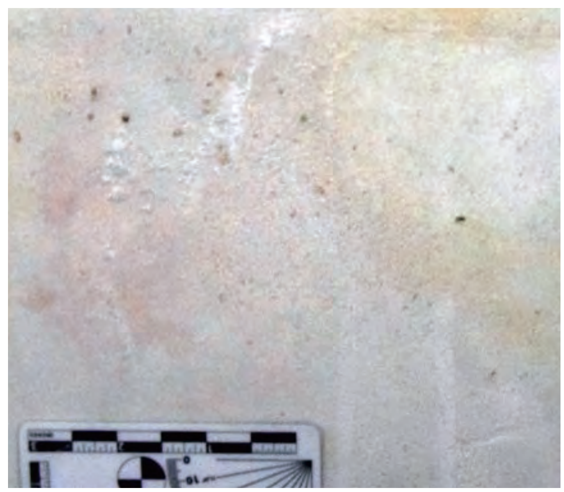
Spotting

Circular staining that might be related to the oxidation of metallic components in the Structolite™ or to an unknown chemical reaction between constituents.



Efflorescence

Chiefly whitish powdery deposit of salts crystallized on the plaster surface.



Moisture Stains

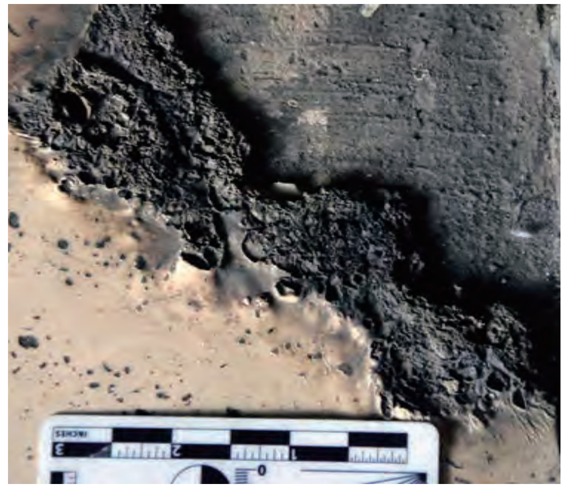
Color alterations of the surfaces caused by active leakage or past moisture infiltration.

Flooring Materials

Conditions

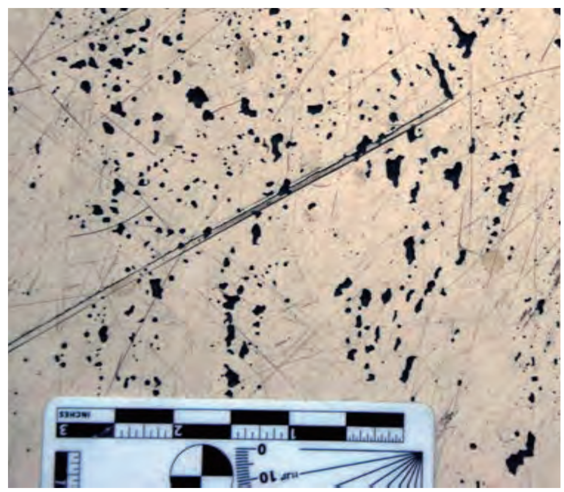
Fire Damage

Flooring has been damage by fire in the proximity to the fireplace hearth.



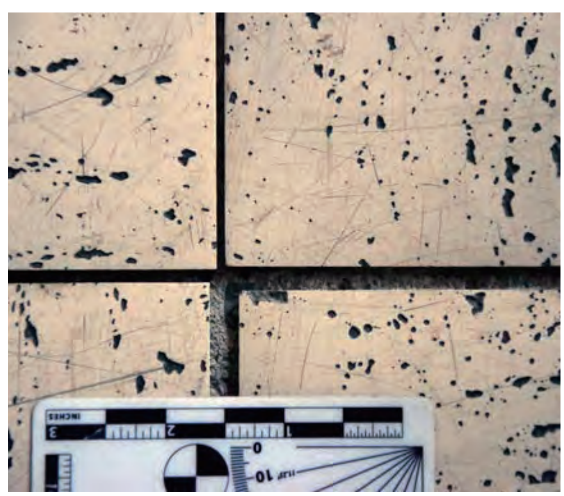
Wear

Scratches and superficial damage from visitation and use.



Tile shrinkage

The flooring present a contraction in comparison to their original dimension due to sunlight exposure.



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