PENN PRAXIS/THE ARCHITECTURAL CONSERVATION LABORATORY

GEORGE NAKASHIMA
ARTS BUILDING AND CLOISTER
CONSERVATION & MANAGEMENT PLAN

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January 30, 2017

Funded by:
The Getty Foundation
2015 Keeping It Modern

Left:
The Arts Building. View from the north.
William Whitaker. January 2017

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PART I

Acknowledgements

Through its Keeping It Modern initiative, The Getty Foundation has provided the financial support that has made possible the continuation of a new partnership between the George Nakashima Foundation for Peace, George Nakashima Woodworkers and the University of Pennsylvania's School of Design to study in depth a less well known and a more craft-oriented tradition of modern architecture in the United States. The Getty's past and ongoing commitment to the preservation of modern heritage helped us to catalyze the efforts undertaken during the various phases of the planning project.

We are indebted to Mira Nakashima, Kevin Nakashima, and Jonathan Yarnall. Their contributions have been essential to understanding the values of the place, unravel the complexities of George Nakashima's designs and philosophical approach, and untangle the many connections embedded in the Arts Building and Cloister. Thanks are extended to Soomi Amagasu, John Lutz, and Alexis Rosa Caldero, as well as other members of George Nakashima Woodworker who have welcomed and hosted us during the various visits to the site and contributed their insights in the preparation of this Conservation and Management Plan (CMP).

This CMP project has made possible the engagement of external consultants and graduate students in a complex research collaboration We would like to convey our thanks to the consultants for the excellent work done: Ron Anthony, David Biggs, Michael C. Henry, and Nicholas Pevzner. We acknowledge the collaboration of Professor Joelle Wickens from the Winterthur/University of Delaware Arts Conservation Program (WUDPAC), Professor Petr Kabele, from the Czech Technical University/Advanced Masters in Structural Analysis of Monuments and Historical Constructions (CTU/SAHC), as well as the contributions of graduate students Andi Troci (CTU/SAHC), Leah Bright (WUDPAC), Shin-Yi Kwan and Jancki A. Vyas, from the Master of Environmental Building Design (MEDB), and Araba Prah and Nicole Mariel Declet from the Graduate Program in Historic Preservation, both at the University of Pennsylvania.

Finally, we are grateful to the staff from the Singh Center for Nanotechnology at the University of Pennsylvania for their assistance in the analysis of materials, as well as to the archivists from the James A. Michener Art Museum Archives for their support on the historical research.

Site: George Nakashima Woodworker Complex.
40°20’25.0”N, 74°57’20.2”W

Introduction

Unusual in its use of time honored Pennsylvania and Japanese craft techniques and outstanding in the ingenuity of a thoroughly modern hyperbolic paraboloid plywood roof, the Arts Building and Cloister (1963-67), designed by architect and woodworker George Nakashima (1905-90), is one of over a dozen designs built on his property in New Hope, Pennsylvania. Christened as Minguren Museum, the building was intended as a space to display artwork by Ben Shahn (1898-69) and other artists, Nakashima's own furniture, as well as a place for artistic exchange and contemplation.

Of paramount significance is the fact that the Arts Building and Cloister embodies Nakashima's constant search for understanding beauty, art, and spiritual transcendence, as no other building at the property does. His ‘private museum’ became a place to nurture spiritual and intercultural dialogue, but also served family and business needs. Although minor changes have occured within a tradition of spontaneous response to deterioration, the compound exhibits a high degree of originality and integrity. This integrity is also perceptible through its continued original uses.

The complex relationship between living tradition and historic site, as the property transitions and continues to serve the making of furniture, has compelled the Foundation to lead the preservation of the building and the collection for the public benefit while continuing to serve George Nakashima’s vision for peace. In exploring the cultural significance of the builiding and setting out policy as well as guidance, the Conservation and Management Plan (CMP) aims to help the Foundation in its new role as steward.

Some policies and recommendations might be seen as a long-term objective, others respond to immediate need, and a few are meant to be applied on a routine basis and are critical to preventive conservation. Regardless of their varied nature, it is fundamental that policies and recommendations are reviewed periodically and are subject to confirmation, modification, or deletion through thoughtful consideration.

The CMP is divided into three parts. Part I provides documentary, graphic, and physical information about the Arts Building and Cloister’s contextual history and condition, including the immediate surrounding landscape and the collections. Part II contains the policies and guidance based on the research findings as well as vulnerabilities to the cultural significance. Lastly, Part III comprises the attachments to the work done by the consultants and members of the Architectural Conservation Laboratory, including the contributions of graduate students and related institutions.

The three parts are designed to be used independently, although references to each other throughout the documents are inevitable. Each volume is divided into sections, which are a reflection of the sequence in the preparation of this CMP.

Part I.

Chapter 1 contains a site development chronology based on the information provided by the 2013 National Historic Landmark nomination, the depreciation accounting books, and the Nakashima Property List of Buildings (September 12, 1990). In addition, the section provides a construction chronology as well as an account of the alterations to the building after its completion.

Chapter 2, presents a summary of the historical research based on published and unpublished sources of a different nature: articles in journals, scholarly publications, account books, hand drawings, letters, and photographs. With the aim to understand the attributes which make this place of value, this section provides an analysis of the education and earlier influences on George Nakashima through 1941, the design and construction of the building, the rise of the hyperbolic paraboloids in the US, as well as Nakashima's design ethos. The section closes examining the many artistic and spiritual connections recognizable through both the building and the collections.

Chapter 3 focuses on understanding the setting, which is based on Nakashima's consideration of creating integrated environments. In addition to the importance of the landscape features carefully selected by Nakashima, this section highlights the importance of the views from the interior and exterior of the building towards the south and the west. Although the integrity of the landscape is high, the clearing on the south property, the modification of the pathway, and the minor loss of features divert the role of the landscape from its original intent.

Chapter 4 explores the understanding of the architectural and technological characteristics of the building and provides an account of the existent conditions, a section of which is dedicated to the characterization and assessment of the wooden elements. The Arts Building and Cloister was Nakashima's last interpretation of modernist structural theory through the combination of Japanese and local vernacular craft techniques. Consequently, the hyperbolic paraboloid roof gets special attention. Observations on the building envelope, the environment and the collections are included as well.

Part II.

Chapter 1 explains the concept of National Historic Landmark and clarifies professional terms used throughout the document.

Chapter 2 expounds the main values that make the Arts Building and Cloister culturally significant as an integrated environment by George Nakashima and a place largely legible through the setting, the collections and the Foundation mission.

Chapter 3 and 4 contains the statement of significance and identifies the character defining elements while offering a few notes for the management of future use.

Chapter 5 includes the body of policies and recommendations in response to the cultural significance, vulnerabilities and the conservation issues identified through the preliminary studies. The various sections include general policies, landscape and management plan, the building itself, environmental management and hygrothermal performance, as well as use, collections and interpretation. Each consultant has informed site policy and guidance in their respective area of expertise.

1. Developmental History

1.1 Site Chronology*

Year	Event	
1943	**George Nakashima arrives to New Hope**	Sponsored by architect and former employer Antonin Raymond, George Nakashima and his family were released from their interment during WWII at Camp Minidoka in Idaho and lived on Raymond's farm in New Hope, Pennsylvania. Since many of Raymond's comissions were government related, Nakashima could not work as an architect and helped on the farm and set up a small furniture workshop.
1945	**George Nakashima leaves the farm**	George Nakashima and his family move into a house near Meetinghouse Road, in New Hope, and continued his activity as woodworker.
1946	**George Nakashima moves to Aquetong Road in New Hope**	George Nakashima purchases three acres of land from a Quaker farmer in exchange for carpentry work. The family lives in a tent on the property, while George builds the first structure on the site, the Workshop.
1946	**The Workshop**	This building is enlarged over the years. Originally, it included a workshop area and an exhibition space but over time, the building becomes specialized for furniture making.
1946	**Nakashima House**	The residence for the Nakashima familiy is built shorlty after the Workshop. In 1954, it is expanded south to provide an additional bedroom for the new born Kevin Nakashima.
1953-1954	**The Showroom**	Using a rich variety of wood species along with 20th century materials, Nakashima builds the Showroom to display furniture and to house a small-office space. The building sits on concrete posts and is covered with a gable roof. On its west end, it opens towards an outdoor terrace and a pool.
1954	**Nakashima House Expansion**	The family residence is enlarged by adding a new bedroom on the south elevation.
1954-1955	**The Finishing Department**	Originally built as a lumber storage, the building is soon repurposed to house the furniture finishing processes.

1958-1959	**The Main Lumber Storage Building**	Together with consulting engineer Paul Weidlinger, George Nakashima experiments with the use of plywood to build his first hyperbolic paraboloid to roof a new storage shed.
1956-1957	**The Chair Department**	Formerly the clubhouse for the workmen, this building is soon converted to a space for assembling chairs. The Chair Department is built as a prototype for the larger Conoid Studio.
1956-1958	**The Conoid Studio**	The Studio displays a distinctive corrugated reinforced concrete roof that represents a particular application of a conoidal shell roof. This roof shape confers aesthetical qualities and produces the required strength through form while maintaining the same thickness across the section, approximately 2 1/2 inches. The building provides spaces for furniture design, meeting, and display of furniture and decorative arts.
1958	**The Lanai**	Sponsored by the Sipmpson Redwood Company, George Nakashima designs this small structure using California redwood. A cantilevered roof mounted upon two concrete piers houses a sitting area which includes a stone Dutch oven.
1958	**The Pool Storage House**	Built as a prototype for the Pool House, this small structure of concrete block is covered with a canted barrel vault roof. Nowadays, it is used for storing chemicals and the necesary equipment for the neighboring Swimming Pool. Mira Nakashima participated in the construction.
1960-1961	**The Pool House**	With its distinctive canted barrel vault roof supported on its sides by stone and concrete block walls, this structure is open on both ends establishing a direct relationship with the landscape. The roof is constructed of plywood and is covered with a waterproofing membrane and copper flashing. It houses dressing rooms and an open space for leisure activities.
1960	**The Swimming Pool**	The amoeba shaped pool was built of reinforced concrete and has a cantilevered overhand on its southern side.
1961	**The Main Lumber Storage Building Expansion**	This lumber storage was expanded adding a new storage space towards the south. Its tilted hyperbolic paraboloid roof is likely the precedent for the Arts Building.

1964-1967	**The Arts Building and Cloister**	With a soaring hyperbolic paraboloid roof, the Arts Building contrasts a restrained and smaller adjacent Cloister. 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 tilted hyperbolic paraboloid roof. The Cloister structure is comprised of exposed concrete block masonry walls. Both the Arts Building and Cloister are connected by a covered walkway or engawa, creating an asymmetrical composition. It was intended as an exhibition space and place for interchange in relation to craftsmanship and the arts.
1967	**Nakashima Garage**	The garage is a small rectangular concrete block building with a gable roof covered with corrugated Transite®. The walls are covered with stucco and have a foundation of stone. It is a one-car garage with an overhead door and a round window. It also includes a laundry room and storage.
1968	**The Main Lumber Storage Building Expansion**	For the second time, the lumber storage is expanded.
1970	**Mira Nakashima House**	Designed and constructed by George Nakashima for his daughter Mira, this rectangular two-story building is covered with a distinctive scissor truss roof covered with cedar shake shingles. Wall materials include concrete block, wood, and textured stucco.
1970	**Mira Nakashima Guest House**	Adjoining Mira Nakashima´s House, this building mirrored the construction features of the main building. It is connected to the house by a covered walkway.
1971	**The Main Lumber Storage Building Expansion**	The building is enlarged again by adding a tractor shed.
1974-1977	**The Reception House**	Using also a scissor truss roof system and open floor plan, George Nakashima built this house with a Japanese style tea room and sunken bath to serve as a guesthouse and space for meetings. Wall materials include stone, concrete block, stucco, Kyoto plaster, and Japanese tiles. A series of sliding shoji doors hides the kitchen.

1977	**The Heating House**	This small structure consists of concrete block walls covered with a gable roof to house a heating plant. The fuel tank is housed in the open area.
1977	**The New Lumber Storage Building**	This storage was built of concrete block and covered with a plywood and asphalt shed roof.
1982	**Nakashima House Repair**	The earlier roof of cast concrete tiles is replaced with wood shingles.
1985	**Mira Nakashima Garage**	With a rectangular shape and vertical wood siding, this structure is covered with a cedar shake roof. It is a non-contributing building according to the National Historic Landmark nomination.
1990	**The Pole Barn**	The Pole Barn was designed in 1990, with additions in 1995 and 2008, to serve as lumber storage. It was designed by George Nakashima's grandaughter. It is a non contributing structure according to the National Historic Landmark nomination.
1990	**George Nakasima passes away**	George Nakashima passes away at 85 in New Hope, Pennsylvania.

* Based on the NHL nomination, the Depreciation Accounting Books, and Nakashima Property List of Buildings (September 12, 1990)

1.2 Construction and Alteration Chronology*

Year	Design Phase	Source
Before June 1963	Preliminary design by George Nakashima	Drawing
June 3, 1963	Earliest dated records; particularly, engineering drawings	Drawing
February 4, 1964	Earliest known drawing of the Arts Building by GKN: a schematic design scheme including ground floor plan, South, East, and West elevations.[1/8" = 1'-0" scale drawing in AAUP dated]	Drawing
March 17, 1964	Site plan, likely used for zoning submission, dated.	Drawing
March 18, 1964	Zoning Permit filed with Solebury Township	Other
	Executive/Construction Phase Begins	
May, 1964	Electrical service extended to Arts Building site, construction begins	Account book
June, 1964	First payments to Town & Country Builder as well as to Robert Lovett, who focus their work on the construction of footings, masonry walls, and poured concrete waffle slab. Work substantially completed by October 1964.	Account book
	McIlvain Co. supplies white eastern pine beams for lintels in west and south window walls (notched into masonry walls), as well as pieces over the fireplace.	Account book
	Rubble stone supplied by Delaware Quarries.	Account book
October Thru December, 1964	Temporary work stoppage on Arts Building site so the crew can focus efforts on the construction of an expansion to the Shop building. Walls and concrete work substantially completed by this time.	Account book
April Thru November, 1965	Construction of Arts Building hyperbolic paraboloid roof.	Account book
	Large order for soft wood products placed with Weyerhaeuser during April [possibly wood used for wall plates, possibly the roof ribs, and "scaffolding" to support roof edge beams and ribs during erection].	Account book
	Order placed with Daniel Buck Inc., for wood supplies, assumed to be the roof ribs.	

	Payment made to McIlvain Co., for what is assumed to be the douglas fir edge beams and main pole.	Account book
July, 1965	First payment made to Buck Inc. for what is thought to be plywood.	Account book
September, 1965	Second payment made to Buck Inc. at the end of the month, roughly double that of the first payment. Sheathing work on the hyperbolic paraboloid roof begins.	Account book
October, 1965	Substantial payment to Histand Bros., roofers. Roofing membrane installed.	Account book
	Excavation work completed on Cloister building.	Account book
November, 1965	Roofing completed. Second, very small payment made to Histand Bros.	Account book
	Payment also made to Buten & Sons, for paint supplies - assumed to be the stain for the plywood. Possibly preservatives for exterior timbers.	Account book
	Footings laid for Cloister and, possibly, cinder-block wall construction completed by the end of the month.	
November Thru May, 1966	Fabrication of windows and doors is underway. The supply and installation of glazing begins around this period. Payments made to Niece Company (local building supplier) over the coming months suggest they are the glass supplier. Near simultaneous payments made to hardware supplier, Finkel & Son, may indicate purchase of related fittings.	Account book
January Thru October, 1966	First of a series of large payments to M & M Plumbing & Heating for work on the Arts Building and Cloister. Work contiues through October of 1966.	Account book
February, 1966	Payment made to McIlvaine Co. made, possibly for black locust posts and beams used in Covered Walkway.	Account book
May, 1966	Factsheet about a well drilled close to the Arts Building.	Notes
June, 1966	Payment made for water well drilling (Zieganfuss) and large payment to M&M made the following week suggesting connection of well water supply to the Cloister Building mechanical room.	Account book

June, 1966	Payment made to Buck Inc. for plywood. Assumed to be plywood and sheathing for the Cloister building and pathway.	Account book
June Thru September, 1966	Payments to Lewis, Inc. (concrete supply) & Delaware Quarries for building stone suggest that work on the garden walls and pond occurred during this period.	Account book
July, 1966	Roof of Cloister building and pathway completed. Payment to Histand Bros., Roofer	Account book
August, 1966	Payment made to Coulton & Sons for septic system installation.	Account book
October, 1966	Vinyl tile purchased and installed during following at both the Arts Building and Cloister	Account book
	Final large payment to M&M. Assumed that the heating system was operational by this time.	Account book
November Thru January, 1967	Finishing work and electrical work continues. Work substantially completed by the end of January.	Photograph
March Thru April, 1967	Built-in Conoid bench with double-back installed, as were the exterior grills, Japanese paper lanterns, shoji screens and curtains.	Photograph
May 7, 1967	Opening reception of the Arts Building, a "small private museum" christened as the "Museum Minguren."	Other
	First Publication of Arts Building in *The Philadelphia Inquirer,* Philadelphia, PA May 7, 1967 p. 144	Printed media

	Alterations	
March, 1970 Thru January, 1971	Three payments [to Gabriel Loire] for the Ben Shahn's mosaic mural "The Poet"	Accounting book
October, 1970	Gabriel Loire Atelier ships the mosaic mural to New Hope during the fall of 1970	Letter
January, 1971 Thru July, 1971	Installation occurs. By July 1971 the mural is in place.	Photograph
August, 1990	"As we hope to set up our so-called "Museum" as a memorial exhibit of my father's life and work, we would like to be able to remove the wood which has been stored in this building to the new shed and restore the older building to its original purpose. We are currently forced to use the Museum for lumber storage, due to lack of other space." (Mira Nakahsima-Yarnall in relation to letter sent to her neighbors on Aquetong Road about the design of the pole barn.)	Letter

Before 1994	Replacement of the lintel above the fireplace damaged by carpenter ants activity. Reportedly, repairs on the plywood shell. This job included alterations to the north and east eaves as well as the installion of new copper gutters.	Oral history
March, 1994	A work list by Mira Nakashima includes repairs of exterior woodwork damage by animal and insect activity, replacement of shoji paper on the main room and Cloister closet, clean up & paint of heating units. About the Cloister: plaster repair and paint, replacement or repair of the fiberboard. First mention to the repair to the window seat projection on the west elevation, as well as the creation of signage for objects to display.	Notes
May, 1994	Detailed handdrawing by Mira Nakahsima of the roof canopy for the window seat on the west elevation of the Arts Building.	Drawing
April, 1999	A photo shows a group of craftsmen moving the Russia Altar of Peace. In the background the canopy for the west window seat is already in place. Sky domes are visible in the porch/balcony. Although not clear, gutter replacement already in place.	Photograph
Ca. 2001	Repairs on the covered walkway in front of the Cloister. Original black locust posts were replaced by ipe machine-made posts placed upon Japanese inspired truncated square pyramids.	Photograph
Before 2003	Original skydomes were replaced by new sky domes. Waterproof layer was applied on the concrete terrace.	Oral History
After 2003	At least four more black locust posts of the covered walkway were replaced. Sky domes were replaced by functional skylights.	Oral History
June Thru October, 2005	Labor and materials for roof repair at the Arts Building billed by Lucien Peebles General Construction.	Account book
July, 2016	The mezzanine floor was scrubbed and refinished.	Report
July Thru October, 2016	On the balcony, the south black locust railing is replaced in kind	Report
August, 2016	The upper section of the stone masonry chimney shaft and crown were repaired.	Report

Hand drawings by George Nakashima of the Arts Building and Cloister. All from George Nakashima Woodworker Archives. Scanned by Architectural Archives of the University of Pennsylvania.

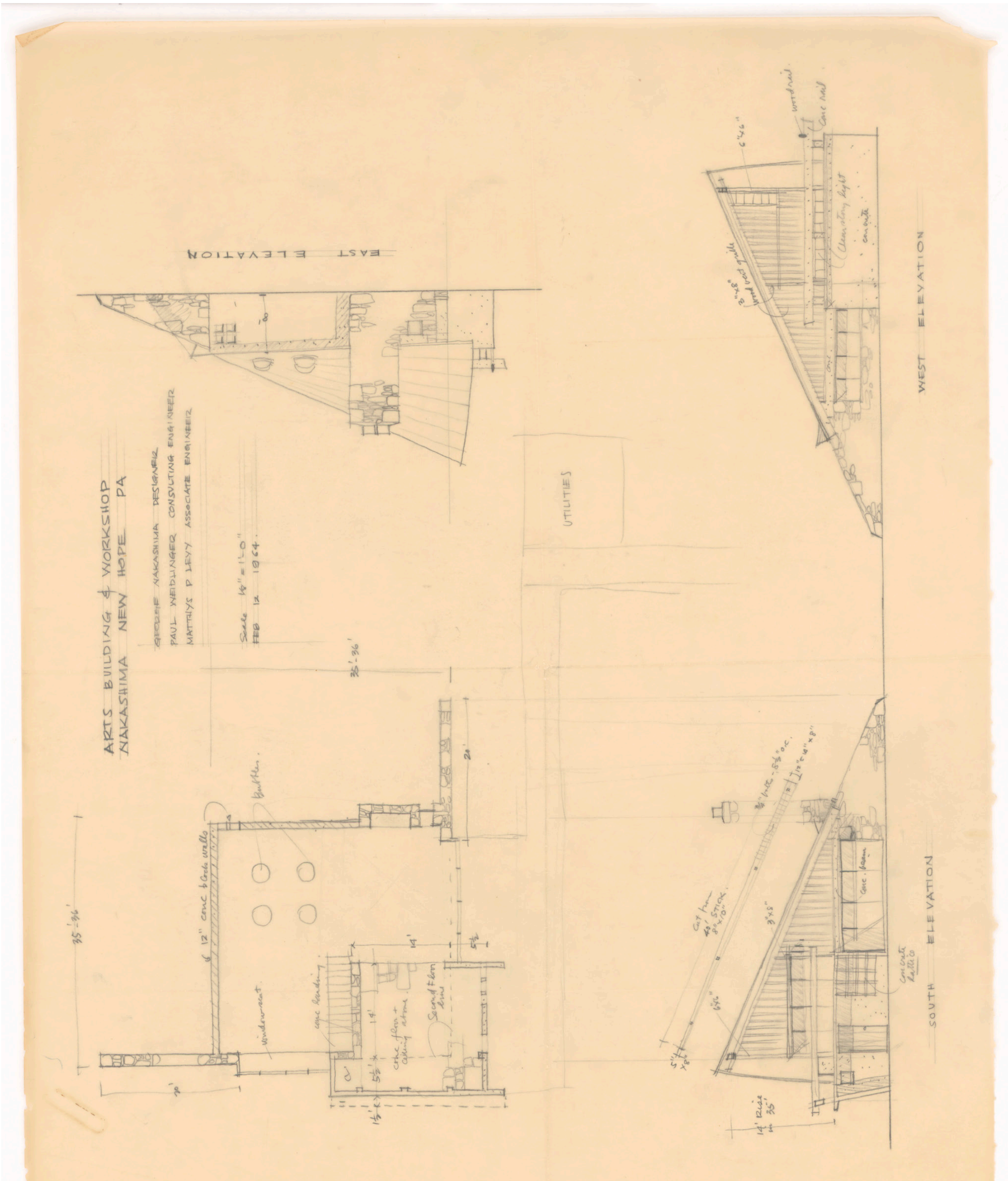
Figure 1. Arts Building & Workshop
Nakashima New Hope PA
George Nakashima Designer
Paul Weidlinger Consulting Engineer
Mathys P. Levy Associate Engineer
Scale 1/8" = 1'-0"
Feb 12 1964

Figure 2. Undated drawing sheet.
The "window wall" was first proposed as wholly screened with wood vertical grills.

Figure 3. Undated drawing sheet.
South elevation (above) and West elevation (below). Elevations show a similar scheme to the as built condition. Annotations correspond to general measurements of windows and doors.

Figure 4. Undated drawing sheet.
This sketch shows indications for the construction of the plywood shell.

Figure 5. Undated drawing sheet.
Elevations and floorplan of the Cloister and convered walkway. It includes architectural detailing for the porch roof and the canopy.



ARTS BUILDING & WORKSHOP
NAKASHIMA NEW HOPE PA
GEORGE NAKASHIMA DESIGNER
PAUL WEIDLINGER CONSULTING ENGINEER
MATTHYS P LEVY ASSOCIATE ENGINEER
FEB 12 1964
EAST ELEVATION
UTILITIES
WEST ELEVATION
SOUTH ELEVATION

Figure 1

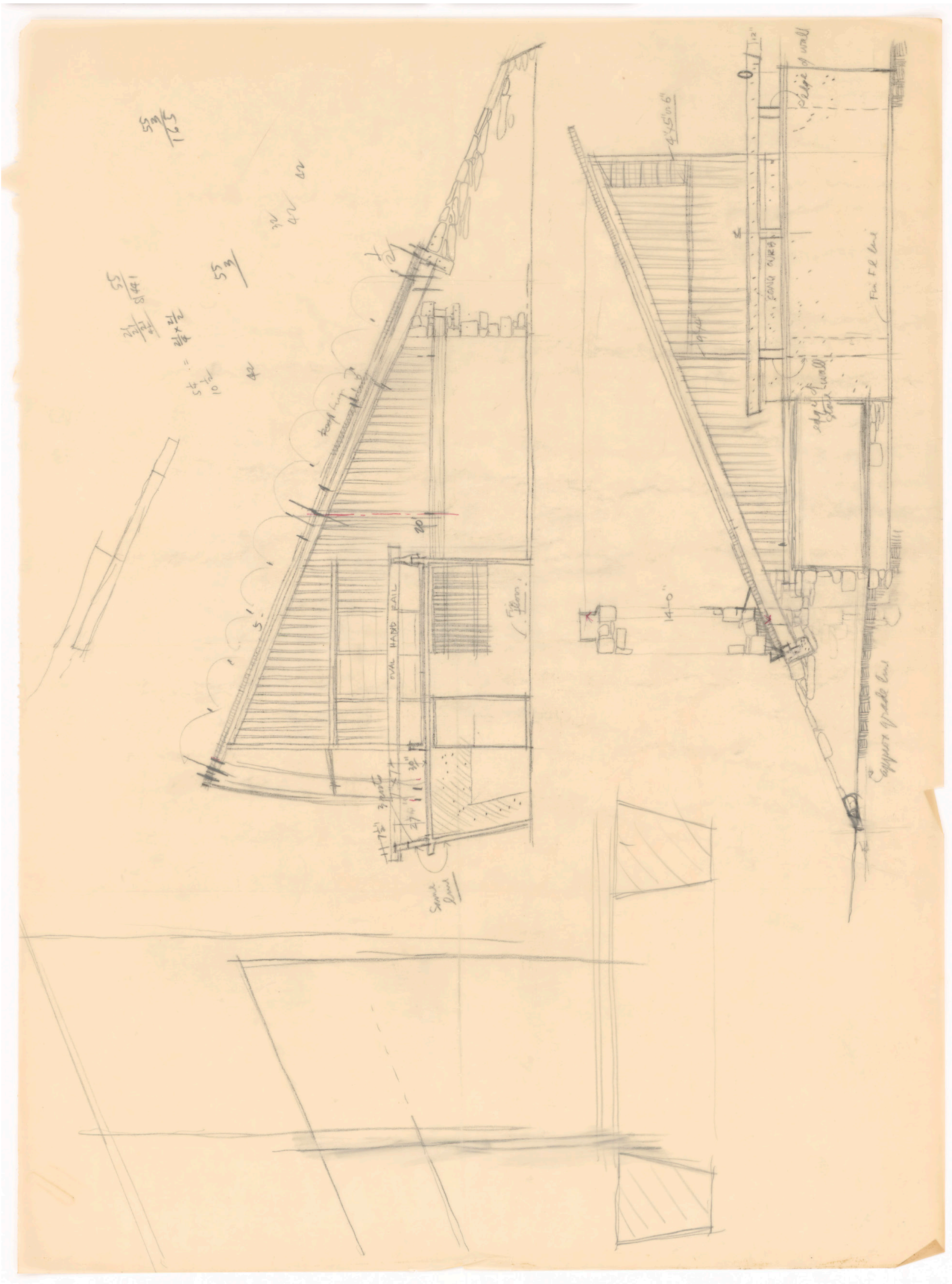


Figure 2

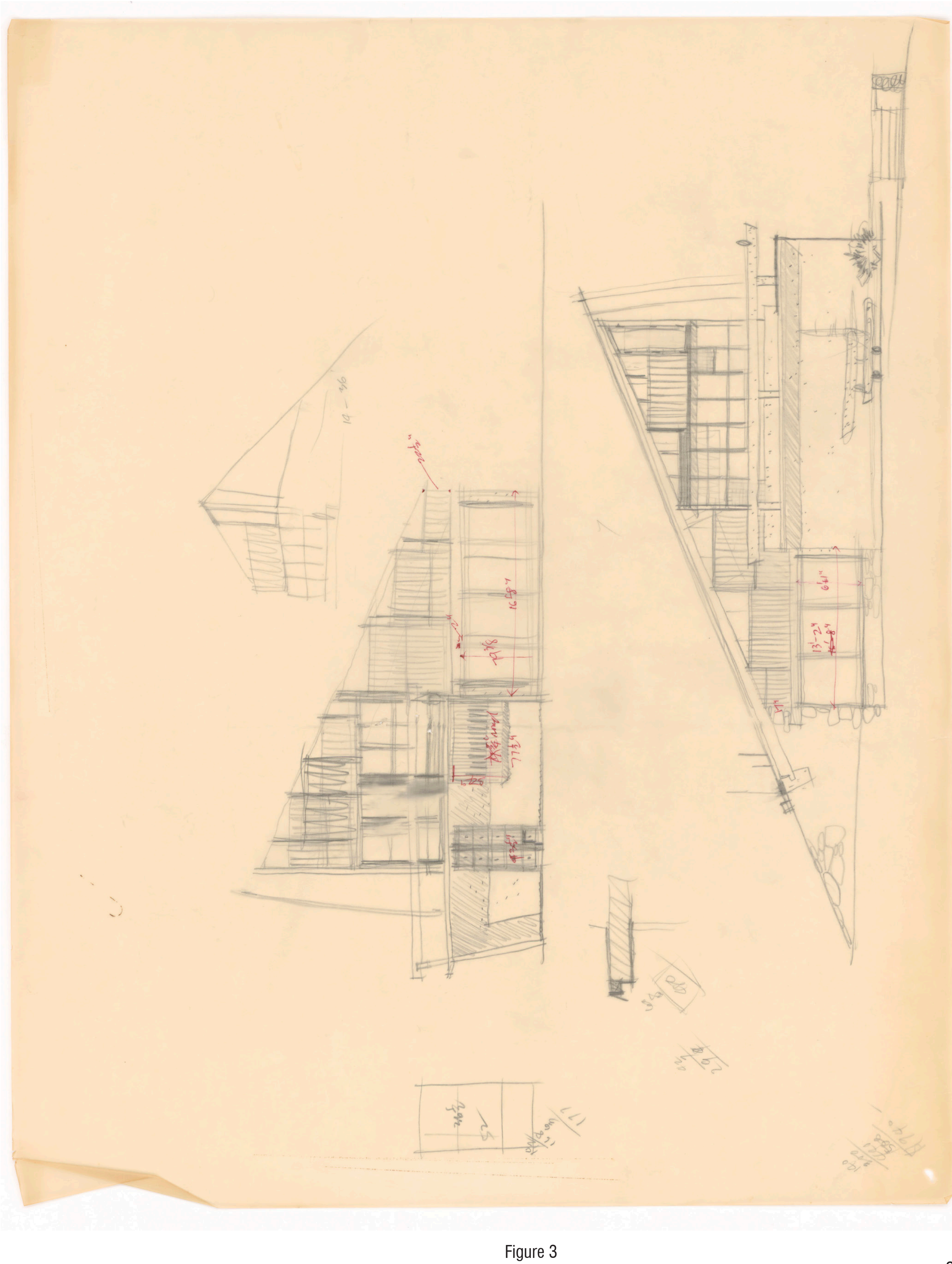


Figure 3

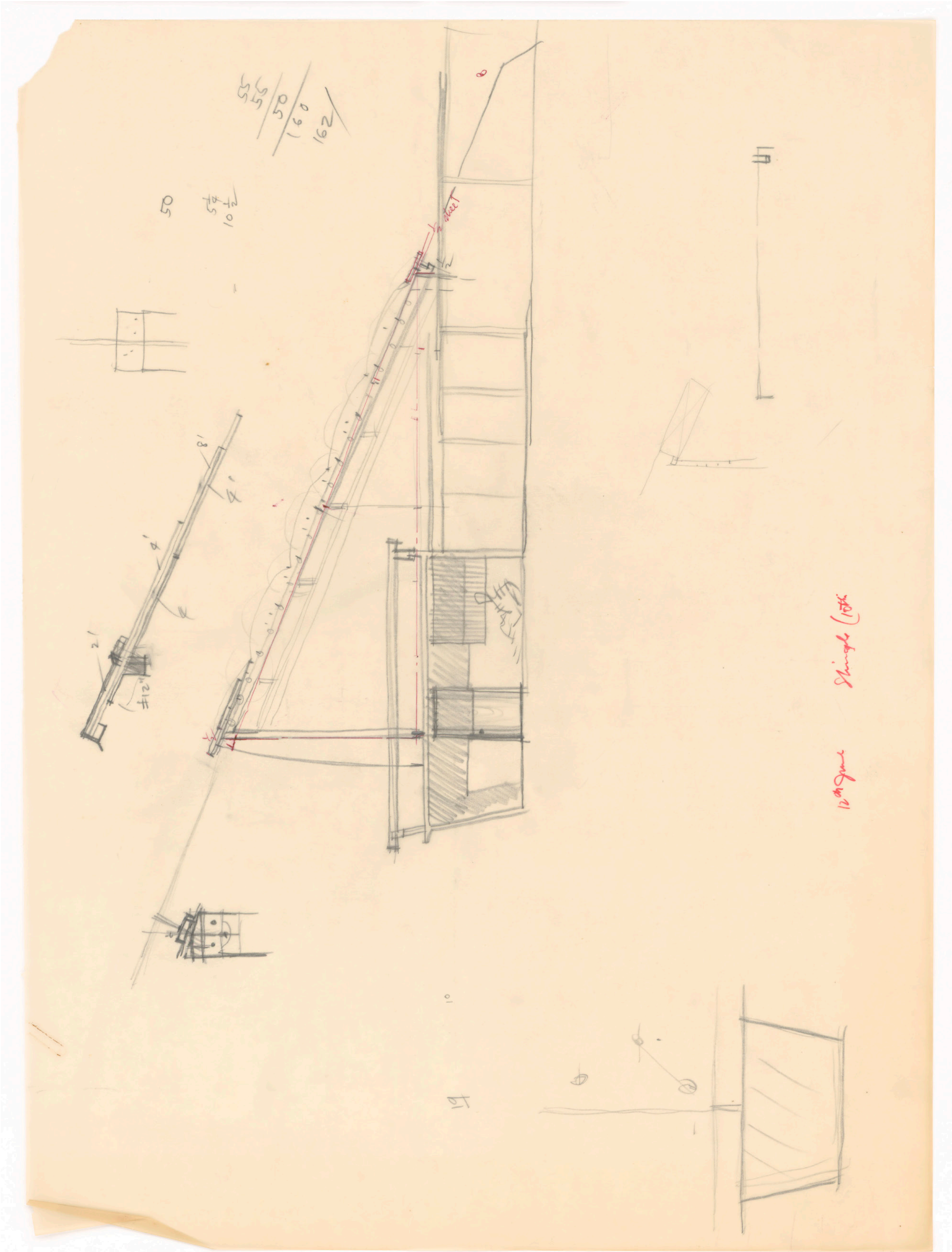


Figure 3

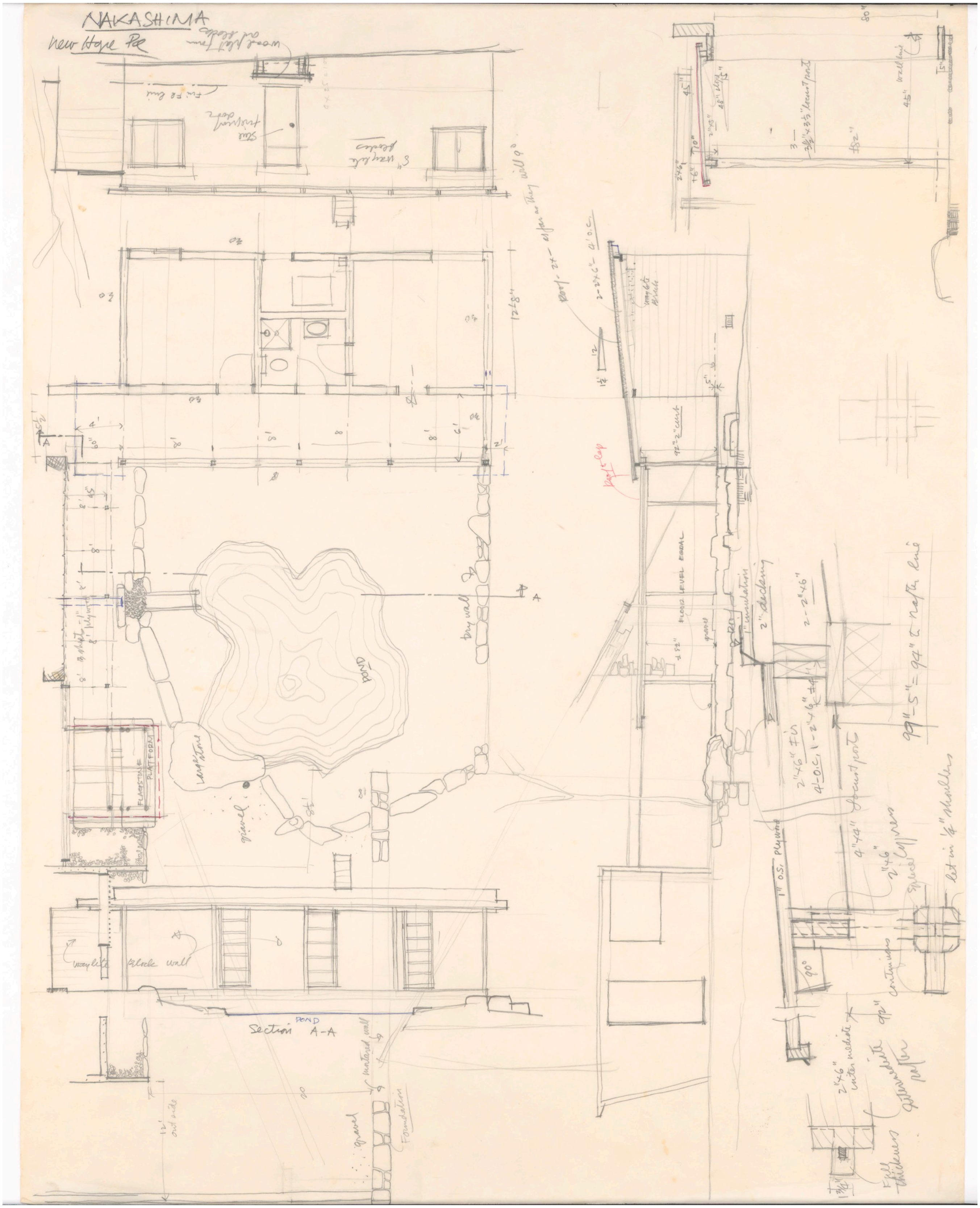

NAKASHIMA
New Hope Pa
Section A-A
POND
dry wall
gravel
FLAGSTONE PLATFORM
Foundation
FLOOR LEVEL 800
2" decking
2-2"x6"
4"x4" Sourt post
99'-5" = 94" to rafter line
1" O.S. Plywood
wayhite
block wall

Figure 4

Left: pouring concrete during summer 1964.
Right: Note the use of plywood for concrete formwork.

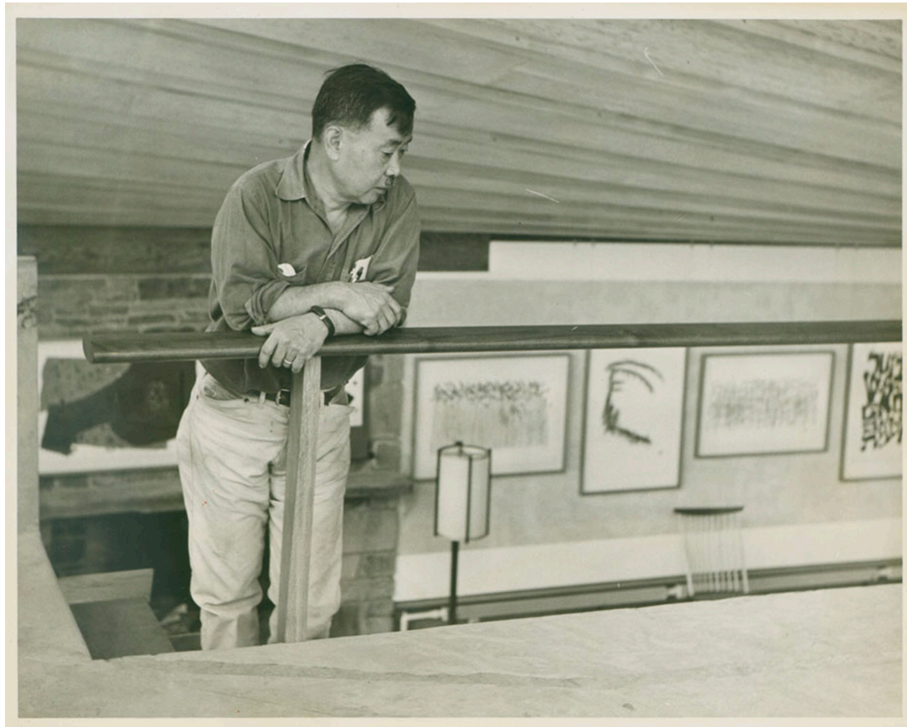
Construction continues.

Left: adjusting the west edge beam to its final position.
Right: scaffold and ribs ready for placing the plywood deck.

Construction of the plywood deck

Left: the installation of glazing infill begins.
Right: Wiew of the Arts Building and Cloister from the south in the early fall of 1967

Left, from top to bottom:
Arts Building looking westwards
Cloister from the Arts Building terrace.
Looking through the south sliding door.
Gallery space looking eastwards.
Conoid bench installed on the loft.
Right:
Sculptural lamp as initially assembled.
All images courtesy of
Nakashima Foundation for Peace



Right: George Nakashima in the Arts Building. Ben Shahn's artwork hangs on the walls. This photograph was probably taken shortly after the exhibition was inaugurated in 1967. Source: George Nakashima Woodworker Archives

2. Contextual History

2.1. George Nakashima: Training and Apprenticeship

The many publications about George Katsutoshi Nakashima (1905-1990) during his lifetime contributed to the legend and mystique of the artist as a furniture maker; his work as an architect, however, is less represented. Although woodworking became for him a profession interwoven with spiritual meaning, Nakashima was formally trained as an architect. After a short stay in Paris, he followed a career in this profession that led him to embrace modernist ideas in his early years, mainly with Antonin Raymond in Japan and India. These previous experiences, especially in Japan, proved instrumental to the particular architectural synthesis Nakashima exemplified in the Northeastern United States.

Nakashima studied architecture at the University of Washington, where he graduated in 1929, and Massachusetts Institute of Technology (MIT), 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 MIT, it was amalgamated with a polytechnic system. In Europe, Nakashima might have been exposed to rising modernist ideas 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 of Le Corbusier's Pavillon Suisse. This student dormitory offered Nakashima a first-hand introduction of modernist interests spreading through Europe; an experience that would be enriched greatly by his work in Japan and India.

Looking to the East, Nakashima moved first to Japan and joined Antonin Raymond (1888-1976) in April 1934. Raymond, who has been recognized as the "father of Modern architecture in Japan,"[2] had established his own practice in Tokyo in 1921 along with his wife Noémi Pernessin Raymond (1889-1980). Before that, the Raymonds had been working in different positions serving Frank Lloyd Wright (1867-1959), first in 1916 in Taliesin, Wisconsin for nine months, and then in 1919 and 1920 at Taliesin and in Tokyo, as paid staff members supervising the construction of the Imperial Hotel and the design of other projects.

This apprenticeship was influential in the Raymonds' practice, 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."[3] The Raymonds considered Wright's use of Japanese inspired ornament in the Imperial Hotel as a vacuous mannerism completely separated from the local climate, traditions, people, and culture. In part, these opinions recalled Antonin Raymond's earlier training in Prague, where he was in touch with the ideas connected to the rediscovery of traditional folk architecture as a way to question contemporary eclecticism. Other influences drew on Auguste Perret's (1874-1954) use of concrete and Le Corbusier's (1887-1965) approach to collective housing, known through magazines, and Raymond's personal exposure.

In the hands of the Raymonds, Western modernist ideas were succesfully synthe-

2. As described in 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, C*rafting a Modern World: The Architecture and Design of Antonin and Noémi Raymond* (Princeton Architectural Press: New York, 2006), 29
3. Kurt G.F. Helfrich and William Whitaker, 24

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.*

sized with Japanese lifestyle and construction, which would be ultimately internalized by Nakashima. Antonin Raymond hired European and Japanese architects and nurtured a climate of interchange, where modernist ideas were discussed and filtered with a vernacular vision, where the spirit of the Daiku, traditional carpenters, and the Minka, vernacular farmhouses, were admired. By joining the Raymond's office, Nakashima worked with architects such as Maekawa Kunio (1905-1986), Junzo Sakakura (1901-1969), and František Sammer (1907-1973), and built a long-lasting network of professional connections and personal ties. More importantly, perhaps, was Junzo Yoshimura (1908-1997), who guided Nakashima in his study of the Japanese spirit, traditions, and architecture, including travel to the shrines and temples of Kyoto. Raymond's publications also played an influential role, like Antonin Raymond: His *Work in Japan* 1920-1935 (1935) and *Architectural Details* (1938), which included detailing evolved from Japanese traditions that Nakashima reproduced "almost literally in both his buildings and his furniture."[4]

During his stay at the Tokyo office, Nakashima was involved in two projects that would be early precedents of his architecture in New Hope: the Raymond's Summer Studio (1933) and the St. Paul's Catholic Church (1934-35), both in Karuizawa, a few hours to the northwest of Tokyo.

At the Raymond's Summer Studio, Antonin Raymond dealt with the site, local materials, and construction craft, which stemmed from Daiku, 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 spaces, were a hand-hewn chestnut and cedar framed structure upon a poured concrete plinth. The house's 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.

Revealing an interest in the raw qualities of the materials, the house and the furniture were of the simplest means. By retaining the prints of the wooden formwork, made of the same species as the walls, the imperfections of the crafted wood were harmonized with the plasticity of the concrete. In so doing, the concrete, as a new material, dialogued with the deep-rooted tradition of wood construction in Japan. The Raymond's Summer Studio was thus a defining model for Nakashima, who witnessed first-hand the possibilities of the vernacular traditions in crafting modern architecture. In fact, Nakashima was among a select group of staff members 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.

The intrinsic qualities of local materials were also favored in St. Paul's Church, where Nakashima collaborated on the design and construction. In 1935, father Leo Paul Ward (1896-1942) commissioned the Raymonds to build a Catholic

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

church, after their Summer House and Studio, to serve the spiritual needs of the foreign community sojourning in Karuizawa. Sections and floor plans showed an asymmetrical basilica arrangement, a pitched roof and 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 for the design of sacred spaces.

Deepening in the possibilities of the Raymond's synthesis, the experience of St. Paul's Church exposed Nakashima to the use of concrete and the craft of wood. On this occasion, both wood and concrete were polished with straw and sand to emphasize again the natural qualities of the materials. Remaining sections of structural lumber was used to fabricate a variety of furniture and furnishings for the interiors.

India

In 1935, the same year that St. Paul's Church was erected, Sri Arubindo Gosh (1872-1950), the leader of an ashram, a spiritual community, commissioned Antonin Raymond to project and build a new residential dormitory for his disciples in Pondicherry, India, at that time a French protectorate. Previously, Raymond had been introduced by his close friend Philippe B. St. Hilaire (Pavitra), a French engineer and ashram disciple himself. The ashram was established in 1926 by Sri Aurobindo with his disciple Mirra Alfassa Richard (1878-1973), a French woman of Egyptian-Turkish lineage who came to be known as The Mother. Richard, St. Hilaire, and the Raymonds shared an interest in Theosophy, which made the latter sensitive to the spiritual needs of the ashram and lead to propose a modernist form to create a peace retreat opposed to prejudices embedded in the colonial fabric.[5]

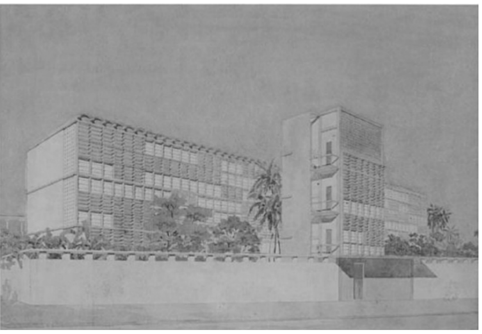
In this project, Nakashima was assigned to an initial visit in 1936, and later to supervise the execution of the construction and interior furnishings along with the most recent addition to the Raymonds' office, a Czech born architect called František Sammer.[6]

The Golconde Dormitory (1935-1942) was projected as a concrete structure facing north and south. Essentially, it was comprised of two rectangular volumes, offset to each other, joined and served by a central functional tower containing the stairs and the hygienic facilities. Modest rooms dedicated to sleep and 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 tropical and humid climatic characteristics. A roof of precast concrete barrel shells, louvers and overhangs play a role of sun shield and heat control.

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. On this occasion, the lack of materials, due to political unrest in Asia and Europe, and the inexperience of the ashram members compelled him to improvise and to develop alternative solutions through craft. This experience would ultimately help Nakashima to deepen even more his understanding of the possibilities of common materials.

5. Christine M. E. Guth, "Crafting Community: George Nakashima and Modern Design in India" in *Journal of Design History* 29 (2016), 366-384.
6. 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. Pankaj Vir Gupta, Christine Mueller, "Golconde: The Introduction of Modernism in India" in *2005 Report on University Research*, University of Austin, Texas.

Below: 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*



Rendering of the Golconde dormitory for Sri Arubindo's Ashram. Source: Kurt G.F. Helfrich and William Whitaker, Ed., *Crafting a Modern World: The Architecture and Design of Antonin and Noémi Raymond*

Within this context, Nakashima became himself a disciple of Sri Aurobindo, and was given the name of Sunderananda, 'one who delights in beauty'. As a member of the ashram, Nakashima evolved a deeper understanding of life and a transcendent sense that profoundly influenced his position on craft and design. The Sadhana, a "spiritual training to attain deep concentration resulting in union with the ultimate reality,"[7] would be ultimately nurtured in New Hope. In fact, Nakashima aspired to create "a center for the evolution of life moved by higher consciousness, a life of the spirit."[8] These ideas would be summed up in his book The Soul of a Tree, published in 1981, where Nakashima revealed a spiritual interpretation of woodworking interweaved with a utilitarian dimension.

In 1939, with the threat of war and having completed most of the concrete work in Golconde's structure, George Nakashima left India 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 Japanese American Marion Sumire Okajima (1912-2004). After marrying in 1941, they moved to Seattle, Washington, where 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 US entry into the war, Nakashima was interned with his family in Minidoka, Idaho, as other Japanese Americans. At the camp, Nakashima met Gentaro Hikogawa, a tradiionally trained Japanese carpenter who was born in Japan and immigrated to the US. Hikogawa improved Nakashima's skill by training him in the use of traditional Japanese hand tools and wood joinery.

After receiving communication from the Dean of the MIT, Nakashima's former employers, Antoni and Noémi, sponsored the Nakashima family release, who settled on the Raymonds' farm in New Hope in 1943. Since most of the Raymonds' commissions were government-related, Nakashima could not work as an architect reflecting a climate of fear as a result of the Pacific war. He turned to farming and later to woodworking, in January 1944, as revealed by an earlier ledger book. In 1946, having bought a three-acre property along Aquetong Road in exchange for carpentry work, Nakashima began a woodworker complex. There he brought together the spiritual aspects and his first-hand experiences with local materials, available technology, and craft.

2.2. Experiments in Modernist Structural Theory: Hyperbolic Paraboloids

When Nakashima began the preliminary sketches for the Arts Building, he had already designed and built eight structures on the property, answering the demand of a business in expansion. Inspired by the growing interest in the functional and visually striking qualities of warped roofs in post war America, Nakashima experimented with the use of plywood as the essential building material to construct three early roof examples. They were the Main Lumber Storage, using a hyperbolic paraboloid, a conoidal roof clubhouse for workers, which quickly became the chair assembly shop or the Chair Department, and the Pool Storage House. While the latter became the model for the Pool House, and the clubhouse roof inspired the corrugated concrete shell for the Studio, the Lumber Storage became the prototype for the Arts Building.

7. George Nakashima, *The Soul of a Tree*, (Tokyo, New York: Kodansha International, 1981), p.138
8. Mira Nakashima, 18

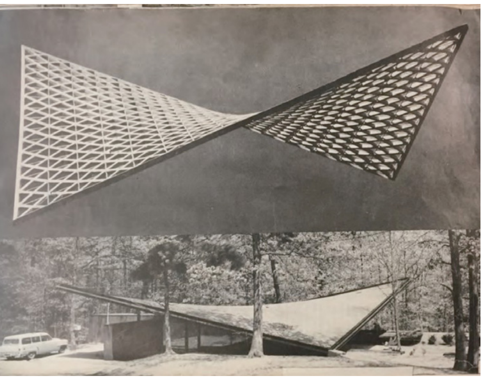
Of European origin, hyperbolic paraboloids were introduced to America during the 1950s within a general climate of innovation. Two main groups favored this context: engineers, architects, and builders, who emigrated from Europe fleeing from war ravages, searching for new opportunities; and manufacturers' 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. Simultaneously, a myriad of publications in journals, university researchers, and conferences accompanied the rising interest in hyperbolic paraboloids. In publishing an article devoted to this type of roof in 1955, *Architectural Forum* illustrated the trend and offered a concise definition:

> A hyperbolic paraboloid is a warped double-curved surface, saddle-shaped, generated by straight lines that slide along two straight line directrices not in the 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.[9]

The article showed various structural combinations, including the two eventually used by Nakashima: the hyperbolic paraboloid and the tilted hyperbolic paraboloid. *Architectural Forum* was familiar to Nakashima, as his Showroom (1954) had been published by the journal a few months earlier 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 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). In Ra-

9. "A New Way to Span Space" in Architectural Forum vol. 103 (November, 1955), 174

Left: George Nakashima Woodworker's Complex before the Arts Building and Cloister. 1962. Author: Ezra Stoller, Esto Photographics. Source: George Nakashima Woodworker Archives



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

leigh, Nowicki, local architect William H. Deitrick (1895-1974), and engineer Fred Severud (1899-1990) had designed the J.S. Dorton Arena (1952), a structure covered with a parabolic cable roof, which earned ample recognition in the United States. In 1955, *Architectural Forum* published Catalano's hyperbolic paraboloid roof, and other influential works such as those of Pier Luigi Nervi (1891-1979). *Progressive Architecture* did the same with Félix Candela (1910-1997), who had attracted attention with his hyperbolic paraboloids in the early 1950s. Nervi and Candela became leading figures who also contributed to the general interest in creating greater and more exciting structures.

In the Mid-West, contemporaneous with Nakashima's Lumber Storage, Professor William Strode and Donald L. Dean, from the Department of Architecture and Architectural Engineering of the University of Kansas, began their own research using plywood sponsored by Douglas Fir Plywood Association (DFPA). 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 consisted of two layers of 1/4-inch plywood strips nail-glued to a plywood box which created the necessary beam on the perimeter. Three reinforced concrete abutments supported the roof structure.

DFPA continued sponsoring research projects, widely lectured in conferences and symposia, 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). This effort accompanied and probably nurtured an increasing interest in plywood as a building material, the use of which became a natural path for Nakashima.

Although there is no documented evidence for affirming that Nakashima knew about all these experiments before building the lumber storage, it is likely the consulting engineer Paul Weidlinger (1914-1999)[10] 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. Nakashima already knew this modern material through Antonin Raymond, who had used plywood for his house in New Hope (1938-39) and earlier works in Japan.

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

George Nakashima's dissatisfaction with the modern practice of architecture in America catalyzed his primary adherence to woodworking, a process that he could control from beginning to end and which demanded an integrated relationship between the processes of design and production. When considering 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. As the hand drawings portray, Nakashima's sketches are not necessarily empty of details but mirror the hierarchy in the construction process.

10. It is likely that Antonin Raymond recommended Weidlinger, who had collaborated in the Reader's Digest Building (1948-1951), which was built in Tokyo by Raymond and Rado's office.

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

Within this context, Nakashima adhered to the "model of the solitary craftsman." He began to work in 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." Intriguingly, this approach resonated with other craftsmen and designers in the Northeast United States, such as Wharton Esherick (1887-1970) and previously with Henry Chapman Mercer (1856-1930).

Despite Nakashima's aloofness, a successful business demanding new facilities, offered him a chance to apply his hands-on approach in architecture that stemmed from his 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 for the construction according to the explicit wish of 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 delineated detailed and measured drawings for the construction of concrete formwork to explain and guide the construction process to his spiritual colleagues. 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 like the construction of a foundry for producing the 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."[11]

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 explore 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.

These attitudes soundly resonated with Nakashima, and rather than acting as a mere designer who envisaged 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 actions, George Nakashima upheld a hands-on approach through the appreciation of the materials and workmanship. For Nakashima, "only with that knowledge can a designer rise

11. Bern Ikeler, "George Nakashima: Tenet and Tools" in *Bucks County Traveler* (December 1951): 45-46

above the status of theoretician and create buildings that in his view successfully synthesize structure and aesthetics, as well as form and function."[12]

In fact, Nakashima more often than not spoke out against a modernist practice focused on questioning meaningless innovation and on drafting at the drawing board. For Nakashima "building is essentially a practical problem, and we must face the hard fact that the fundamentals are tools and not paper."[13] Nakashima felt that the division between designer and craftsman "compromised the aesthetics and the literal foundation of a building."[14] Undoubtedly, Nakashima merged this practice with the Raymonds' principles, earlier discussed, 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."[15]

In the case of the Arts Building and the Cloister, various and detailed sketches were delivered to the builders. This action does not contradict the widespread idea that Nakashima was intuitive and produced only few project drawings. This practice agrees with the constant supervision by George Nakashima, and even with his direct participation in the construction process. Known drawings include exterior elevations, plan, and highly defined detailing of architectural elements such as post connections and windows. This collection of drawings reveals the breakdown of the project in a manageable scale depending on the operation, and implicitly aknowledges the existence of a construction hierarchy and the involvement of other actors.

Depreciation books offer a glimpse of the construction chronology. The building permit was paid in March of 1964. In May, procurement of materials inaugurated the construction, which was extended until April of 1967(see 2.2 Construction and Alteration Chronology). One of the actors in this process was Robert 'Bob' Lovett, who had begun his collaboration with Nakashima working at the workshop in 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 a sequence of buildings at Nakashima's property, among them the Arts Building.

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 have been familiar 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

12.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): 19
13. Ibid.
14. Ibid.
15. Charles S. Terry, "George Nakashima, Woodworker" in Japan Architect (February 1963), 59-68

2.4. The Relationship with Ben Shahn and the Minguren Movement

Undoubtedly, Nakashima's friendship with Ben Shahn and his later involvement with Minguren nurtured Nakashima's interest in establishing an association with the arts and craftsmanship that transcended his woodworking activity in New Hope. Both aspects coalesced with Nakashima's spiritual beliefs and personal search for enlightenment, which is arguably fundamental to our understanding of the Arts Building and Cloister.

George Nakashima's addition to Ben and Bernarda Bryson Shahn's house. Date Unknown. Source: George Nakashima Woodworker Archives/Archiectural Archives, University of Pennsylvania.

In the mid-1950s, George Nakashima became a friend of the Russian American artist Ben Shahn (1898-1969). Both men implicitly shared beliefs about the redemptive power of the arts and their ephemerality as well, although they reached their ideals from distinct spiritual paths. This acquaintance eventually resulted in a fruitful collaboration in the arts and architecture. Ben and his wife Bernarda Bryson Shahn acquired various pieces of furniture by Nakashima, and Nakashima designed and built two additions with built-in furniture to the Ben and Bernarda Shahn's house in Roosevelt, New Jersey.

Benjamin Shahn, son of Russian Jewish émigrés , naturalized American,was a famous and resourceful plastic artist who expressed his ideas using different media such as easel paintings, 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. Nevertheless, 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.

In the late 1950s, Ben Shahn commissioned George Nakashima to design the extension of his house in Jersey Homesteads, a New Deal community now called Roosevelt, New Jersey. The original building was a single-story cinder block structure designed by Alfred Kastner; Louis I. Kahn being the assistant architect in the office.

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. 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 on the western aisle. This detail is repeated in the structural elements of the Cave at the Arts Building; an interior grill bears high resemblance to the work in the Cloister, and exterior 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.

The second work comprised an addition to the second floor, including a studio for Bernarda, a master bedroom and a terrace. Both the design phase (earliest alternative schemes are dated October 1965) and the construction occurred simultaneously with the Arts Building.

The Nakashima and Shahn correspondence and written accounts offer a glimpse into the close friendship and professional relathionship between both families. Financial records reveal that Ben Shahn's prints were sold in the woodworker complex as early as 1963, and presumably the year before. It is possible that the idea of building a gallery for exhibiting art was already present.

Unfortunately, Shahn died in 1969, shortly after the Arts Building was completed along with the first exhibition of his artwork. On one of the visits to the property, “Ben noticed that George had designed a wall with a perfect cant for a mosaic.”[16] To this end, Ben Shan painted a gouache titled ‘The Poet’s Beard,’ which had to be enlarged 5.5 times and eventually used as the base design for the mosaic.

In 1970, George Nakashima hired the services of Gabriel Loire (1904-1996) through the Société d’Exportations d’Art Religeux and the New York based Loire's agent in the United States. Loire was a well-known French stained glass mural artist based in Chartres, France. Among his commissions were the Main Line Reform Temple in Wynnewood (1960), Saint Thomas Moore Church in Allentown (1969), as well as the large-scale mosaic Passion of Sacco and Vanzetti (1967) designed by Shahn and destined for Syracuse University in New York. Pres-sumably, this last work influenced Nakashima on his choice. Poet's Beard was shipped to New Hope in October 1970 and installed on the exterior of the building in 1971.

In the 1960s, George Nakahshima was also involved in the design and construction of two sacred spaces: the Catholic Church of Christ the King in Katsura (1964-65), near Kyoto, and the Chapel of Christ in the Desert (1964-1967), in Abiquiu, New Mexico. Both projects offered Nakashima an opportunity to address faith through the creation of an integrated environment.[17]

The Japanese commision came trough Father Leopold Tibesar (1898-1970), who baptized Nakashima. The later had been in Japan in the late 1920s and was named Superior of the Maryknoll Missions in Seattle in 1935. Tibesar and Nakashima may have met earlier through Antonin Raymond's office, and when Nakashima returned to Seattle, the Catholic priest allowed Nakashima to use the workshop in the Maryknoll Boys’ Club.[18] When a group of Japanese Amerian Catholics wanted to build a church dedicated to the Maryknoll Fathers who supported the Japanese during their internment in WWII, among them Father Tibesar, Nakashima offered himself voluntary.

For Christ the King, Nakashima, with the assitance of his daughter Mira then a student in Tokyo, envisioned a 98 x 50 feet diamond shaped tilted hyperbolic paraboloid to cover an axially planned church. The whole structure, including the supporting walls were expressed in concrete. On its lower end, the roof extended from the entrance to a circular baptistry. Balancing the design, this baptistry supported a tall cross, which was placed opposite to the highest peak of the roof.

While Christ the King related to an urban environment, Christ in the Desert was an answer to the natural character of the Chama Canyon, and the materials available:

16. Mira Nakashima, 187
17. Ibid., 218
18. Ibid., 40

primarily stone, adobe, and wood vigas. Structure relied on the potentialities of these materials, therefore shaping the appearance of the building. The general form was expression of a central plan with four one-story wings of equal length extending from a central double-story glass lanterned nave.

The commission of this chapel came through Father Aelred Wall (1917-1983). George probably first met him while making the furnishings for the Benedictine community of Mount Savior, in Elmira, New York between 1961 and 1963. It is possible conversations with Nakashima happened before Father Aelred's moved to Abiquiu (and even Nakashima presumably had offered his place).

In New Hope, the Cloister probably drew upon this connection to the simplicity of monastic life and to the hospitality in the Benedictine tradition. As the oral history suggests the Cloister was intended to host Japanese craftsmen visiting New Hope. This program was probably related to Nakashima's association with the Minguren Movement.

In 1963, Nakashima 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 stone wall of volcanic rock called 'Stone Crazy' at the 1964-1965 World's Fair in New York. Nagare and Nakashima's first acquaintance became 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, Nagare brought a group of seven craftsmen from Shikoku to participate in the Japanese pavilion construction and to recreate the traditional stone masonry of Japanese castles. This pavilion, which intended to embody the best of Japan, combined three buildings that merged traditional and contemporary Nipponese designs, emphasizing the contrast between old and new, both in architecture and content. It offered an overview of the technology, products, and food along with a glimpse of pre-industrial Japan to the World's Fair visitors.

Nakashima probably abhorred the technological purview of the fair. However, the improvised character that Nagare showed during the construction aroused his sympathy. In response, Nagare invited Nakashima, being a craftsman himself, to join Minguren. Nakashima did not hesitate to collaborate with this group, establishing a strong tie that was memorialized when the Arts Building was renamed Minguren Museum. Other material evidence of this to 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 to the second story at the Arts Building. Additionally, Nakashima placed a sculpture called 'Keyhole' by Masayuki Nagare, initially made for the Japanese Pavilion, near to the entrance.

Along with the architectural projects, 1964 was a hectic year. After preliminary contacts in the 1950s, and probably earlier, Gira Sarabhai invited Nakashima to visit the National Institute (NID), where he became a consultant and supplied designs for furniture. On his way to India, Nakashima visited Nagare in Takamatsu. At his return, the Arts Building and Cloister in New Hope became a natural repository for this renewed transnational interchange, as its collections and use have

George Nakashima and the first Altar of Peace completed. 1986. Neal Boenzi. Source: George Nakashima Woodworker Archives.

George Nakashima's sketch for the Altar of Peace. Note scuplture by Source: George Nakashima Woodworker Archives.

demonstrated throughout the years. The Arts Building and Cloister bridges art, craft, and education all interwoven with a deep spiritual meaning. As defended by Nakashima, architecture became the expression of an ideal. Besides the events involving the community, this is also a space of retreat and contemplation.

2.5. The Foundation for Peace

In 1983, Nakashima purchased a large walnut log from his logger, Frank Kozlosky. The log was obtained from a 300-year-old tree in Long Island, 12 feet long, and tapering in diameter from 5 to 7 feet. This extraordinary specimen became the seed for Nakashima's vision of bringing peace “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.”[19]

The first Altar, to be installed at the Cathedral 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 on a base, connected by butterfly keys, and engineered to allow expansion and contraction because of thermic loads.

When George Nakashima passed away in 1990, the first Altar of Peace was already placed and there were negotiations to install a second one in Russia.Eventually, this was housed in the Academy of Sciences in Moscow in 2001. In 1996, a third Peace Altar was dedicated in Auroville, an international spiritual community near Pondicherry founded by Sri Aurobindo and Mother Mira in 1968.

The Altar of Peace Project was renamed as the Nakashima Foundation for Peace in 1995, which would set the Altar of Peace Project and the advocacy of related cultural programs as its main goals. Marion Nakashima, donated the Arts Buildings and Cloister to the Foundation in 2003. Besides being the center for a mission committed to peace, the building houses wood boards for crafting new future altars, personal objects gathered through the years by George Nakashima and his family, prototype furniture and archival material, and it is used for concerts and other events related to the Foundation for Peace’s goals.

19. Ibid., 236

Arts Building and Cloister site map with character areas.
(See Naka A-01. Site Map and Naka A-02. Ground Floor)

3. Understanding the Landscape
Nicholas Pevzner, Landscape Architect

3.1. Site History

Context and Setting

The Arts Building and Cloister landscape is part of the George Nakashima Woodworker's Complex, a collection of fifteen buildings occupying a south-facing gently sloping site nestled amid patches of residential properties and oak-mixed hardwood forest, in the Lower New England-Lower Piedmont ecoregion, just west of the Delaware River in Solebury Township, Buck's County, Pennsylvania. It is located about two miles south of the town of New Hope, PA.

The Arts Building and Cloister are the southernmost of the buildings on the property, and occupy the relatively flat ground at the bottom of the gentle slope. The landscape around the Arts Building contains a series of carefully designed gardens and plantings, interpreting traditional Japanese landscape design and mediating the Arts Building's relationship to the larger Nakashima property.

The Arts Building and Cloister is surrounded on three sides — north, east, and south — by mixed deciduous forest, and on the southwest by lawn with hay meadow beyond. The landscape immediately surrounding the Arts Building includes a straight stone wall, pea stone patio, and stone-lined pond, with associated vegetation (pond planting). The larger borrowed landscape of the Arts Building includes the individual trees to the west and southwest, and the forested character of the view to the north, east, and south.

Chronology

The immediate site of the Arts Building prior to the 1964 was predominantly forested, with an adjacent clearing that corresponds roughly to today's west-side Lawn. The Swimming Pool and the Pool House had been built three years prior, between 1960 and 1961, and were connected to the rest of the complex' buildings (such as the Conoid Studio, Chair Department, and Finishing Department) via a gravel driveway.

In 1938, an historical aerial photograph shows areas of agricultural land being cultivated amid a forested extension. This was the Bucks County's scenery Nakashima experienced before he purchaded the 3 acres of land from a Quaker farmer.

Early in the history of the George Nakashima Woodworker's Complex, the Pennsylvania Department of Agriculture planted Scotch Pine (Pinus sylvestris) on the southern slope of the property, probably for erosion control.

Prior to construction of the Arts Building, the Seasonal Pond was excavated, lined with a clay bottom and surrounded by boulders and planting.

In the 1960s, George Nakashima planted cryptomeria (Cryptomeria japonica) and Dawn Redwoods (Metasequoia glyptostroboides) along the primary Pool House

Below: George Nakashima Woodworker's Complex before the Arts Building and Cloister was built. 1962. Author: Ezra Stoller, Esto Photographics. Courtesy of George Nakashima Woodworker Archives.

gravel drive, between the Arts Building and the Pool House, in the existing clearing south of the Pool House gravel drive. In the 1980s, just west of the stepping stone path to the Arts Building, George Nakashima planted two rows of flowering cherries, which persist today.

Also in the 1980s, just to the south and east of the George Nakashima Woodworker's Complex property, the forest was cleared and a neighboring house was built. This house is visible today to the south of the Arts Building when looking out across the main Pond.

3.2. Existing Conditions

The Arts Building and Cloister landscape contains a number of primary zones, or character areas. Two main areas that dominate the design are the South Patio and the main Pond. Both echo elements of traditional Japanese garden design, and both are framed by the L-shaped covered walkway that connects the entrances of both the Arts Building and the Cloister. These two areas, along with the stone pavers of the covered walkways, are most directly experienced from within the Arts Building and Cloister, or when arriving.

South Patio

To the south of the Arts Building proper, is a raised pea gravel patio (the South Patio, see A1), which serves as the point of arrival when coming via the stepping stone path from the main Pool House gravel drive. The South Patio grade is two steps up from surrounding grade, flush with the interior floor elevation of the Arts Building. Along the south side it is held by an 18"-thick low dry-stacked stone retaining wall; along the east and west sides the patio is retained by lines of large rocks in linear arrangements.

Along the southern side of the South Patio, there is a sculptural arrangement of two large three-dimensional stones in conversation, plus a composition of four flush square paving stone plates. A slow stepping-stone path leads visitors along the northern edge of the South Patio to a very large flat mica schist stone in front of the entrance. The reflective mica in the schist stone catches the sun when viewed from inside the Arts Building, resulting in a visually dramatic experience when opening the front door (see A2).

A second row of stones, protruding slightly higher from the pea gravel, serves as the northern edge of the South Patio, dividing its fine gravel from the rougher gravel directly below the overhang of the Arts Building roof. A triangular wooden lantern, with a natural stone cap, anchors the eastern side of the South Patio.

Main Pond

The Main Pond (see A3) is a central visual feature of the Arts Building landscape. The main Pond is roughly circular, and is lined with large stones, small stones, lines of wooden posts, and planting. A small waterfall flows into the Pond from the side facing the Arts Building (see A4). The pond uses recirculated water, using a pump housed inside the Arts Building.

There are a number of fairly large stones that feature prominently in the Pond landscape. One of these, labeled “large stone” on George Nakashima’s drawings, is exceptionally large and noteworthy, and is the focal point of the main Pond. Irregularly shaped and vaguely saddle-like, it predates the construction of the pond and Arts Building landscape, found in-situ, and roughly mirrors the hyperbolic paraboloid shape of the Arts Building roof.

Pond Planting

The Pond Planting areas are lower in grade than the South Patio, enclosed by large stones and featuring bare soil. The vegetation includes small shrubs and one large Eastern red cedar (Juniperus virginiana) tree. The red cedar tree is the visually dominant vegetation in this planting area, which spans both sides of the main Pond.

Gravel Driveway

At the north side of the Cloister and the east side of the Arts Building, the Gravel Driveway (see A5) terminates in a large parking area. For visitors arriving by car, this driveway offers the main arrival sequence. The driveway is framed by woodland trees on both sides, and large rocks framing the edge of gravel. A rectangular patch of groundcover vegetation and a Black Locust (Robinia pseudoacacia) tree occupy the corner between the Arts Building and the Cloister, framed by lines of small- to medium-sized stones delineating the edge of planting. From the parking area, a visitor can pass under the covered walkway between the Arts Building and Cloister, which serves as a spatial threshold, across a large mica schist paving stone, and into the main Pond space.

Also visible from the Gravel Driveway is the heating oil tank adjacent to the Cloister, partially screened by the ash (Fraxinus) tree in front of it.

West Pond, West Gravel, and West-Side Groundcover Planting

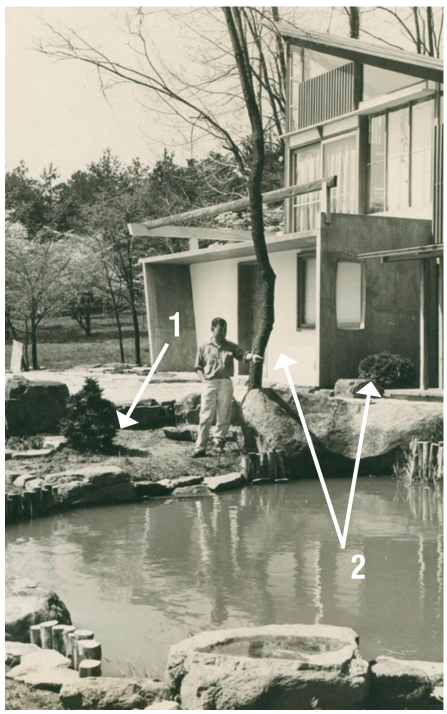
The west side of the Arts Building features a small pond and a patch of groundcover planting (see A6), as well as two areas of rough gravel delineated by linear frames of small- to medium-sized stones (see A7). The water in the West-side Pond is not circulated. The pond and planting can be seen from inside the Arts Building through a large full-height window. The rough gravel patch on the southern side of the west façade of the Arts Building stretches just over halfway along the length of the mosaic mural. Flowering dogwood trees are growing from between the framing rocks in two places along this stretch of west façade — in the rocks lining the West Pond and the West Gravel.

South-side Wooded Verge and East-side Wooded Verge

The woods just to the south and east of the Cloister are remnant patches of the woods that predate the construction of the Arts Building (see A8 and A9 respectively). The South-side verge is dominated by a mix of beech (Fagus), tulip poplar (Liriodendron tulipifera), black locust (Robinia pseudoacacia), and ash (Fraxinus sp.). The East-side verge is dominated by black oak (Quercus velutina) and swamp white oak (Quercus bicolor). The South-side wooded verge contains some white pine (Pinus strobus) trees and some stands of bamboo.

West-side Lawn and Seasonal Pond

To the west of the Arts Building and South Patio is a large expanse of mowed grass with occasional trees. Within the West-side Lawn, a Seasonal Pond acts as a visual point of interest (see A10). This Seasonal Pond is clay-lined, and lined with large stones and vegetation, but the water is not pumped or circulated. A hay meadow extends south beyond the West-side Lawn, immediately to the south of the Seasonal Pond.



South Patio and Pond Planting, Historic (1967) and Current Conditions (2016):

1. Planned vegetation that conveys original design intent, now mature. 2. Formely planted vegetation that conveys design intent that is currently missing.

Source: George Nakashima Woodworker Archives (left). Photo by author (above, right).

3.3. Analysis and Evaluation

This section offers an assessment of the integrity of the landscape immediately surrounding the Arts Building and Cloister, and traces the changes that have taken place in this historic landscape. Where appropriate, this section offers evaluations of the condition of contributing and significant elements of the historic Arts Building landscape.

Vegetation

Vegetation was an important design element for George Nakashima on the property, and this is equally true of the Arts Building landscape. As with all vegetation, the passage of time, and the process of biological growth, continually alter the landscape.

The trees and shrubs around the Arts Building can be characterized as belonging in one of three categories:

1. Those that he planted as saplings have since grown up to be large mature trees, altering the visual character of the landscape compared to historic photographs, but continuing to comply with the landscape's design intent.

2. Those that were present early in the design of the Arts Building, but that have since died and been removed, occasionally resulting in a geometric outcome that now lacks rationale. In this case, the missing vegetation is keenly felt, and its absence adversely impacts the design intent.

3. A third category of trees — those that have self-seeded and have been allowed to remain — may not have been part of the original design intent, but their removal may cause more dramatic adverse impact to design intent than their continued growth. This category of vegetation needs to be evaluated on a case-by-case basis.

South Patio and Pond Planting

The primary example of the first category — small planted trees that have grown up — is the Eastern red cedar that George Nakashima planted next to the main Pond, in the Pond Planting zone. This tree, appearing as a small seedling next to George Nakashima in the historic photo below, has grown to be a full, mature tree in the almost 50 years since it was planted. The mature tree continues to demonstrate design intent.

On the other hand, the missing deciduous tree and small evergreen shrub constitute voids that violate the design intent of the Pond garden. The dominance of the Eastern red cedar and the absence of the formerly larger and more dominant deciduous tree has altered the design intent.

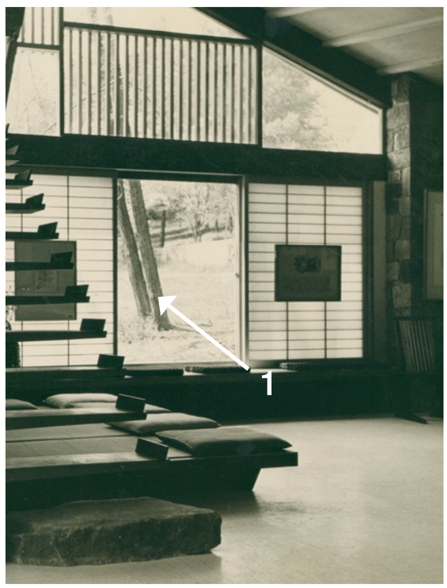
While it would not be advisable to remove or otherwise damage the Eastern red cedar at present (and indeed all attempts should be made to maintain its health), if in the future the red cedar were to die, original design intent through the planting of a large deciduous tree and a small red cedar in their historic relationship could be restored.

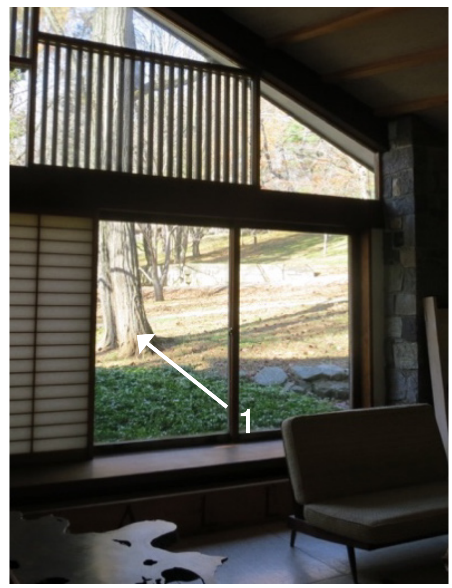
West Gravel and West-side Planting, Historic (1967) and Current Conditions (2016):

Formely existing trees that are currently missing, adversely impacting the design intent, which should be replanted (2); Self-seeded trees that were not part of the original desing intent but which should be allowed to remain (3).

West-side Lawn, Historic and Current Conditions:

Black locust trees visible from inside the Arts Building, contributing to the Arts Building landscape (1). These twinned trees are continuing to grow well.





West Gravel and West-side Planting, Historic (1967) and Current Conditions (2016):

Missing retaining stone(s) at edge of Pond Planing (1). Stone that has moved or been added to the Pond Planting garden, resulting in an unintentional arrangement. Note also the electrical outlet at the base of the South Patio Stone Wall, which is non-contributing and which alters the design intent (2).

Source: George Nakashima Woodworker Archives (left). Photo by author (right).

The small evergreen shrub by the sliding glass door Arts Building entrance could be replaced at any time.

West Gravel and West-side Planting

Along Ben Shahn's mosaic mural wall, is another prime example of the second category: formerly planted vegetation that has since been removed, upsetting the design intent. The rectangular geometry of the West Gravel formerly responded to the presence of a deciduous tree, which is now missing.

West-side Lawn

The two large mature black locust trees just west of the West Pond, visible from inside the Arts Building and still alive and in good health, are an important contributing feature of the Arts Building landscape.

Stone

The Arts Building landscape relies heavily on sculptural stones, stone borders, flush paving stones, and larger pre-existing in-situ stones to organize space, direct movement, and serve as visual compositions. Stone is much more stable than vegetation, and most of the stone around the Arts Building remains in good shape. In several places, however, stones have deviated from the original design intent. These situations can be characterized as follows:

1. Stones that have been removed or displaced, or that have migrated, resulting in an altered design intent.

2. New stones or other elements that have been added, altering the design intent.

3. Stones that have become obscured by soil, turf, or groundcover vegetation, altering the design intent.

South Patio Stone Wall and main Pond Planting:

In the Pond Planting area that currently hosts the large Eastern red cedar tree, comparison with historic photos suggests that a large retaining stone is missing, breaking the clear delineation that historically existed between the South Patio and the Pond Planting zone.

There are also new stones present in the Pond Planting which do not appear in historic photographs, suggesting that they are indeed the missing elements of the stone border, having moved or been displaced.

Along the south side of the South Patio Wall, at the eastern end of the stone wall, an electrical outlet protrudes from the grass in front of the wall. It is a non-contributing feature, distracting from the simplicity of the wall's geometry, and the visual presence of the electrical outlet should be minimized if possible.

For stones that have migrated or are missing, attempts should be made to restore these primary structuring elements, in consultation with historic photographs. Of primary note is the area between the South Patio and the Pond Planting: attempts should be made to locate the missing stone(s) of the retaining wall border between the two zones, and to reset them.

West-side Lawn

The west-side lawn features an approach path that was recently improved with stone paving. The new paving visually dominates the more subtle paving stones on the South Patio, minimizing the feeling of arrival. The new paving also departs from the design intent for the western approach, which was intended to be much less dominant, composed of separated stepping stones amid grass. This previous version of the approach path is visible in historic photographs.

The new stone paving is non-contributing, and should be rethought as part of a restored approach sequence, which should reference the original path geometry and material.

West-side paving stone approach path as desinged, 1967 (20; current conditon showing overly dominant stone paving, 2016.

Gravel and planting areas around perimeter of Arts Building and Cloister are dotted with instances of the subterranean termite control system (2), which are not part of the original design intent and are non-contributing.

Source: George Nakashima Woodworkers Archives (above left); Photo by author (above right, right)

Gravels and Stone Munch

The small, loose paving material that covers up the various surfaces around the Arts Building is important not only for its visual character, but also for the tactile experience it affords, and the sound it makes when stepped on. There are five sizes of gravel present in the Arts Building landscape (coarse crushed gravel, fine pea gravel, coarse pea gravel, larger stone mulch, rounded river stones).

The original gravels are still present, and continue to contribute to the design intent, but the gradual mixing and migration of some of the gravels from their intended locations is slowly eroding the design intent of the landscape. Nakashima did not use steel borders or edging to make sharp distinctions between different gravels, so the division between zones ends up following roughly along the lines set out by linear rows of larger stones.

On the right, from top to bottom, the gravels are:

B1. Coarse crushed gravel at the north driveway.
B2. Larger stone mulch as used in the North Gravel and one zone next to the main Pond.
B3. Fine pea gravel used on the Arts Building entrance.
B4. Fine pea gravel used on South Patio and covered walkway.
B5. Rounded river stones as used along the River Stone Strip between the main Pond and the Cloister.

Wooded Landscape Features

There are three primary wooden landscape features in the Arts Building landscape:

1. Wooden posts lining areas along the main Pond.
2. Wooden logs lining the north edge of the North Gravel area.
3. Wooden lantern on the South Patio.

Wooden Posts

The wooden posts at the edges of the main Pond are in an advanced stage of deterioration, with some posts completely missing. They posts are in constant contact with the water; many are rotten at the base and splitting at the top. The posts should be restored or replaced as necessary to maintain their appearance as part of the pond perimeter.

Wooden Logs

The wooden logs at the north edge of the North Gravel area separate it from the North-side Wooded Verge beyond. This is the only example of logs being used to separate character areas. The date of these logs is uncertain. Follow-up interviews with employees at the wood shop and at the tree maintenance company that manages the woodland for George Nakashima Woodworker should be conducted to determine whether the logs are contributing or non-contributing features of the Arts Building landscape.

Wooden Lantern

The wooden lantern is of a design that appears in several other locations on the George Nakashima Woodworker's Complex property, and is an important contributing element of the Arts Building landscape. The lantern on the South Patio was recently remade, following George Nakashima's original design, by craftsmen in the wood shop.

Views

The primary view that extends the Arts Building landscape beyond its immediate surroundings is the view from the main gallery space of the Arts Building to the south, across the pond, towards the South-side Wooded Verge (see C1 and C2). Historically this view would have consisted of a solid wall of forest immediately beyond the Arts Building clearing, enhancing a feeling of seclusion and focusing attention on the pond garden landscape.

In the 1980s, the neighboring tract of forest just beyond the eastern property line was bought and a house developed. Much of the forest around this new house was cleared and replaced with lawn. This resulted in the forest to the south and southeast of the Arts Building, instead of extending as a solid wall of vegetation, to instead be transformed into a thin strip of porous woodland. This visual porosity is especially evident in the winter, when the deciduous trees lose their leaves, distorting the design intent of the pond landscape.

Other contributing views of the Arts Building landscape are the views to the west from the main gallery room through windows in the western elevation (see C3), and to the west from the South Patio across the Seasonal Pond (see C4 and C5). The north and east elevations of the Arts Building are solid and offer no views. The potential for the nearby East-side Wooded Verge and North-side Wooded Verge to be contributing features should be studied further.

Wooden Posts, Historic (1967) and Current Conditions (2016): Pond post at edge of main Pond, with arrow highlighting missing posts.

Balloon Photo with arrows showing the logs separating the North Gravel area next to the Arts Building, from the North-side Wooded Verge at the left of the photograph. Clearly visible is a stump from a freshly removed mature tree, next to one of the balloon operators dressed in red.

Wooden Lantern, Historic (1967) and Current Conditions (2016)

Source: George Nakashima Woodworker Archives (left); Photo by author (right)

Aerial view of George Nakashima Home, Studio, and Workshop complex.
Source: Pennsylvania Imagery Navigator/Delaware Valley Regional Planning Commission.

Gravel driveway from Conoid Studio to northeast parking area.

Approach

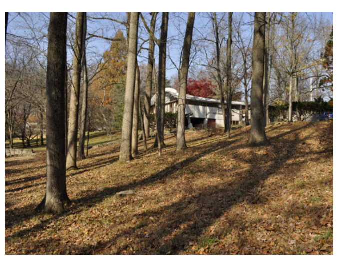





Departure








3.4. Visual Corridors

Photographs taken during a site visit in late October 2016.

The left group illustrates the sequence approaching the Arts Building from the Conoid Studio through the driveway on the eastern limit of the site.

The group on the right illustrates the opposite direction.

Aerial view of George Nakashima Home, Studio, and Workshop complex.
Source: Pennsylvania Imagery Navigator/Delaware Valley Regional Planning Commission.

Gravel driveway from Conoid Studio and visitor pathway leading to the Arts Building.

Approach

Departure

Photographs taken during a site visit in late October 2016.

The left group illustrates the sequence approaching the Arts Building from the Conoid Studio through the driveway leading to the Pool House and visitor pahtway.

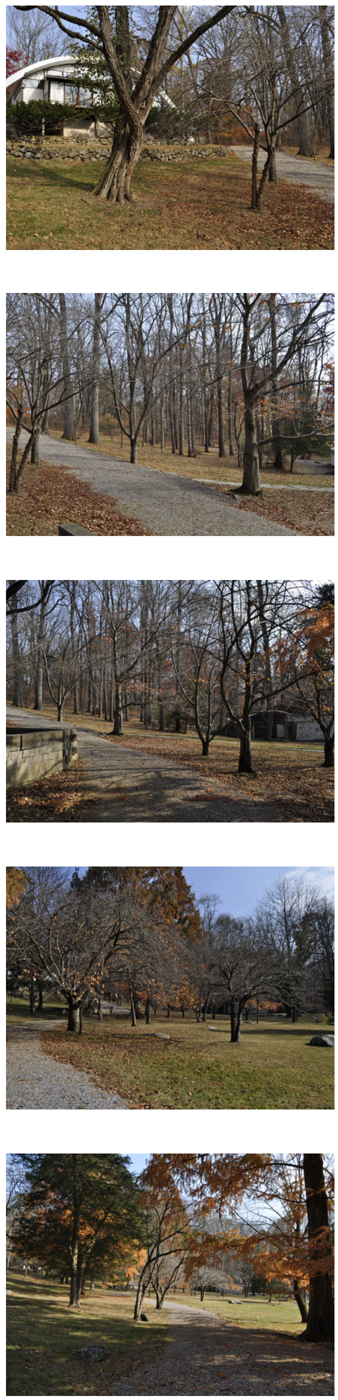
The group on the right illustrates the opposite direction.

Aerial view of George Nakashima Home, Studio, and Workshop complex.
Source: Pennsylvania Imagery Navigator/Delaware Valley Regional Planning Commission.

Gravel driveway from Conoid Studio to the Pool House.

Approach

Departure



Photographs taken during a site visit in late October 2016.

The left group illustrates the sequence approaching the Pool House from the Conoid Studio through the driveway diving the group of residences, workshop and studio from the lawn.

The group on the right illustrates the opposite direction.

Aerial view of George Nakashima Home, Studio, and Workshop complex.
Source: Pennsylvania Imagery Navigator/Delaware Valley Regional Planning Commission.

Views from and to other locations on the site

1a.  1b. 

Views of the Arts Building from the Conoid Studio (1a) and from the Chair Department (1b), respectively.

2.  3. 

View of the large lawn on the southwest (2) and the Conoid Studio (3) from the Arts Building terrace.

4.  5. 

Views of the Arts Building from the Conoid Studio (1a) and from the Chair Department (1b), respectively.

6.  7. 

Views of the Arts Building from the Conoid Studio (1a) and from the Chair Department (1b), respectively.

8a.  8b. 

Views of the Arts Building and sorrounding woodland from the west side of the lawn.

9a.  9b. 

Views of the Arts Building and sorrounding woodland from the south lawn.

3.5. The Arts Building and Cloister Site Boundaries

The Arts Building and Cloister stands apart. Faithful to his principle of creating integrated environments, George Nakashima carefully designed the immediate surroundings of the compound. Natural features found their proper place in a progression from a selected arrangement of pavements, plantings and ponds to the wildness of nature. Exceptional in its ability to make the visitor feel peace, this environment still imparts an idea of retreat.

In legal terms, the place is comprised of two components: the Arts Building and Cloister understood as all the associated fabric within its boundary walls, and Limited Common Elements, which are the exterior architectural elements and the associated landscaped and planted areas. These limits are described in the Minguren Condominium bylaws. As a part of her estate planning, Marion Nakashima created this condominium association and divided George Nakashima Home, Studio, and Workshop property into three units. Within the Condominium, the Foundation owns the Arts Building and Cloister and has responsibility to assure the Limited Common Elements are kept in a state of good repair and condition. In its respective percentage interest and to the extent established by the bylaws, the Foundation shall contribute to the administration and burdens of the common elements, which include elements such as driveways, pathways, and parking stalls, as well as the Pool House, the Swimming Pool, and the Reception House.

The strict interpretation of the bylaws helps to limit the components described above to the fabric and the immediately surrounding designed landscape. However, the management of the place as a cultural resource compels one to embrace a broader extension. This extended area would consist of the south and east side wooded verges, as well as the views towards the west side, including but not limited to the lawn and the seasonal pond.

This setting contributes to the distinctive character of the Arts Building and Cloister and is integral to George Nakashima's intent. In interpreting the visual approach and departures from the place, it has been possible to define a perimeter which draws on the concept of a buffer zone. In addition to the codes and ordinances compliance, in cultural planning terms, changes within this area must be assessed regarding their impact on the spatial scale, approach and departure sequences, including the visual relationship with the rest of buildings situated on the woodworking complex.

Towards the east, south, and west, this perimeter is limited by the Minguren Condominium property boundaries. Surrounding land on the south side of Aquetong Road is enrolled in the Agricultural Security Area program. This enrollment does not guarantee that land -as is- will be permanently preserved, but provides a series of benefits that may discourage further scattered development.

Proposed buffer zone and legal boundaries

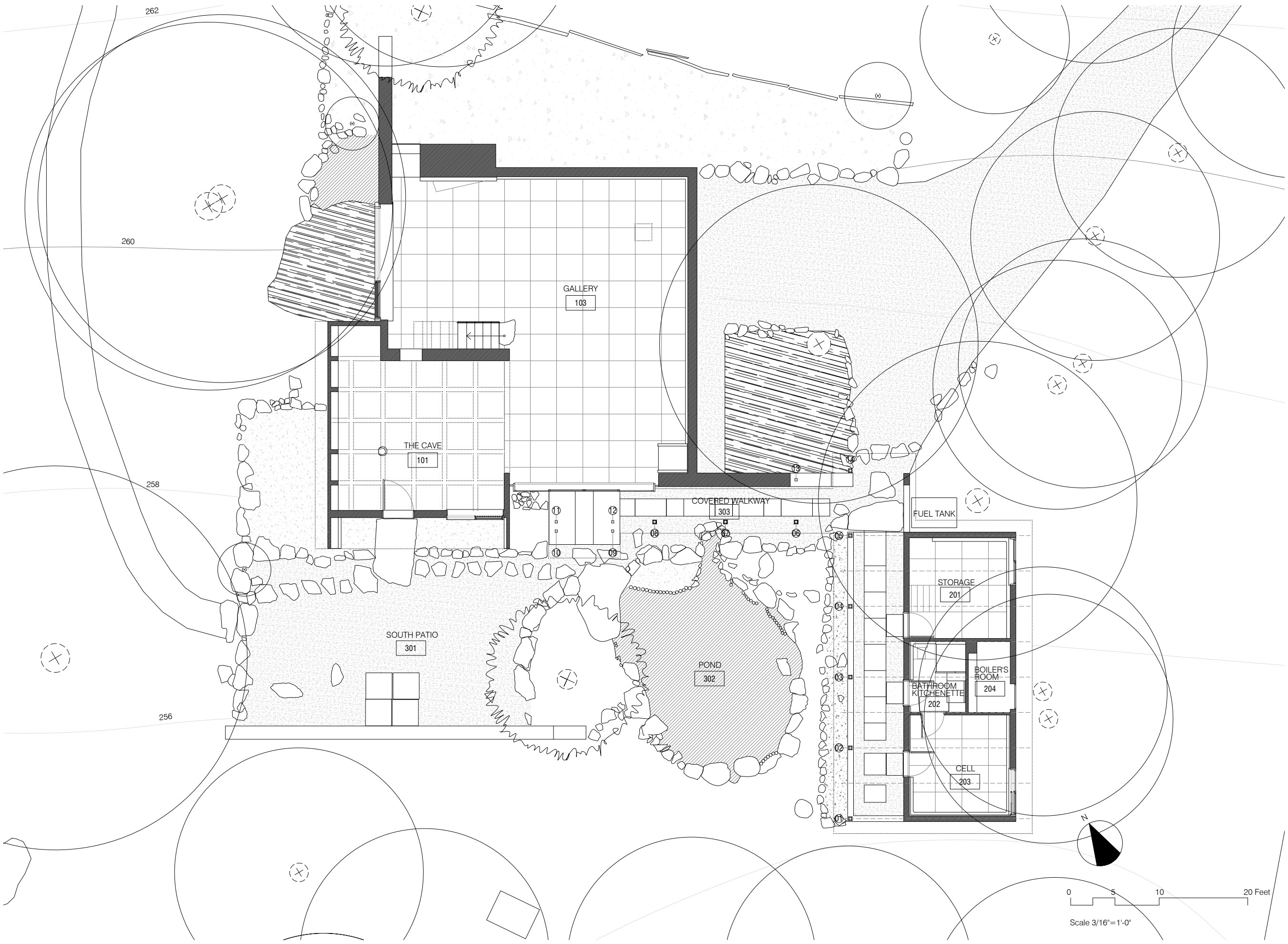
• • • • George Nakashima House, Studio and Workshop site - Minguren Condominium

Arts Building and Cloister - owned by the Foundation

Limited common elements

Proposed buffer zone

Agricultural Security Area



Arts Building and Cloister site map with character areas.
(See Naka A-01. Site Map and Naka A-02. Ground Floor)

4. Understanding the Building

4.1 Architectural and Material Description

Visitors walking down the path from the Conoid Studio soon recognize the expressive Arts Building with its tilted hyperbolic paraboloid roof that contrasts with a restrained and smaller attached Cloister. Both buildings stand apart in an isolated wooded area on the eastern limit of the property, where the slope flattens out. As described earlier, the compound displays Japanese and Bucks County influences, which are recognizable through the use of typical architectural elements that are merged in a new way of expression. In this building, it is possible to find a combination of traditional materials, such as stone and different woods, with innovative twentieth century materials, such as plywood and concrete block.

The Arts Building is a two-story structure about 23 feet high, nearly 36 feet by 40 feet in plan, intersected by a tilted hyperbolic paraboloid that has a lower peak on the northeastern corner[1], about 9 feet high above the finish floor, and a higher peak soaring vertically approximately 14 feet on the southwest. Obliquely rising from two 18 inch-thick random rubble masonry abutments in the west and the south, the Arts Building opens entirely towards the south and west* through the interplay of structural wooden elements and single and double-glazing infill. Conversely, two load-bearing reinforced concrete block masonry walls enclose the space towards the east and north and secure the lower edges of the roof.

A reinforced concrete volume, just above 8 feet height, with a waffle slab and inclined west wall, projects outwards on the southwestern corner of the building. This volume gives form to four functions: to anchor the higher peak of the roof using an Eastern white pine post connected to a standing beam; to announce the main entrance; to serve as an exterior terrace; and to act as Ben Shahn's mosaic support. Upon this volume, an interconnected combination of wood and poured concrete handrails limits the terrace.

Connected to the Arts building by an L-shaped covered walkway and porch, the Cloister is a simple one-story construction about 11 feet tall and measures approximately 19 feet by 39 feet in plan. The Cloister structure is comprised of exposed concrete block masonry walls pierced by two windows and a door on its east elevation, and by three doors on the west elevation.

Interior spaces

In the main entrance, the transition between the exterior and the interior is formally expressed through a single ample door inserted in 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 compressed 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 inclined wall reinforced with concrete ribs on the west side, and a stone masonry wall on the north side. The east side remains open to the main exhibition area.

* In the description, the author uses the architectural north. The building is skewed about 15° clockwise from the north-south axis.

Stone slabs of various sizes and shapes form the flooring, which is heated by a radiant heating system. A lower waffle ceiling, which consists of a six by five reinforced concrete grid, emphasizes the compressing effect. On the northwestern corner, hidden by a folding door, there is a bar with water supply. Five skylights with fixed shoji screens and a window with sliding shoji screens provides a filtered light to this space.

The exhibition area reads as a flowing, variable-height large room, divided into two sections: a large exhibition area and a sitting area around a fireplace. Reportedly, the north and east wall are plastered with Structolite™. The flooring is of vinyl asbestos tiles simulating travertine produced by Amtico. Referencing the exterior materials, the fireplace is constructed of uncoursed random rubble stone 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 to 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 loft overlooks the main space of the gallery and has direct access to the exterior terrace through an opening with sliding doors. A walnut floor, built-in spindle-back settee (a Conoid bench with double back), and built-in shelves enriched with a variety of different connections characterize the space. For ventilation, there are two single paned casement windows with a crank handle.

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

The Arts Building is further screened by Japanese-inspired hinged cypress grills and shoji screens. The varying combination of glazed spans and grills generates different degrees of privacy while offering shade and controlled view of the surrounding landscape.

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 granule-surfaced waterproof skin. The pavement is comprised of reddish fieldstone flat slabs directly placed upon the ground and with gray gravel, which covers the rest of the pathway.

Below: The Arts Building's exhibition space. Notice the cantileverd steps leading to the mezzannine. November 2015.

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 on a different level, in the rear, the Cloister walls directly meet the ground level.

Divided by concrete block partition walls, the Cloister layout is comprised of four spaces: a storage room, now used 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 boiler.

Douglas fir wood plates rest upon the concrete block walls, and provide the necessary connection between rafters and walls. Rafters support a decking of tongue and groove fir boards, probably 2 by 4-inch. Like the covered walkway, the roof is finished with a granule-surfaced waterproof membrane. The presence of a plywood substrate as indicated in George Nakashima's sketches is unknown.

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 screen 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 vinyl tile simulating travertine. In the living/sleeping area, three walls are covered with Structolite™.

The Hyperbolic Paraboloid Roof: Plywood, Copper, and Impervious Materials.

For the Arts Building, Nakashima reproduced the plywood shell roof first developed for the Main Lumber Storage (1958). 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 face of the plywood.

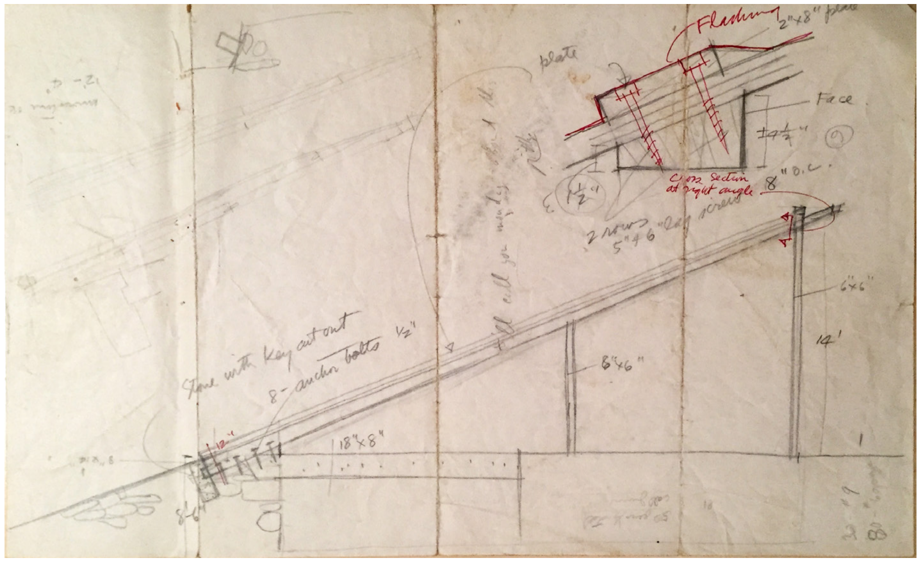
The New York engineering firm of Paul Wiedlinger Associates suggested the use of three layers of 1/2-inch plywood, shifted ninety degrees to overlap joints, and nailed with twelve 6d nails per foot. Hand measuring revealed that each panel is 5/8-inch thick, and 4’ wide and 8’ long, which was a common standard in the plywood industry since the early 1930s. Therefore, the as-built thickness shows an excess of 3/8-inch compared to the initial design.

Regarding the construction, Robert “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. Opposite sides are laid on the ribs and opposite ends, which appear not to be glued, abut to the adjacent panels. Available hand drawings show that plywood boards were fastened with 2 rows of staggered nails at the panel edge placed on the ribs.

This plywood shell was connected to tapered edge beams on two sides, and to warped plates installed on the load bearing walls. Archival photo documentation suggests that the plates were fastened with two rows of staggered bolts spaced 8 inches on center. The bolts were embedded into a poured concrete bond beam capping the concrete block masonry. Part of the bolts were countersunk to secure the plate to the bond beam. A number of them, approximately each two feet, extended beyond the plate plane and were used to join the three layers of plywood and an upper 2x8-inch plate.

The latter was installed all around the plywood shell perimeter. A sketch by Nakashima shows a cross section at right angle through the assembly on the west elevation. The plate was screwed to the beam with 2 rows of 5-inch and 6-inch long screws spaced 8 inches on center.

Above: Craftsmen placing the first plywood layer in the Arts Building. Author unknown. Source: George Nakashima Foundation for Peace.



Cross section at right angle through plate and edge beam by George Nakashima.N.d. George Nakashima Collection, James A. Michener Arts Museum Archives. Gift of Mira and Kevin Nakashima.

The sketch also shows the structural configuration. The edge beam is supported by an upright on the upper end, at a middle point, and assembled to a notched stone at its lower end. 1/2-inch anchor bolts secured the edge beam to the masonry below. Although as built upright sections differ from the annotations, the arrangement is a fairly faithful reflection of this scheme.

Beyond the perimetric structure, the plywood shell projects to form wide eaves, which taper towards the roof's upper corner. The lower layer of plywood sets back and projects only about two feet. Currently soffits are painted opaque white. Flashing trims and fascia, reportedly made of cypress, protect the edge of the eaves. The fascia is comprised of different segements, probably because the wood was not available in the required length as well as because of later alterations. Scarf joints were used in the south and west elevations, whereas in the north and east elevations the fascia appears to be abutted and screwed to the plywood shell.

The covered walkway and Cloister's porch shows a similar fascia. An inset detail by Nakashima shows a 1 1/8-inch thick wooden strip notched to receive and house the plywood panel, whereas on the walkway an inset detail depicts a 1 3/4-inch by 5 1/2-inch cypress fascia. Therefore, these components perform a double function: they protect the edge and stiffen the border, which has more proclivities to deterioration. In the case of deterioration, they can be replaced without affecting the plywood deck.

According to Bob Lovett, the roof was finished with two layers of 3/4-inch Celotex™[20], asphalt saturated felts, and eight tons of marble chips on top of the asphalt lining. 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. These bituminous coatings may involve liquid bitumen with asbestos fibers admixed.

The hyperbolic paraboloid roof eaves are covered with copper sheets, which are overlapped and present sealed joints. The outer edges of the outward sheets are bent over an edge nailer. The outer edges of the inward copper sheets turn up to

20. Usually, Celotex™ was an insulating fiberboard which could be used as ordinary sheathing in walls and cealings. The board had a waterproofing treatment. Roof sampling will offer the opportunity to investigate and identify the type and the properties of the material.

form a gravel stop that contains the built up roofing. This assembly creates a wide channel to carry water towards the gutters. Expansion joints are not recognizable.

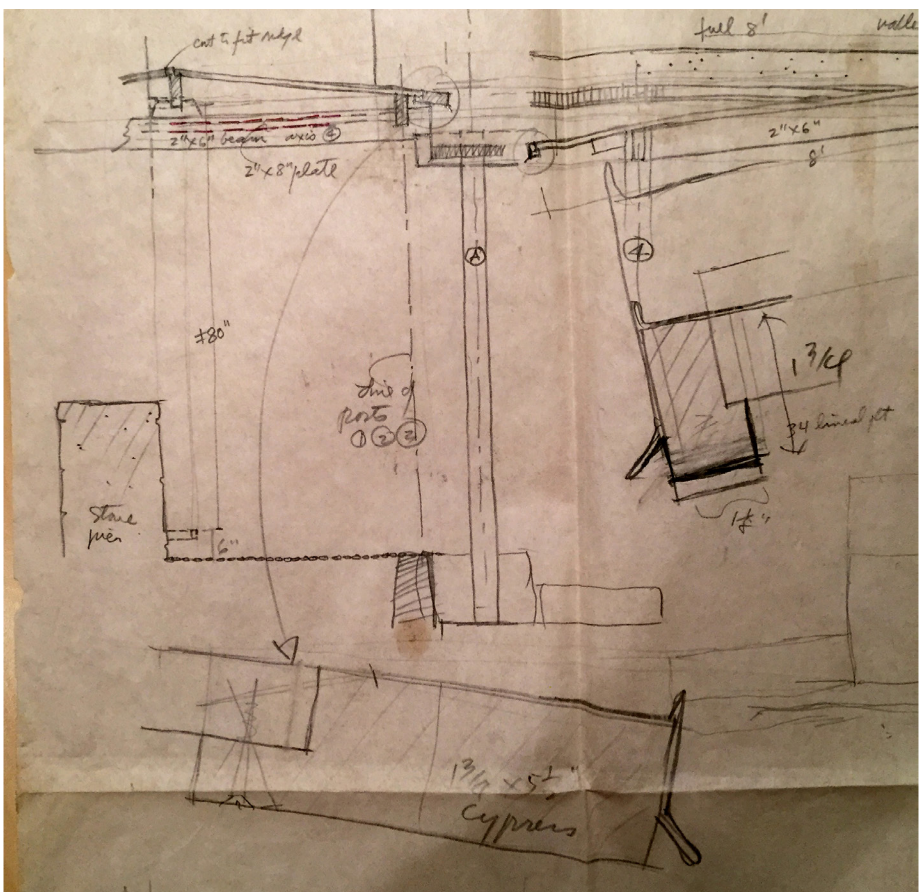
Box-style copper gutters (approximately 3 1/2” x 3 1/2”) are directly fastened along the drip edge of the eaves in the north and east elevations. Instead of outlets and downspouts, the gutter ends are open and extend beyond the eaves’ limits to drain the rainwater directly to two ponds strategically situated on the west and south patio. Gutters appear to be custom made, manufactured from 0.250” patinated copper sheet and the sections assembled by overlapping and nailing their ends. Numerous hidden copper hangers help to preserve the squared section shape and to connect the gutters to the gravel stops, also crafted with copper sheets.

A canopy, a deviation from the original design, protects the window seat on the west elevation. Copper sheets are connected using standing seams. Seams and edges appear to be adequately sealed. Copper is also used on the flashing of the stone masonry chimney and in the patinated copper flashing trims installed in the covered walkway, which connects the Arts Building and Cloister, as well as in the Cloister’s roof and porch.

The Envelope

Stone

In the Soul of a Tree, Nakashima praised the Bucks County barns and admired the



Sketch depicting two types of fascia by George Nakashima.N.d. George Nakashima Collection, James A. Michener Arts Museum Archives. Gift of Mira and Kevin Nakashima.

stone masonry traditions of the English Quakers, thus suggesting his recognition of and reference to local materials and traditions. Nakashima admired the durability of stone masonry stating, “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.”[21]

Nakashima’s craft of stone masonry is evident in most of the buildings throughout the property, first in his residence, 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 site and the vicinity. 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.[22]

The stone masonry is comprised of a variety of stones of distinctive type, size, and color: volcanic stones (gift of Masayuki Nagare), granite, yellow sandstone, brownstone, argillite, granite, Pennsylvania black limestone, diverse colored sandstones, and possibly diorite, basalt, siltstone, and shale.

In the abutments, the stones are arranged in a random pattern with some regular courses interrupted by large stones, a technique which is reminiscent of the Bucks County stone masonry barns. Overall, shapes are irregular, from more rounded to 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 stretchers; other stones act 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-cement mortar, the color of which ranges from light brown to gray, a quality that is likely related to the 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.

Concrete Building Blocks

A genuine material of the twentieth century, the history of the concrete block dates back to the last decades of the nineteenth century. In detailing the Cloister, Nakashima annotated the use of 8" Waylite[23] on the east and west elevations.

The Cloister stands tight to the technical recommended restrictions for construction with concrete blocks. Its greatest height is around 11 feet and its maximum width approximately 12 feet. The interior partitions walls, 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.

A magnetometer confirmed the presence of horizontal reinforcement on the bed joints. Vertical arrangement is unknown. If the Cloister load-bearing walls were reinforced by grouting the CMU cores is unknown. Data obtained through IRT

21. George Nakashima, *The Soul of a Tree*, 71
22. Delaware Quarries was 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. The origin of the stones at the Arts Building is pressumably diverse.
23. Waylite is a type of lightweight block that was develope commercially in the 1930s.

camera inspection was not conclusive. In the east elevation, lintels, which are reminiscent of those used at the Workshop and the Main Lumber Storage, are made of reinforced concrete. Footings dimensions and arrangement are unknown.

The as-built conditions reveal the use of stretcher units and single corner units, the faces of which are on plane. Unit nominal dimensions used at the Cloister are 8 by 8 by 16-inch for the load-bearing walls, 4 by 8 by 16-inch for the partitions, and 8 by 4 by 16-inch for the top row in the plinth. At the Cloister, two types of concrete blocks that vary in color have also been identified. A dark gray color was used in the wall foundation at the southeastern corner, while a lighter concrete block, the Waylite, was used for the rest of the masonry.

The bond follows the typical running bond pattern, which at some point is replaced by a stack bond construction in the plinth.[24] It is noticeable that the mortar joint profile is concave, very likely produced with a rounded jointer, probably 5/8 inch. This joint was recommended for exterior walls because it easily sheds water.

In the case of the Arts Building, the CMU masonry walls are rendered with a white stucco. A magnetometer confirmed the presence of horizontal reinforcement on the bed joints. Presence and arrangement of vertical reinforcement are unknown. The stucco was applied as a two-coat system. The scratch coat is 3/16 inch thick, and the finish coat is 1/8 inch thick. On the interior, panels of Styrofoam™, placed between the CMU masonry and the lath provides insulation.[25] As a finish, Nakashima selected Structolite™, a ready-mix base coat plaster, that resembles vernacular clay wattle and daub plaster.

Typical infill wall. Arts Building, West elevation.

Glass

Glazing infill in casement and sliding windows, as well as sliding doors is single glass. Pressumably the weight influenced this decission. Insulated glass is used for the infill in the window walls except for the lower panes in the corners, and the niche close to the terrace. Both types of glass are original to the Arts Building. Nakashima selected traditional Japanese elements to establish grades of transparency and translucency in the carefully designed west and south elevations. Hinged grills characterize the exterior while sliding shoji are recognizable in two locations: the window seat on the west elevation and the sliding window at the side of the main door. On the south elevation, casement fabrics filter the light coming through the sliding doors at main gallery and the loft.

Infill wall

The Arts building infill panels are 2 inches thick and are comprised of six different layers. From exterior to interior: white cement stucco, scratch coat with wire mess, two 1/2 inch Celotex™ fiberboards, scractch coat with wire mesh (7/16 inch), and finish coat (1/16 inch). Both the exterior and interior finish is troweled smooth.

White Translucent Finish

To the interior, the plywood deck is painted white a translucent finish. SEM-EDS spectrum indicates the presence of titanium (Ti), calcium (Ca), sulfur (S), zinc (Zn), magnesium (Mg), silicon (Si), and minor traces of aluminum (Al), phospho-

24. 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.
25. Reported by Aram Dadian, who participated in the roof repairs in the early 1990s.

26. The original framing plan, projected by Paul Weidlinger Consulting Engineering, suggested a six by six grid of identical squared spaces.
27. American Biltrite Rubber Company, which still exists, was founded as Ewell Rubber Company in 1908. The company first produced shoe heels and soles 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.

rus (P), and potassium (K). These chemical elements suggest that the pigments can be titanium dioxide plus calcium sulfate. Presumably with addition of zinc oxide, as well as magnesium silicate as extender. CCD Raman analysis confirmed the presence of titanium dioxide and calcium sulfate. The complexity of the spectra suggests that the binder is a combination of different oils, which have not been identified yet. Alkyd is excluded.

The Use of Reinforced Concrete

Recalling traditional Japanese coffered ceilings, George Nakashima chose a waffle slab to cover the wide space of the vestibule in the Arts Building. The extant framing is a six by five grid of identical squared spaces. In the row next to the inclined wall, the spans were substituted by openings to house five skylights.

Essentially, the waffle slab is is a reinforced concrete monolithic two-inch thin slab integral with six by six-inch tapered joists. It is supported by exposed concrete walls on the east and west elevations, and by a stone masonry wall on the north. The wide span on the east is possible due to an upturned beam. This structural arrangement exhibits Nakashima's mastery to craft the creative and aesthetic aspects of the structure, while controlling technical aspects.

Although the as-built reinforcement is unknown, during a visit to the Michener Museum in March 2015, a frame plan by Paul Weidlinger shows the typical reinforcement for the joists and the slab. 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 below the grid slab had to be 8 inches thick with #4 rebar 10 inches each way in each wall. Rebars in the joists in the north are bent and anchored into the wall.[26]

In the early 1990s, the framing experienced a significant deformation that caused cracks providing an easy path for rainwater. This condition prompted an improvised solution and resulted in the installation of a vertical wooden log. This support, located in the intersection of two joists becomes a vertical continuation of the upright that bears the higher peak of the hyperbolic paraboloid roof.

Flooring materials

A combination of traditional and modern flooring materials establishes an interrelationship between the interior and the landscape. The Cave floor is laid with local stone slabs of different sizes and shapes. The main gallery space floor is laid with vinyl flooring, which was also used to cover the Cloister floor. In the loft, a raised walnut floor partially covers the exposed concrete.

On the exterior, different sizes of stones add visual interest while at the same time accomplish 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; pea gravel completes the path. A dark river rock band is used to cover the ground that receives the water runoff from the Cloister roof.

Nakashima selected artificial 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 inches; 3/32-inch gauge

Amtico Rubber Flooring, a subdivision of American Biltrite Rubber Company[27], commercialized under the vinyl-asbestos travertine tiles type.

The fact that Amtico produced such a diversity of flooring materials implies that the tiles used by Nakashima might be free of asbestos since 36 by 36 inch was a standard within the solid vinyl tiles.

Building Mechanical Systems and Installations

Building mechanical systems and installations in the Arts Building and Cloister include heating, electrical installations, telecommunications installations, plumbing, and sewage collection systems.

Heating is based on a central system that feeds pipe radiations. Each radiator is a welded steel pipe with steel radiating fins and is connected to the following radiator by the pipes. These elements are mounted along the east and north elevations, as well as under the window seat and concrete curb on the west elevation. The radiatiors are integrated into the architecture by housing them under a wood board that reads as a baseboard all around the main gallery. Pipes installed below the stone paving heat the Cave.

The boiler is housed in the Cloister, in a utility room with access from the east side. The fuel tank stands outdoors on the north side of the Cloister, partly hidden by the concrete block 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.

Although not original, artificial lighting is occasional and strategically located, enhancing the architectural experience. Kent Hall and desk, as well as Noguchi-style lamps, are used in the interiors, providing an indirect and filtered warm light. The lights in the skylights in the Cave are not longer functional. There is a light fixture inside the wet alcove. The skylights have adequate electrical installations for housing lights. However, in their current configuration they do not allow space for a bulb. Outdoors, there is a tri-legged lamp installed on the south patio and two aluminum sconces on the Cloister.

There is no air-conditioning system. However, the casing windows strategically placed in the loft area and sliding windows and doors allow enough interior natural ventilation.

A water pipe system distributes water to a faucet and heater 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.

Ben Shahn's Mosaic Mural

As described earlier, prior to his death, Ben Shahn painted a gouache cartoon, "Poet's Beard", that served as the design for a mosaic mural to be ultimately installed in the Arts Building. The location, the angled concrete wall on the northwest elevation, was described by Nakashima as follows:

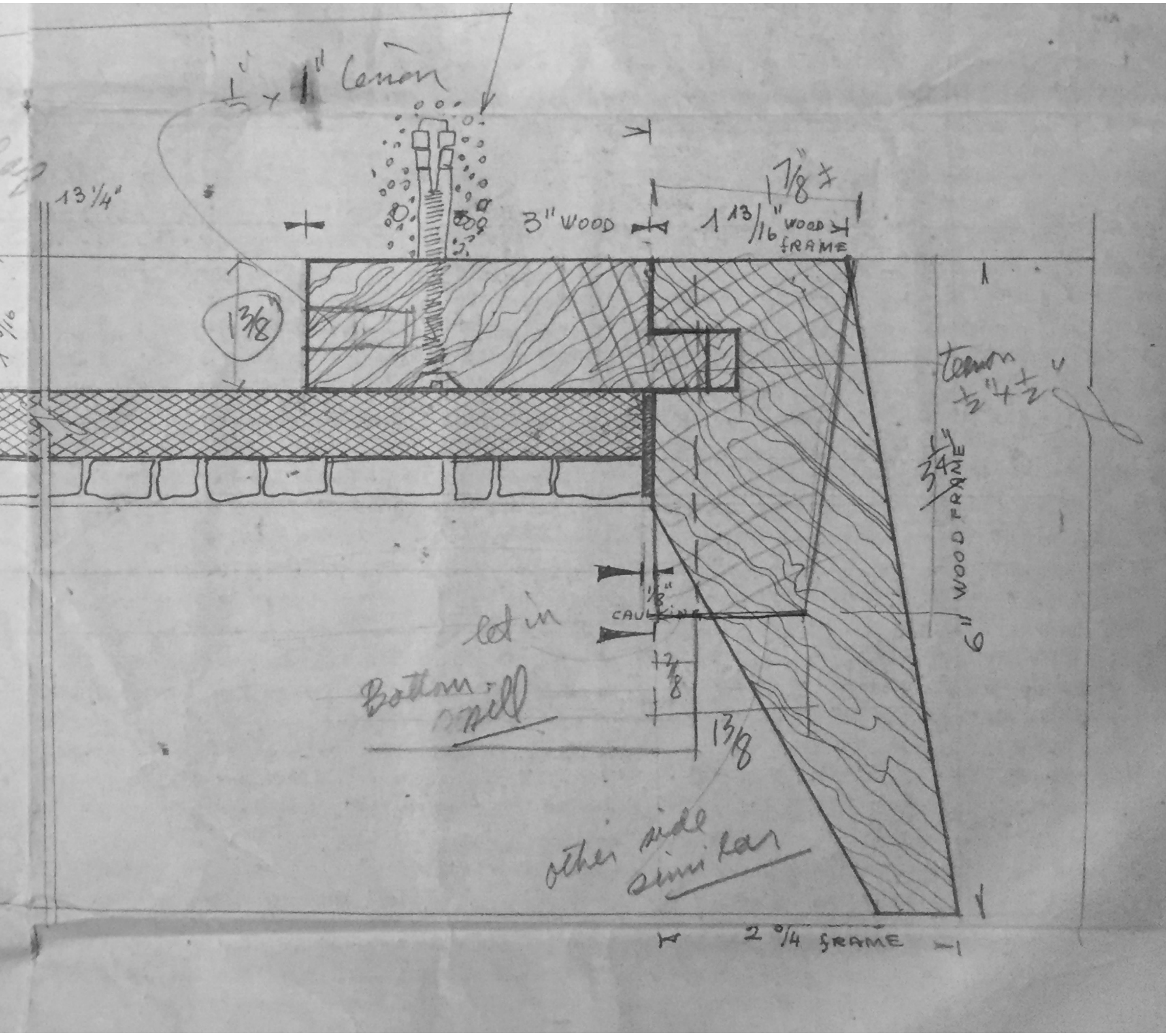


Fig. 4.1. Detailing for installation of the mural mosaic.
Provided by Gabriel Loire, June 1970, with corrections by George Nakashima.
Source: George Nakashima Collection, James A. Michener Art Museum Archives.
Gift of Mira and Kevin Nakashima.

> 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 (…)
> 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.[28]

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 1970. The mural was divided into 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. Together with the panels, Gabriel Loire delivered detailed plans and instructions for the installation. Although the archival documentation does not contain information about the materials employed for the manufacture, Jacques Loire reported the use of marble tesserae (which can be an highly metamorphed limestone), tesserae made of glass paste from Venice, and slab glass (French: dalles de verre, which is thicker than the common stained glass). These tesserae were cut with a hammer in the studio and positioned with a mortar of epoxy resin on plywood boards.[29]

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.

A letter signed October 13th, 1970, indicates that 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."[39] It appears that the final solution was to employ a type of elastomer adhesive, although it could be a repair treatment where the epoxy failed.

Nakashima modified the detailing proposed by Gabriel Loire. A wooden frame was intended to house completely the mosaic. However, Nakashima excluded the upper rail from the final installation. In addition, 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.

28. 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.
29. Jacques Loire. Email to the author. December 16th, 2016.
30. 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.

Fig. 5.1. View of the west elevation from the north. Note the original gutters, the original head in the sliding window, and the skylight domes. The concrete floor of the terrace is exposed.
Source:
George Nakashima Woodworker Archives

Fig. 5.2. Northwest elevation view. Date: December 2104. Note the new gutter system, the copper canopy , and the new flat skylights. The copper patina is indicative of new and old flashing campaigns. The concrete floor of the terrace exhibits a waterproofing coating painted in white. Landscape features have been changed overt time.
Source:
Architectural Conservation Laboratory

4.2 Architectural Archaeology

This section presents the research findings regarding the alterations to the building. Methodology employed the direct observation of the building itself, the comparison of archival images to the as built conditions, the recollection of maintenance and accounting records, and interviews. The following individuals reported their memories of past repairs: Mira Nakashima, Kevin Nakashima, John Lutz, and Aram Dadian.

View of the Arts Building under construction. Note the flashing sheets covering the north overhang. An upturned fascia board is visible on edge. This configuration creates a wide channel to carry off rainwater and snow melt to the ponds at the west and the south. Courtesy of George Nakashima Foundation for Peace.

Water Disposal System

The collection and disposal of rainwater and snow melt are a critical aspect for any building. In the Arts Building, eaves and gutters are the principal means of carrying water off the roof, which ultimately protects the building. In the case of the Cloister, a shed roof drains towards a band of river stones laid out adjacent to the porch.

The photographs taken during and shortly after construction reveal a different material and configuration on the lower eaves of the hyperbolic paraboloid roof. Forming a continuum with the roof, the flashing protecting the eaves along with an upturned fascia creates a wide gutter.

Reportedly, failures on the design of this experimental detailing facilitated moisture infiltration that eventually caused rot and prompted the replacement. Pressumably performed in the early 1990s, the repair involved the replacement of deteriorated plywood underneath the eaves, new flashing, a new built-up roof and the installation of the current box-like gutters. Although this design deviates from the original intent, it appears to function better.

In 1994, another major alteration to the exterior was the repair of the window on the west elevation. This repair included the installation of a copper canopy designed by Mira Nakashimal, which would conceal both the white eastern pine lintel and the head of the original window (see figure 5.1.).

To control leaks, the original exposed concrete terrace was waterproofed with a fiberglass 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 it provided a watertight seal that protects the interior from moisture penetration.

The Covered Walkway and the Cloister Roof

In the south elevation, the black locust bearing posts of the covered walkay and the porch were replaced in two different repair campaigns in early 2000s. The intervention also altered the original finish of the plywood soffit in a large area of the porch.

The original 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 unplaned surfaces that are left with the natural contours.

Above: views of the Cloister from the terrace and the south patio. Note the ballasted roofing and the gravel stops. Courtesy of George Nakashima Foundation for Peace

A Japanese-inspired cross-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 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.

Unlike the original configuration, the new uprights 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 join new and original members.

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 white paint different from the earlier translucent white 'stain' used by Nakashima. Furthermore, 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 involved roof waterproofing and new copper flashing. However, as the archival images show, the sheds were a ballasted roof. Gravel stops are visible on the perimeter and on the Cloister roof recognizing the footprint of the living space underneath.

The Exterior Envelope

Regardless of the canopy addition on the west elevation, the Arts Building and Cloister's exterior envelope possess a high level of integrity. Subtle repair occurred as elements deteriorated, usually in kind.

On the upper level, the wooden rail support appears to have been replaced in kind. In addition, the sliding window sill was replaced because it was rotten.[31] Above it, the thin wall was cleaned and repaired with a similar finish. (Fig. 5.3)

Repairs to the stucco on the main entrances were done as well. As reported by Aram Dadian, the proportions were two parts white Portland cement, one part lime, and three parts white sand. On an area around the northeast corner, a whiter cementitious mortar was used for filling cracks, resurfacing spalled areas, and repairing chipped edges.

In early 2000s, the five acrylic sky domes observed in Fig. 5.1 were first replaced in kind, and ultimately, by customized skylights. The earlier sky domes consisted of a fiberglass dome installed in an aluminum frame. The new installation was thought to facilitate water seepage and eventually were substituted by functional skylights, which were manufactured by Aram Dadian with wood and polymethyl methacrylate sheets.

31. This intervention took place after George Nakashima died. 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.

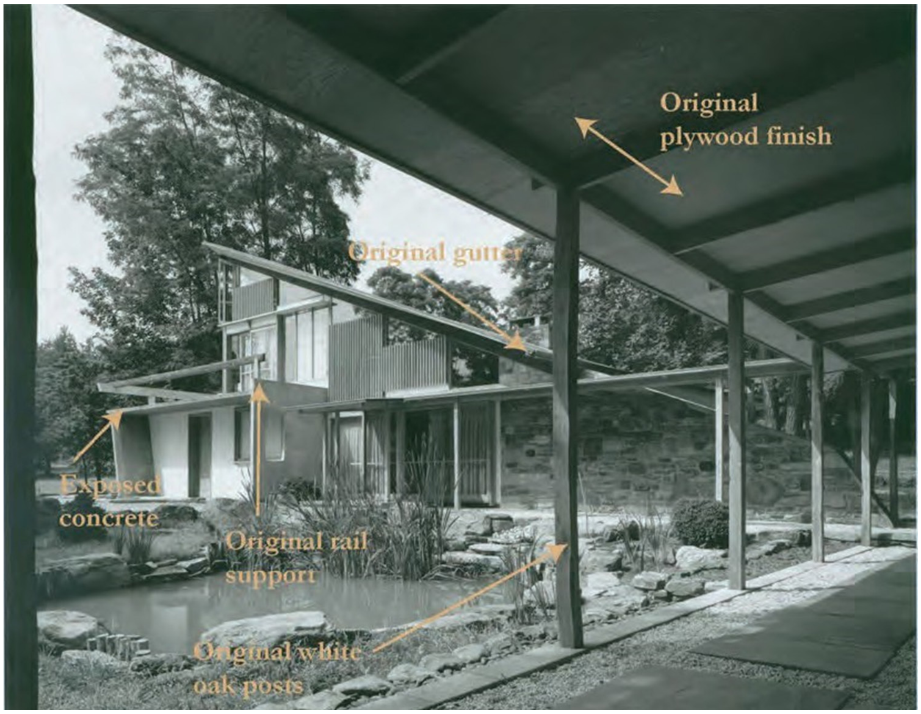


Fig. 5.3. South elevation view. Date: 1965. Note the original black locust posts, plywood soffit finish, rail support, and gutter. Source: George Nakashima Woodworker Archives.

Fig. 5.4. South elevation view. Date: December 2014. Note the new gutter system, the new ipe posts upon ipe bases, and the opaque white paint covering the plywood soffit. As shown in Fig. 5.1, the concrete floor of the terrace has been waterproofed.

Interior of the Cave from the Gallery. Courtesy of George Nakashima Foundation for Peace

Interior

An early photograph of the Cave reveals that panels covered with Japanese paper were installed on the niches between the concrete stub walls. The wider middle niche was Japanese bark paper.[32] The adjacent niches show two other different patterns. 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 in the lower face of the concrete grid. At least three systems have been used to hide the wet alcove: a divider, a curtain, and, eventually, a folding door.

In the early 1990s, a wooden column was installed to support the waffle slab, which had a noticeable deflection that compromised the structure and the building tightness. In the area, surrounding the post base, removal and reinstallation of the floor stone is recognizable. 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.

Reportedly, leaks deteriorated the finishes of the inclined wall. Panels and shelves were removed, and the wall was rendered with a white plaster with a rough finish. Ghosts on the sides of the stub walls indicate the original position of the former shelves. Mira Nakashima recalls that when the wood shelves shrank, because of the hygroscopic nature of the wood, they became loose and usually fell out.

Above the fireplace, the lintel was replaced as a consequence of carpenter ant activity. Repair occurred to the adjacent window as well. Below, a 1967 photograph (fig. 5.5) partly shows the original lintel 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.

The grain figure of Nakashima's original fireplace lintel was undoubtedly selected in relation 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. 5.6). Reportedly, the plywood deck along the north wall was replaced and repaired in kind to mend the deterioration caused by leaks. During this intervention, the skylight was also covered in the same manner as those in the exterior terrace.

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. In 2016, repairs include the refinish of the loft floor, the replacement in kind of the south black locust railing, and repointing of the stone masonry chimney.

32. Mira Nakashima. Email to the author 01/28/2017.

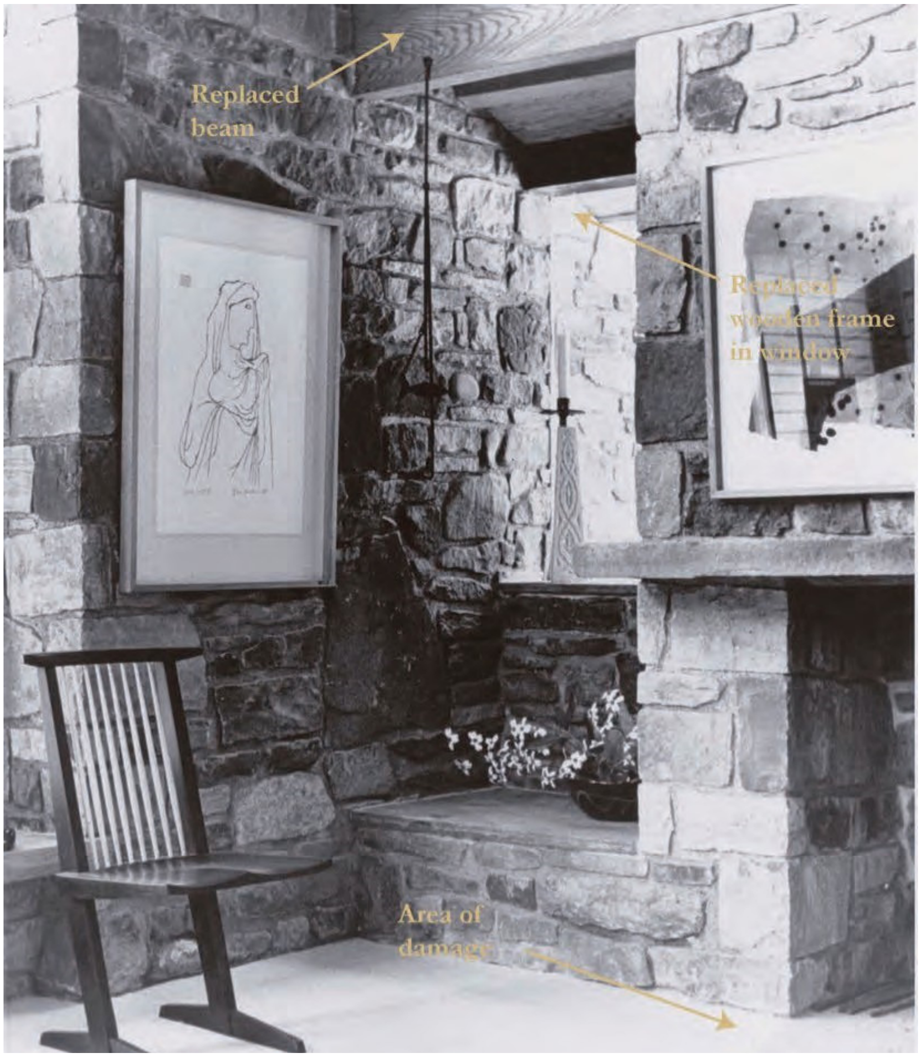
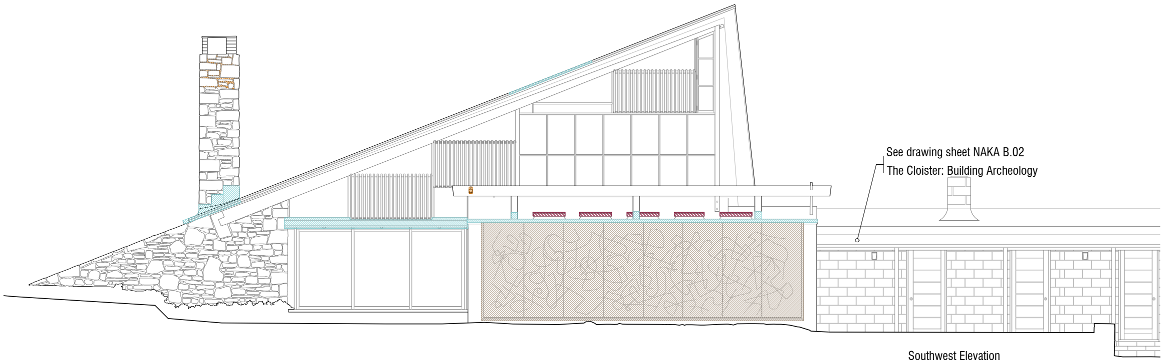


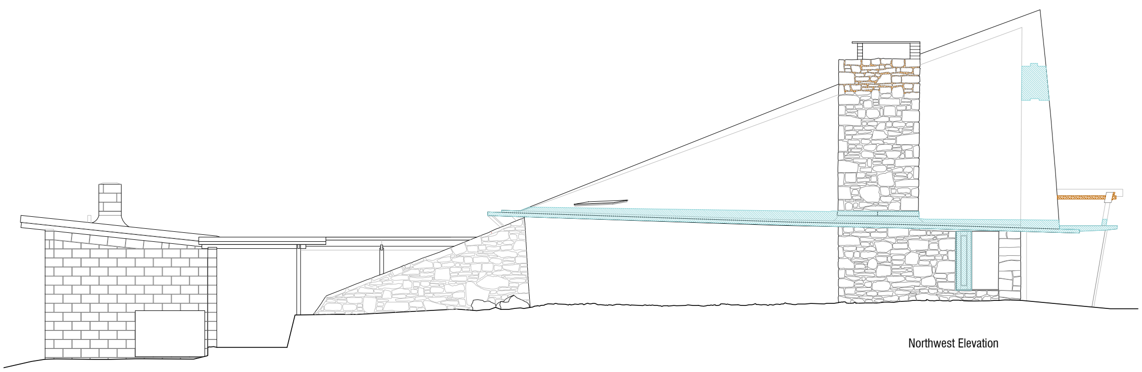
Fig. 5.5. Fireplace corner. Date: 1967. Author unknown. Source: George Nakashima Woodworker Archives.

Fig. 5.6. Current state of the fireplace corner. Date: November 2014.

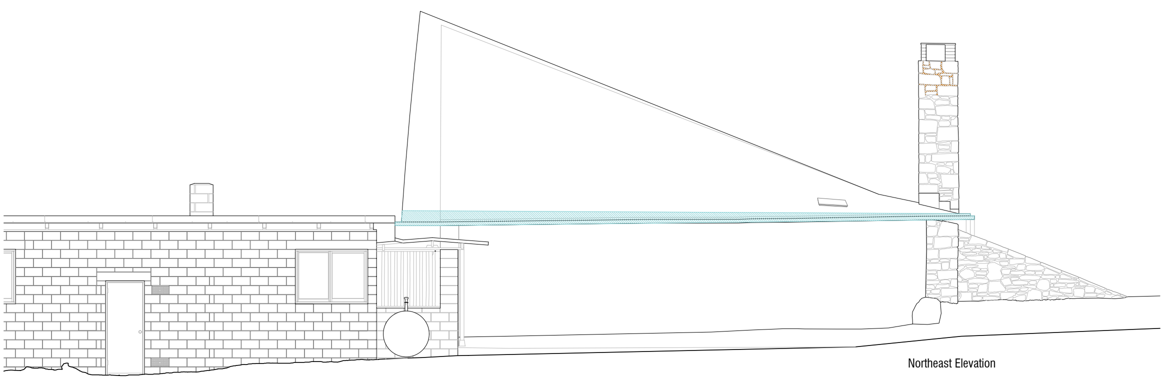
Alterations to the Building Fabric



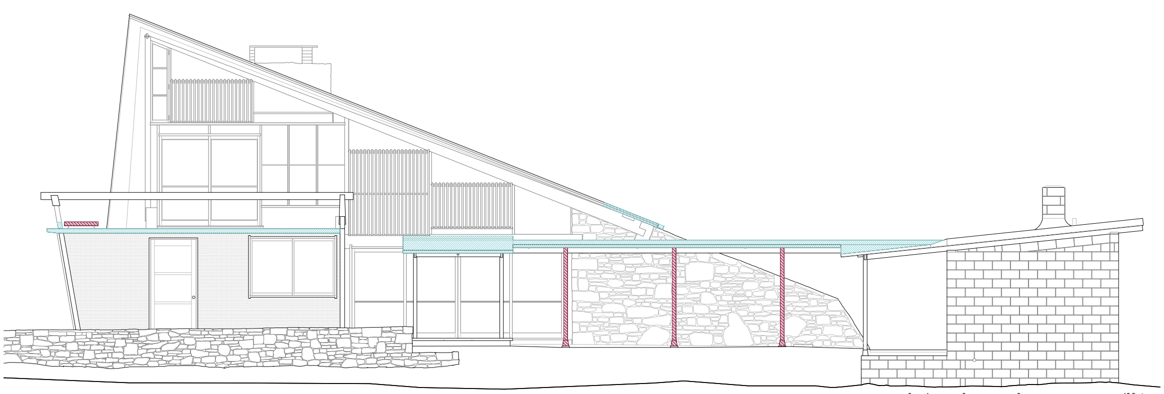
Southwest Elevation



Northwest Elevation



Northeast Elevation

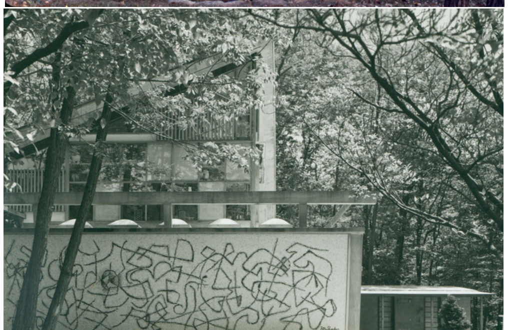


0 1 3 6 12 Feet

Southeast Elevation

Scale 3/16" = 1 foot

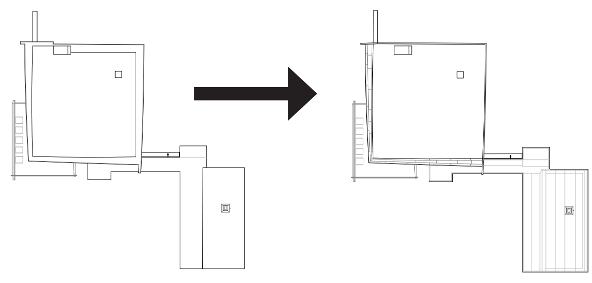
1967



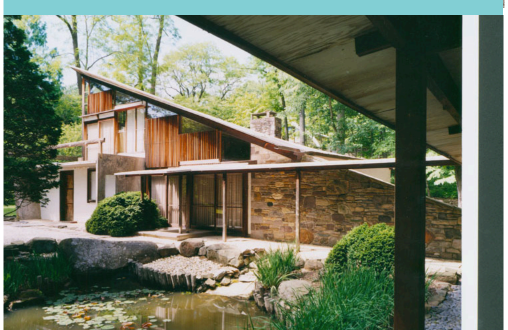
1970s

“The Poet” mosaic mural is installed.

1990s



East and north eaves were repaired and the water disposal system modified.



2000s

Black Locust *menkawa* posts are replaced by Ipe straight uprights.

2010s

Repair works on the chimney stack.

4.3. Conditions Assessment

This section identifies the primary processes of deterioration observed at the Arts Building and Cloister. Conditions are recorded by building element and location. They are discussed regarding the original material and subsequent alterations and maintenance, as well as their environment. In the following section, the consultants provide an assessment based on their respective areas of expertise. Note that the climatic and situational contexts are described in section 5.6. Envelope and Interior Assessment by Michael C. Henry.

Preliminary visual survey took place during two field visits in February and March 2015. On February 15th, 2016, César Bargues conducted investigation with an IRT Camera to detect failures in the building envelope. On November 4th, 2016, the condition assessment was reviewed.

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, CMU masonry, reinforced concrete structure, wood frame, mosaic, interior finishes, and flooring.

Findings

A. Arts Building

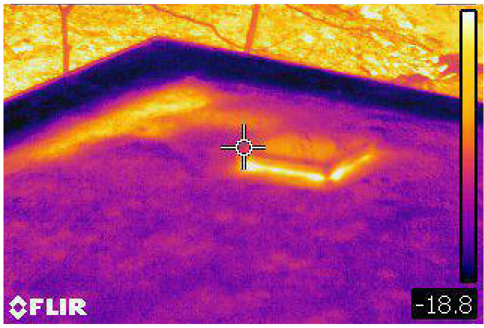
Hyperbolic Paraboloid Roof

The investigation of the building envelope with an IRT Camera revealed a thermal anomaly on the north end of the hyperbolic paraboloid roof. Roof probes, approximately each two feet square, demonstrated the presence of moisture entrapped below the asphalt underlayment. The fiberboard insulation is saturated and the outer face of the plywood deck was visibly wet but not deteriorated. The area of damage is about 9'x14'.

Pressumably, this condition is associated with a leak detected and repaired in the summer of 2015. This leak was caused by a roof puncture close to the north side of the skylight, where the ballast layer was unevenly distributed.

The removal of the ballast for repair revealed that the asphalt lining is in overall good condition. Embedded aggregate or loose stone ballast upon the asphalt lining slows down their rate of aging. However, where marble gravel was washed out for long period of time, the exposed asphalt lining shows alligatoring[33].

Service performance of roofing asphalt depends upon chemical and mechanical characteristics. Chemical changes resulting from exposure to light, heat, and oxygen facilitate oxidation and produce progressive embrittlement. Therefore, service stresses, which include the gravity loads depending on the inclination, and thermal expansion and contraction can cause alligatoring and eventually failures



From top to bottom:
A. Infrared image of the northeast end of the hyperbolic paraboloid roof. February 15th, 2016.
B. Cutting plugs to investigate the roof. May 9th, 2016.
C. Saturated fiberboard insulation and wet surface of the plywood deck.

33. Exposure to UV light result in composition and moisture content as a roofing asphalt ages in service. The shrinking of the surface results in an appearance that resembles cracks.

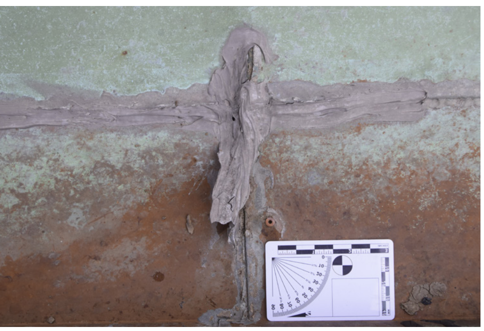
34. When exposed to atmospheric conditions, a conversion film turns the initial light reddish-brown copper from light brown to darker colors and then to greenish turquoise over the years. This patina makes copper resist further corrosion. The patina can be copper oxide or sulfides when the products are 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).

where the moisture can migrate.

On the eaves, the flashing elements show different rates of weathering, accordingly with the replacement and repairs done in the past. A greenish patina covers the eaves, while the more recently installed flashing and gutters remain dull brown with green staining because water carries the corrosion products of both eaves and earlier elements.[34] Typically, a discrete crack is visible on the flashing sheets contiguous to a flashing juncture. This condition is related to the design and the restriction imposed to thermal expansion and contraction. In a number of locations, sealants are failing and show a lack of adhesion. In the south elevation, the lower end of the flashing covering the edge is loose.

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 copper sheet. If this type of corrosion continues, current leakage in the junctures will be expedited. Furthermore, there is noticeable damage because of impact to the gutter edges; a section has been deformed probably by fallen branches. The base exhibits damage by marble chips carried off by the snow melt and rainwater.

During the site visits, tree litter and moss patches were visible covering the ballast on some locations. Marble gravel washed out from the roof and leaves were clogging the gutters. This condition can allow the rainwater to overflow directly to the 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 fascia.



Above: Failing sealant and crack adjacent to a flashing juncture at the hyperbolic paraboloid roof eave on the west elevation. Below: Fascia and gutter at the hyperbolic paoraboloid roof eave on the east elevation. Gray stains on the bottom of the gutter indicate water flowing between the gutter and the fascia. The fascia connection is rot, as the plywood edge. Note crevice corrosion and galvanic corrosion in the gutter juncture.

Regarding the roof plywood shell, the assembly is exposed to interior and exterior conditions. While the ceiling in the interior is in excellent condition, on the exterior, the plywood shows rot and minor damage from animal activity. A number of baldcypress ribs show moisture stains caused by a past leak not longer active or conditions during the construction process. Such stains are minor visual alterations that do not affect the wood structurally.

Both on the exterior and the interior, the plywood sheets show minor microchecks, which appear on the surface in the form of multiple hairline cracks or slightly open superficial parallel splits of different lengths. Particulary on the exterior, under severe moist and dry conditions, according to the technical guides, these checks may in time become cracks penetrating virtually the full thickness of the face.

Causes of these checks are found in the chemical properties of the wood 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. 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. 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.[35]

Areas of the plywood sheets adjacent to the chimney stack are rotten. In addition, on the east fascia, a plywood sheet shows rot affecting the exposed first ply. It appears that the glue is acting as a barrier to prevent further decay.

Terrace

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, in the interior, holes in the plaster covering the ceiling and rust stains are the effect of the earlier rainwater penetration.

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.

Long-term loading and insufficient support caused deflection and visible cracking in the waffle slab. It is necessary to point out that this slab is not uniformly loaded. 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. On the northwest, the white eastern pine upright supporting the tapered beams rests upon an upturn concrete beam. This beam, which is monolithic with the gridded slap, had no support underneath.

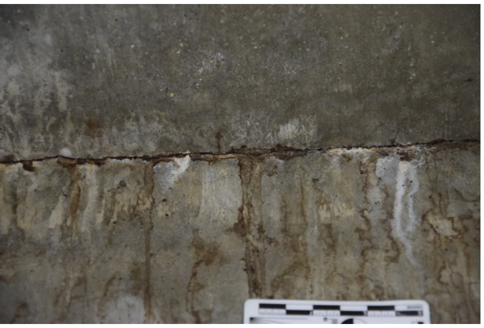
In the early 1990s, this deflection was corrected with the addition of a wooden column, which was installed at the intersection of two joists providing additional support. Rust staining indicates that moisture infiltration through the cracks has affected the rebars.

Regardless of this episode, exposed concrete surfaces are in good condition with minor problems of aesthetic nature. Imperfections as a result of an improper placing of concrete are visible. Flaws include honeycombing, bugholes, and uneven edges because of joints between the formwork panels. Surfaces also show impact damage, scratches, efflorescence, superficial erosion, soiling, and biological colonization. After visual examination and sounding with a hand-held hammer, no incipient spalling and blind delamination is recognizable.

In the interior of the building, various hairline cracks are visible on the waffle 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 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

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



Above: Corrosion products and leaching caused by moisture infiltration in the past. Below: Hairline cracks visible at the intersection between an electrical conduit and the concrete.

exterior surface of the concrete. In the areas where moisture interacts with the rebar, corrosion products accompany the deposits.

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.

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. This defect is observable in some surfaces on 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[36] 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 a moderate to severe problem in concrete structures because the affected areas are weaker and more permeable that sound areas. Technical literature recommends patching these areas as early as the form is retired, the greener the concrete the 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 skylight openings, hairline cracks are visible both in the slab thickness and on the soffit following the direction of the electrical pipes. This cracking could be related to corrosion of the electrical metallic pipes, or to the expansion and contraction of this material because of thermal loads, or to both causes.

Damage by mechanical impact and hooks are present on the bond beam capping the stone masonry wall. The use of the metallic hooks perforating the concrete should be avoided. Minor scratches are visible elsewhere.

On the exterior surfaces, different rates of superficial erosion on the unprotected surfaces were observed. This erosion is characterized by the 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. Along with erosion, on the north and west elevations, which remains most of the time in shade, concrete surfaces show biological colonization, mainly comprised of algae and lichens.

At the soffit on the entrance area, hairline cracks with leaching deposits are visible. The rest of the concrete surfaces shows good condition, except for some small areas that show chipped edges and impact damage.

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

East and North Wall Assemblies

On the exterior, the stucco covering the CMU masonry is original except for a few areas of repair, particularly around the northeast corner. Setting into an area of drainage adjacent to a slope, the north wall shows a higer rate of deterioration than the east wall. In the upper third of the former, horizontal cracking parallel to the bed joints is visible. Cracks range from 2 1/2 feet to nearly 18 feet long with an approximate width of 1/32 to 1/16 inch. Carbonate calcium deposits cover this cracking. Typically, these types of longitudinal cracks are caused because the net axial tension, such as that due to wind uplift on a roof connected to a masonry wall or the overturning effects of lateral loads, exceed the capacity of the masonry wall.

On the rest of the surface, discrete hairline cracks follow the perimeter of the masonry units. Darker areas are visible along the line of these cracks, along with efflorescence. Surface loss through disaggregation around these areas is visible This is likely due to crystallization of soluble salts in surface pores. Salt sources could be the soil, the foundations, the concrete blocks, or the cement mortar. Microchemical spot testing revealed small traces of sulfates, no chlorides or nitrates.Two large calcium carbonate deposits occur between 3 and 4 feet high. Water dripping from both deposits was noticed.

It appears that moisture chiefly migrates through the mortar joints, which may have higher permeability compared to the concrete blocks. Causes of this dampness can be rising damp, condensation within the wall assembly, or rain penetration. If raising damp is occuring, moisture migration through the wall masonry is likely due to the lack of a waterproof membrane or through-wall flashing on the foundation. Moisture sources could be the water table below grade, and the water surface from rainfall and snow melt. X-ray diffraction analysis revealed the presence of small traces of copper on a sample taken from the large carbonate calcium deposits. Pressumably, this would confirm the roof as a source of moisture. Reportedly, a French drain was installed. Its performance is unknown.

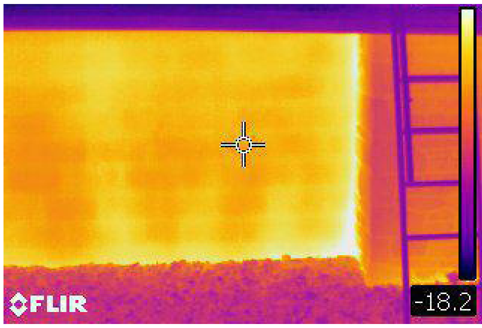
The northeast corner is slightly out of plumb at the level of the wall plate, which might involve the whole masonry section, and display hairline cracks. On the east side, the lower part of the wall shows a hairline crack as well. This area has been repainted in the past, but now is open again. This condition might be indicative of a slight settlement, structural deformation, or both.

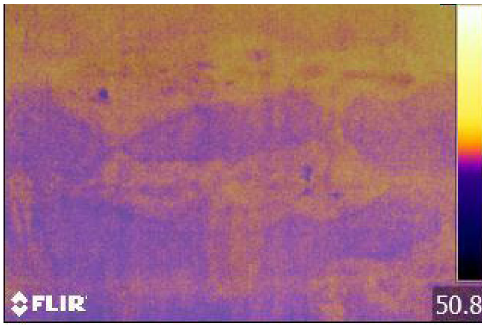
Infrared imaging revealed the existence of thermal bridges on the interface between CMU and stone masonry. Areas of the CMU wall are slightly colder than others forming vertical bands.

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





From top to bottom:
A. Infrared image showing the presence of a thermal bridge in the interface between the CMU wall and the stone masonry on the north elevation. The photograph was takenat 7:32 am on February 4th, 2016. The building was heated during the night.
B. Close up to the darker areas and hairling crack occuring at the concrete block perimeter.
C. Overlaid infrared image on the previous photograph. Note how the darker wet areas are warmer. The photograph was taken at 6:04 am on November 4th, 2016. The building was heated during the night.

Above: Close up photograph of the "step cracking" above the mantle on the fireplace. Note efflorescence.
Below: Typical moisture stains on the wood frame

materials. Efflorescence was visible on the following locations:

• On exterior surfaces below the gutters at the west and south elevations.
• On two areas of the right side of the fireplace: below the mantle and below the lintel. Note that the masonry behind the lintel comprises concrete blocks as well.

On a limited number of stone units, the surface has erupted into blisters and is flaking. These conditions are primarily related to processes of granular disintegration because of moisture infiltration and salt crystallization.

Hairline cracks between stone units and the mortar were noted throughout the masonry. On the interior, above the fireplace, a "step cracking" is visible. It becomes wider towards the top of the masonry with a thickness equal to 1/16-inch. On the exterior, along with hairline cracks the lower ends of the buttresses show failing joints.

Algae, lichen, and mosses pervasively cover the stone in the areas exposed to rainwater or ground water splash. Algae is also visible on the firebox right return and floor. Biological activity varies across the seasons. During the fall, moss covered large areas, which were reduced during the colder winter. Additionally, areas of soiling varying in tone were observed on areas where previously algae had grown. 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.

Wood Frame

Overall, exposed wood displays a gray appearance, which is due to the slow degradation of the material caused by various factors in combination, including sunlight and UV raditation.[37] Mildew growing on exterior surfaces was noticed as well.

Unaesthetic repairs with epoxy are visible elsewhere. Damage caused by squirrels, birds, and insects is present. Squirrels have damaged wood surfaces by gnawing and scratching elements, such as the grills installed on the elevations or the plywood. Woodpeckers have pecked looking for insects, possibly attracted by carpenter bee activity. Holes made by the latter are visible on the fascia. The site is protected against subterranean termites by bait stations.

On the fixed glass panes, the weather stripping consists of cypress stops exteriorly mounted and nailed to the wood frame. On a few places, traces of a deteriorated sealant was visible. On the south elevation, at the side of the sliding door, the lower wood stop is deteriorated and needs replacement.

On the interior, wood frames and built-in shelves show discoloration and moisture stains. While discoloration is caused by exposure to daylight and UV radiation, moisture stains are the result of a single wetting or of periodic wetting and drying cycles. Cause can be active or inactive. Sources of moisture can be water vapor that condensates, rainwater penetration, or both. This phenomenon possibly damaged one *shoji* screens originally housed on the shelves in the loft.

37. 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.

Generally, windows and doors are in good condition, although their shrinking and swelling seasonally reduce their operability. Isolated conditions include two mechanical impacts to one of the lower panes of the sliding door at the south elevation. A sliding door leaf is lifting. In this location, the gap between the door leaf and the window frame accumulates dirt.

Prefabricated plastic skydomes installed with an aluminum frame were thought to be a source of leaks; consequently, new skylights with wood frames and methacrylate panes were manufactured to replace them. Now, some condensation occurs, as revealed by moisture stains in the wood frame.

Infill Walls

On the south elevation, the interface between the infill wall and the concrete surface shows a gap running vertically. This condition allows moisture infiltration and heat loss. Similarly, on the west elevation, the joint stands open. The interface between infill walls and stone masonry show a vertical hairline crack. Stains because of past dauber wasp nest are visible.

Interior Finishes

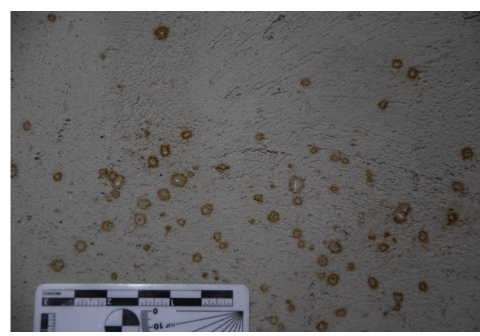
Discontinuities between the stone masonry and the concrete block masonry, and between those systems and the openings' frame have been causing moisture infiltration, which ultimately has led to damages to the plaster as evidenced by staining and efflorescence.

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

On the left side of the window seat, the stucco shows color alteration, disgregation and material loss. Efflorescence is visible on the upper part of the jamb. Presumably, water is penetrating either through the interface between the adjacent wood frame and the concrete structure, the stone masonry and the concrete, or both.

The walls plastered with Structolite™ show corrosion products in the form of small spots. The spots are tipically reddish and display a whitish deposit on its center. SEM-EDS spectrum indicates the presence of aluminum (AL) and small traces of iron (FE) on the plaster. Pressumably, the corrosion products could be related to the oxidation of these metallic constituents. SEM-EDS indicates also the presence of sulfur (S), calcium (Ca), and silicon (Si), typical elements present in the Plaster of Paris ($CaSO_4 \cdot 2H_2O$) and Quartz. Small traces of other chemical elements include phosphorus (P), potassium (K), magnesium (Mg), chlorine (CL), and sodium (Na).

The curtains need to be woven and re-hung on the curtain track. The fabric, which is a casement, is in good condition.



From top to bottom:
A. Efflorescence and color alterations below the window sill. Source of moisture is likely water vapor that condensates on the window glass.
B. Moisture stain and color alteration on the left jamb of the window seat.
C. Disintegration and material loss visible in the stucco on the left side of the window seat.
D. Corrosion products on the plaster.

Above: View of the Cloister roof.Note moss growing on the granule surface membrane.
Below: Typical alligatoring visible on the sealants.

Flooring Materials

The vinyl tile flooring system is in moderate condition. In the gallery area, many Amtico™ travertine tiles show total or partial lack of adhesion to the concrete subfloor. The causes can be moisture migration through the concrete subfloor, the glue has reached the end of its service life, or both. 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. This failure can occur between the adhesive and the subfloor or between the tiles and the adhesive. Moisture source is likely to be water below grade. The presence of vapor barriers below the concrete slab is unknown.

The tiles display shrinkage. a contraction probably related to the sunlight (infrared radiation) exposure. This condition has led to uneven joints, discoloration, and ultimately can also cause embrittlement. The weight of the wooden specimens leaning on the concrete wall have deformed the tiles. On the left side of the fireplace hearth, damage by fire is recognizable. The adjacent stone slab shows scaling.

On the Cave, stains and scaling are noticeable in some units of the stone floor. Missing and failing joints are visible as well.

B. Cloister

Covered Walkway and Cloister Roof

The granule-surfaced waterproofing membrane is in good condition. However, on some locations sealants are deteriorated and show alligatoring. Tree litter and areas of biogrowth are visible. Scratches are visible on the plywood soffits and of frame elements. Also, the plywood sheets show moisture stains and rot on the edges adjacent to the fascia. The third and fifth rafters, beginning from the southern side, show evidence of rot above the west CMU masonry wall. Above this wall, the wood stops show deterioration as well. Material loss and rot is visible on the wood stop between the fourth and fifth rafters. Between the third and fourth rafter, the wood stop is broken. Plywood soffits are paint opaque white, which is a deviation of the original intent.

As in the Arts Building, the wood elements show damage caused by woodpeckers and carpenter bees. Condition of the posts are extensively explained in the following section. Unaesthetic epoxy repairs are also visible. The finish of the wood elements has darkened considerably. Possible causes are:

- photo degradation (cross-linking /oxidation) darkens oil
- polymer degradation (cross linking / oxidation) darkens oil
- dirt compounded into macro-morphology (can turn a linseed oil coating black)
- mold-fungi action[38]

The concrete block masonry is in good condition, with a few minor problems such as dark stains with efflorescence, biological colonization, hairline cracking on the perimeter of the blocks, and dirt covering the lower section of the walls, particularly on the south and east elevations. One CMU unit below the wooden grill shows a vertical hairline crack as a result of differential thermal movement

38. Andrew Fearon, e-mail message to authors, December 9th, 2016

between walls. While the rainwater runs into a gravel path on the west elevation, the south and east masonry is completely exposed to the rainwater splash transporting soil particles.

Dust, spider webs, remnants of a dauber wasp nest and corrosion products are present in the aluminum lighting fixtures. On the east elevation, the door was cut and repaired during the summer of 2016. The door sill has been modified.

Concerning the interiors, the wood frames of the windows facing east show discoloration and moisture stains. These moisture stains are probably produced by water vapor condensing on the glass pane, by rainwater penetration, or both.

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.

During the last visual survey in November 2016, the cell in the Cloister was in use. The water vapor condensation on the window glass worsened and water dripped onto the plaster at the sides of the window sill. Environmental monitoring should be implemented to execute a comprehensive study of the interior conditions to understand further when and where condensation occurs, and to engineer a solution.

Fifth (above) and fourth (below) rafters are easily penetrated by an awl. Note horizontal checks and material loss in the first wood stop.

In the shower, the paint coating is peeling off. The vinyl flooring is in good condition, some lack of adhesion was noticed.

C. Ben Shahn's Mosaic

Although the mosaic shows a high level of physical integrity and good condition, the following were recorded: color alteration, missing tesserae, granular disintegration, failing substrate, biological colonization, and superficial erosion. While most alterations are limited in extension, the biological colonization by micro flora along the lower section of the mosaic is affecting various panels.

Discoloration is due to the use of epoxy resin to adhere the tesserae and hide the screw heads, which fasten the mosaic to a wood substructure. This application has stained the tesserae covering the screw as well as the surrounding tesserae altering their appearance. Discoloration was noticed on the joints between panels.

On the right, the plywood shows delamination of the outer face as well as checks. Note the contrast between the original translucent finish and the opaque white coating on the left.

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. Curiously, this condition is stressed in front of a row of large stones placed perpendicularly to the mosaic. While on the rest, the existent gravel diminishes the effect of the water splash.

Missing tesserae may be due to a weak assembly, since some of them have lost adhesion to the bedding layer or, occasionally, the epoxy. The granular disintegration, which appears to be active deterioration, occurs in various specific locations.

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 abraded coarse surface.

Lastly, the wood frame surrounding the mosaic exhibits 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 substructure is unknown.

The vinyl flooring in the Cloister is in good condition. *Shoji* screens along with minimum use have protected the tiles.

Summary

Water penetration, associated with failures or damage 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 fabric integrity.

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

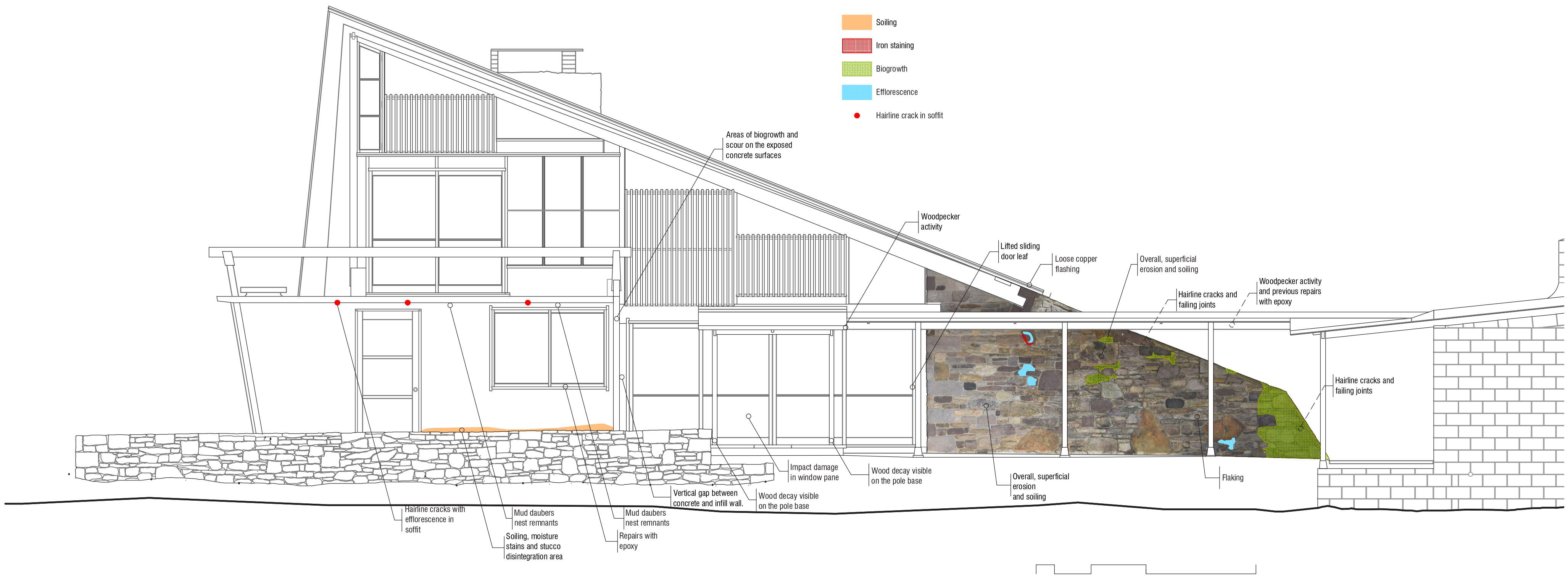
The consequences of melting snow must be also considered where icicles and ice dams form at roof eaves and clog the gutters. Water that is retained behind the ice dams could ultimately penetrate through failures in the waterproof coating or may rise above the flashing, therefore, causing leaks in the future.

Structural damage incudes the horizontal cracking on the north wall. However, moisture is speeding the deterioration of the exterior stucco and is an active force in salt migration. Along with hairline cracks, efflorescence and surface disgregation is recognizable.

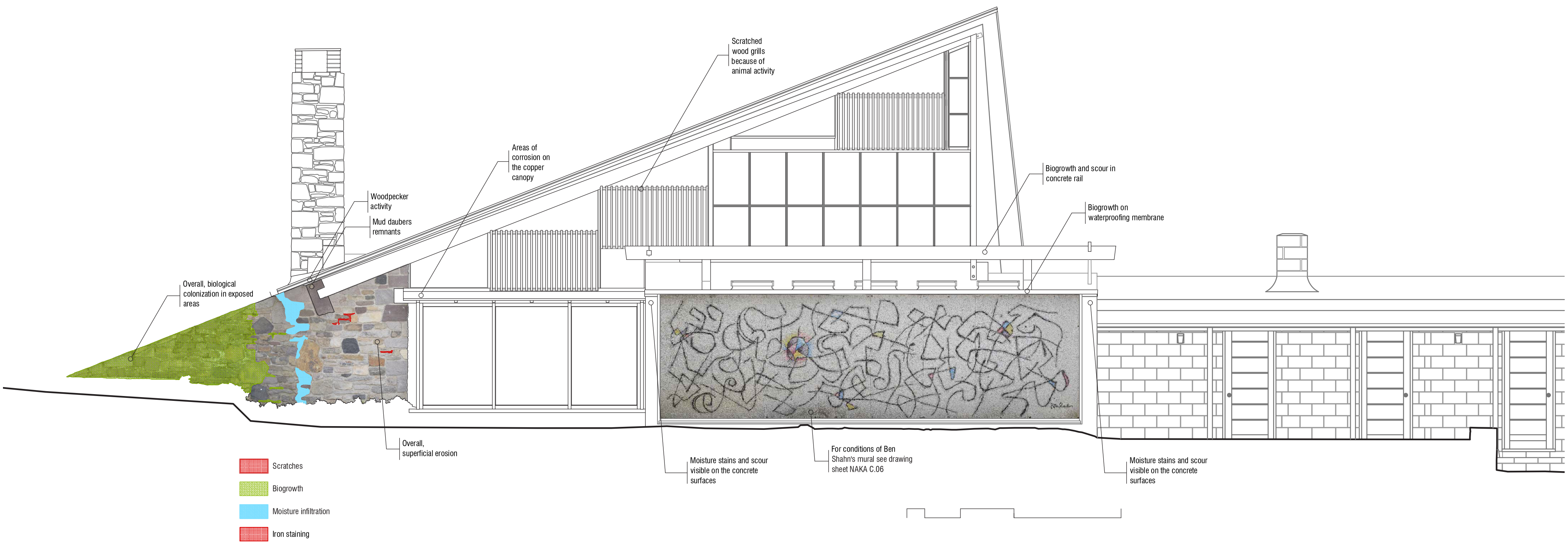
Although in overall good condition, the stone masonry shows a variety of deterioration mechanisms due to the composite nature of the stones. Cracks on the chimney stack and fireplace need to be monitored.

Condensation of water vapor, rainwater penetration or both, along with daylight and UV radiation, are factors of deterioration of the wood elements. Damage by squirrels, woodpeckers, and carpenter bee are visible elsewhere.

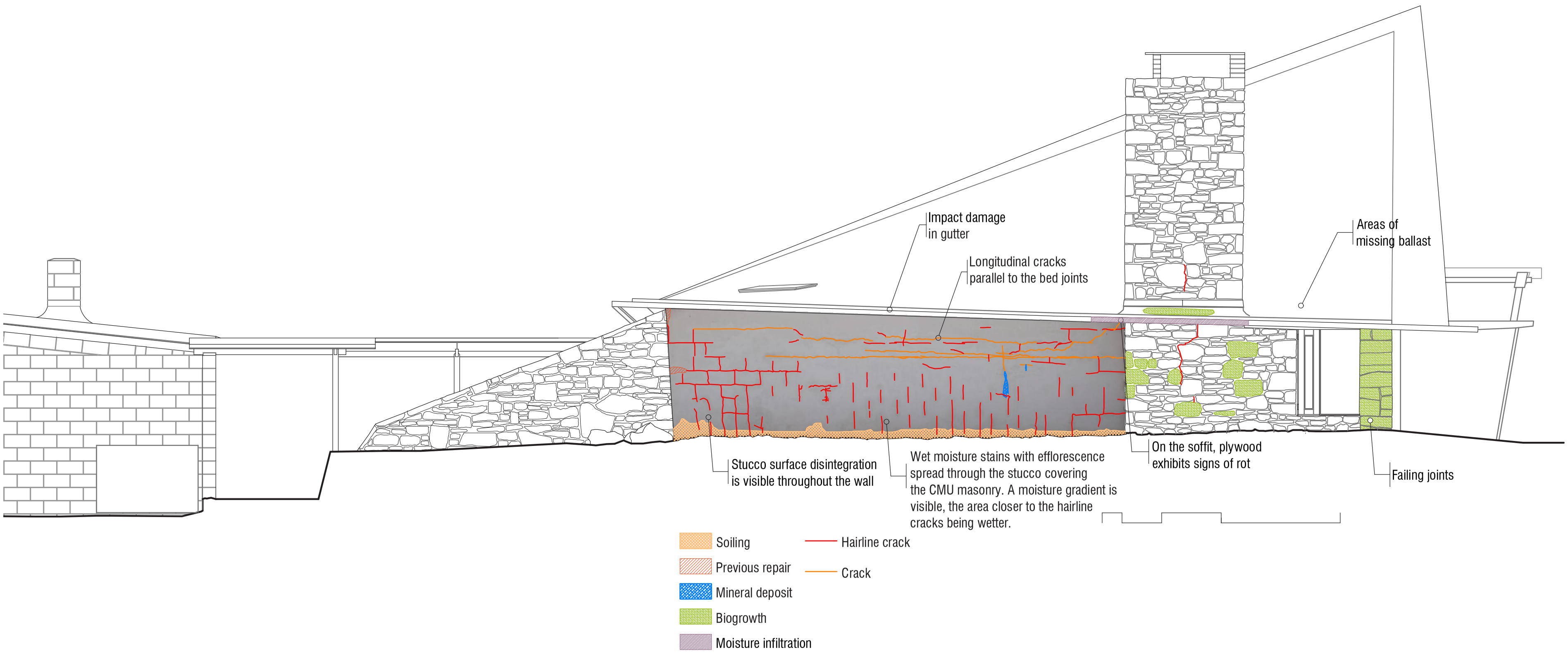
On the interior, the vinyl flooring is close to reaching its service life and will require attention soon. Prior to any repair on the finishes, further research of the assemblies and monitoring of the environment needs to be carried out. As revealed by the infrared imaging, thermal bridges are recognizable in almost every interface between disimilar materials and assemblies.



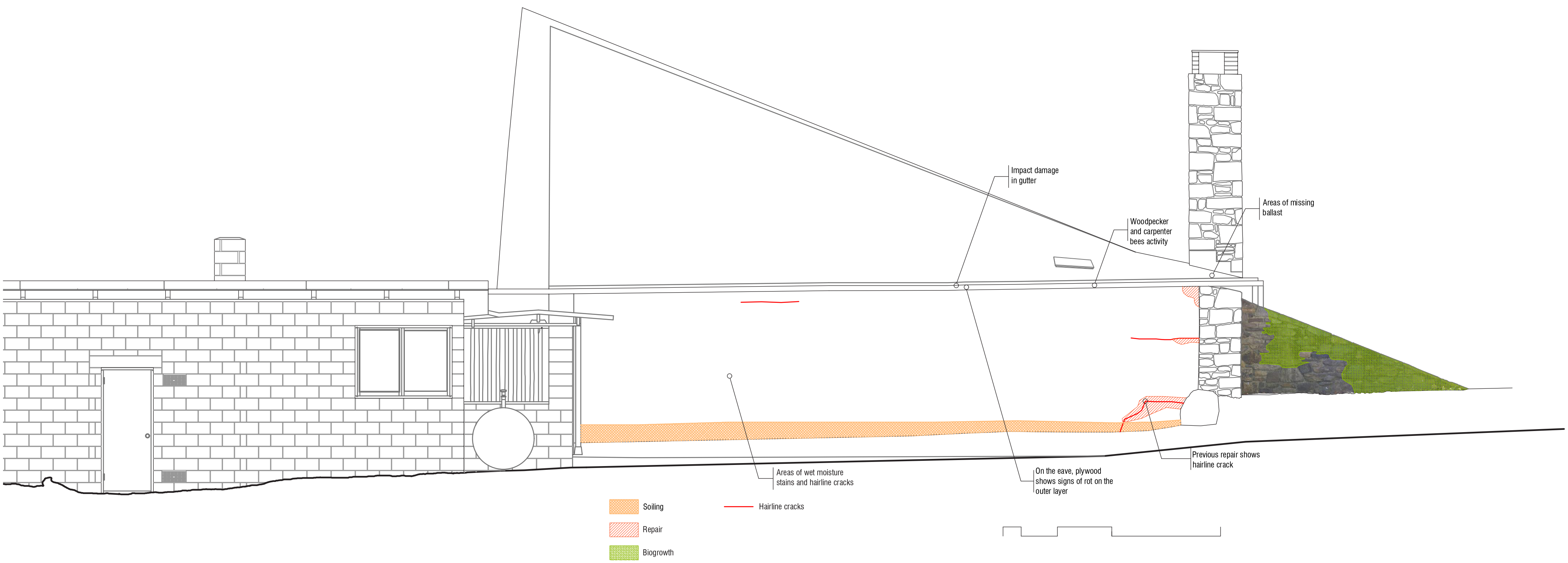
NAKA C01 - SOUTH ELEVATION



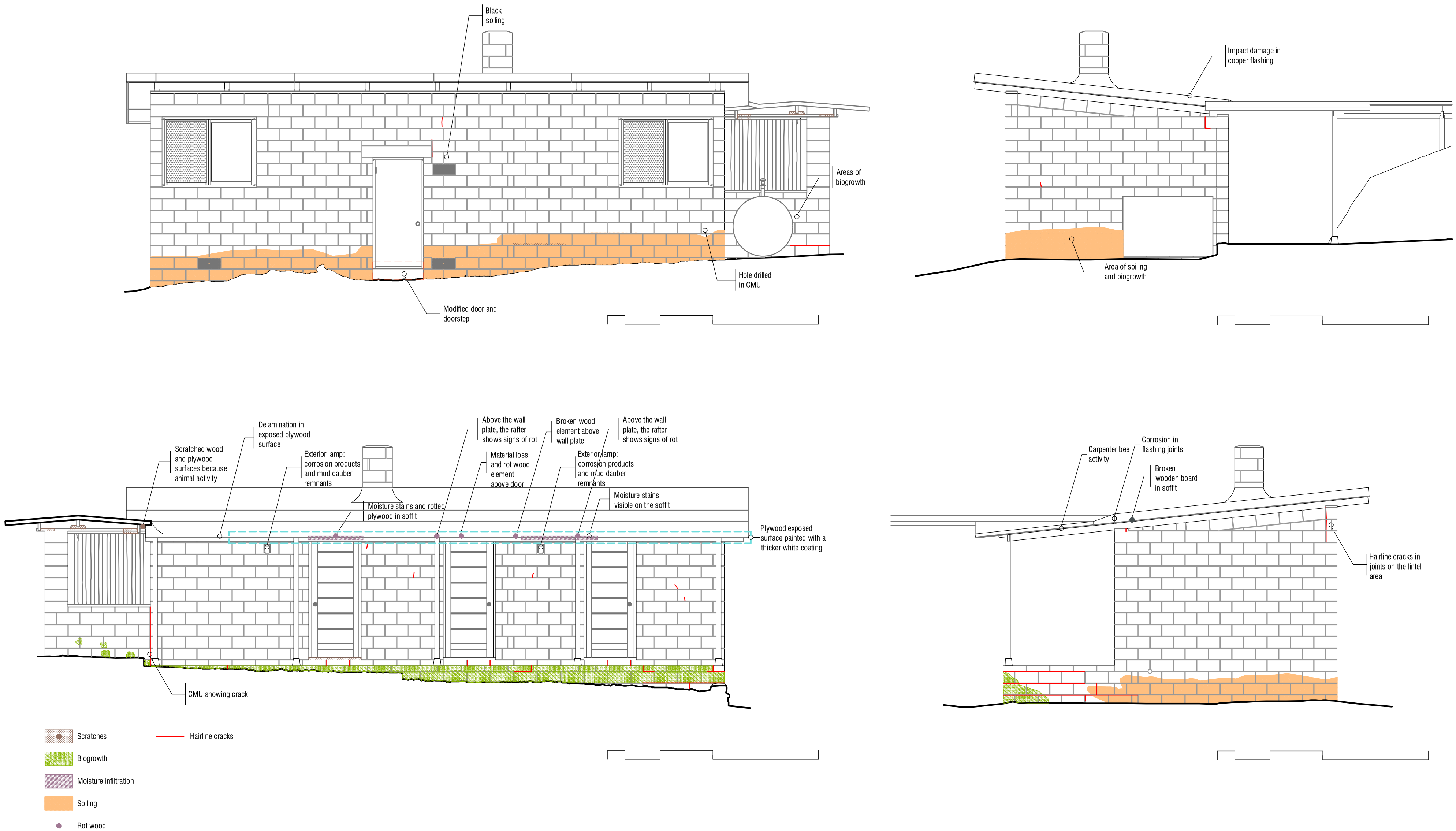
NAKA C02 - WEST ELEVATION



NAKA C01 - NORTH ELEVATION

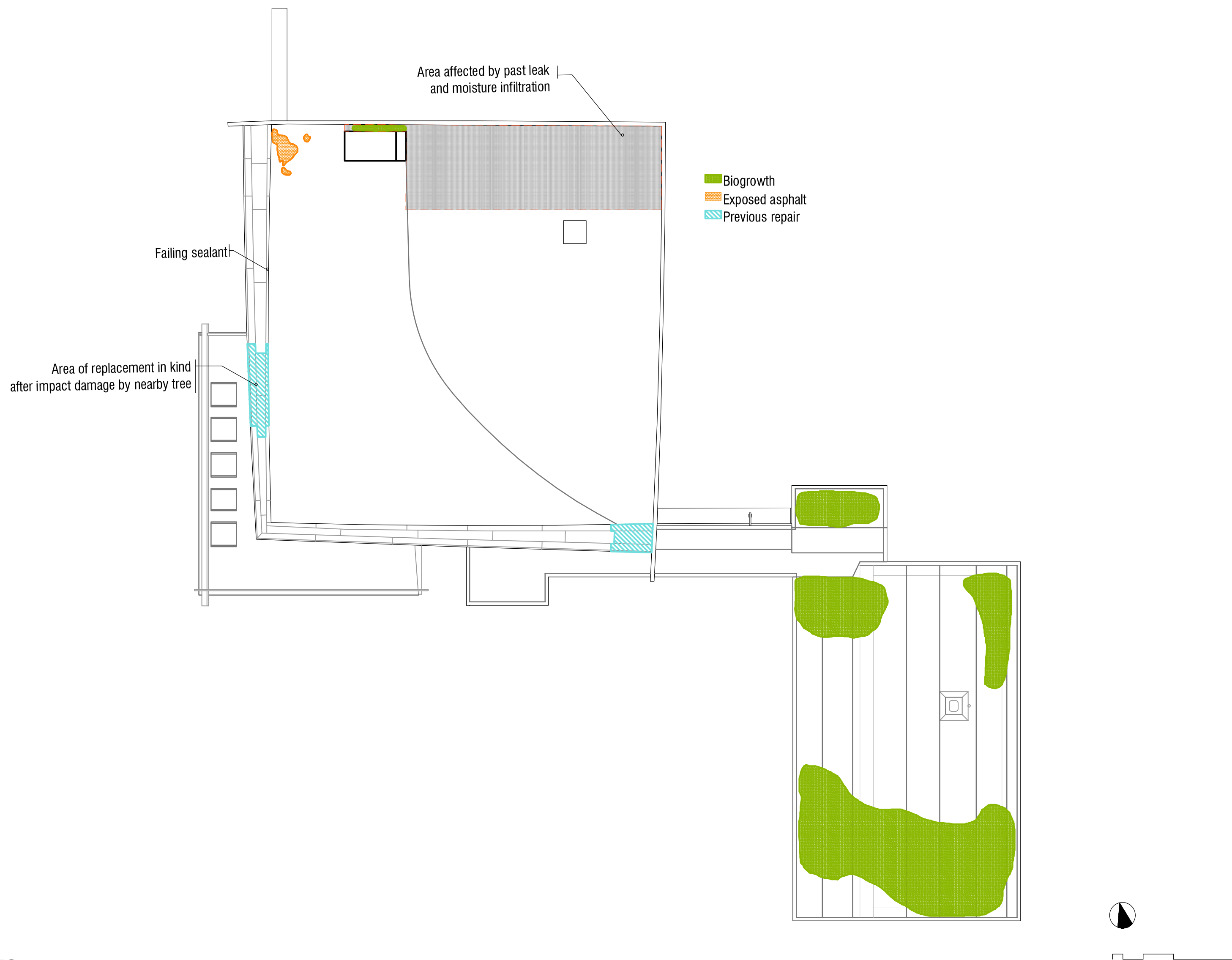


NAKA C02 - EAST ELEVATION

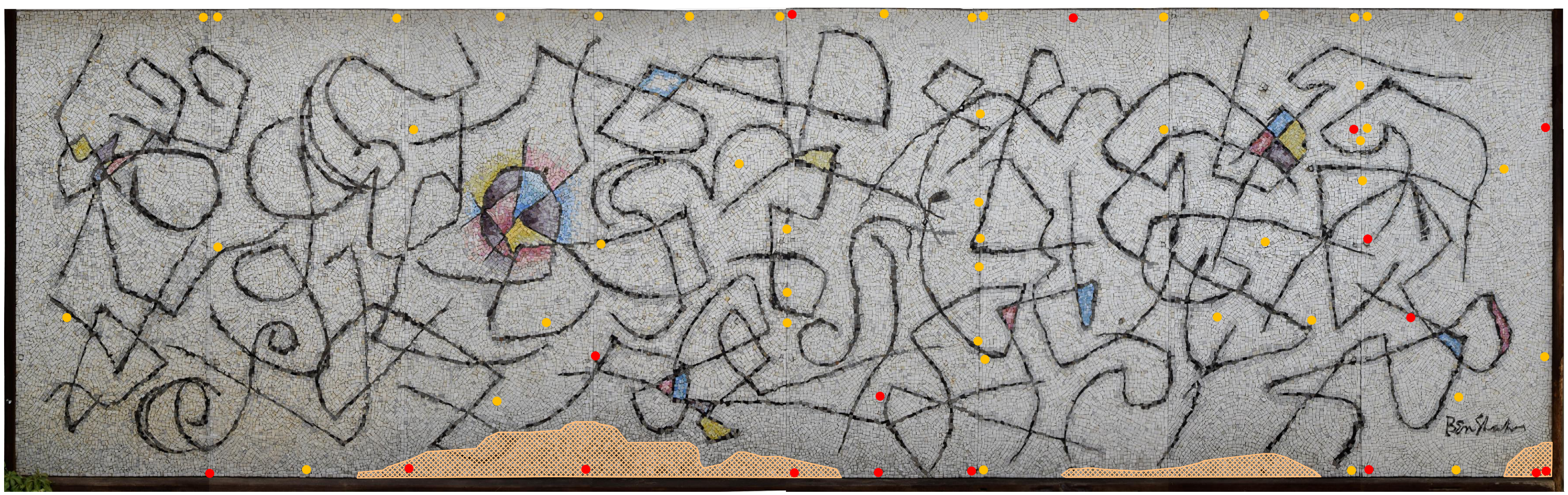


NAKA C05 - CLOISTER ELEVATIONS

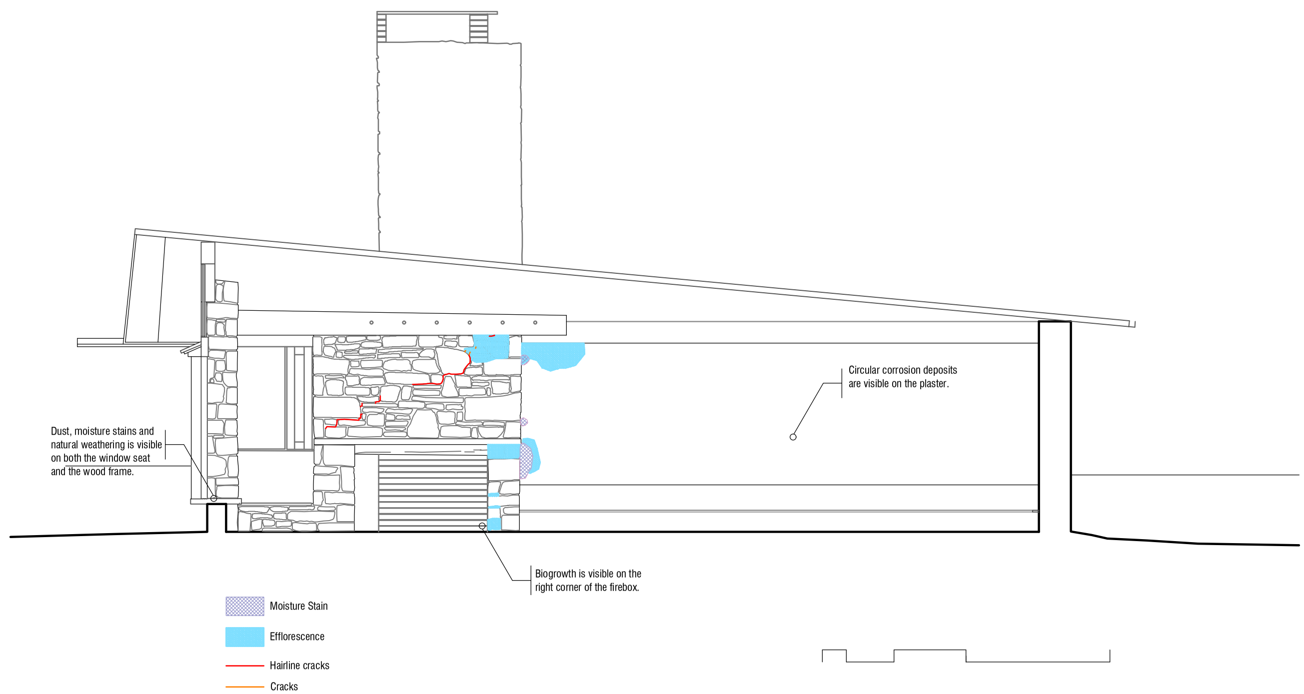
NAKA C06 - ROOFS



Soiling
Missing tesserae
Color alteration



NAKA C07 - BEN SHAHN'S MURAL MOSAIC



NAKA C08 - INTERIOR NORTH ELEVATION

4.4. Wood Assessment
Anthony & Associates, Inc.

Of the twenty-one buildings that are part of the George Nakashima Woodworker National Historic Landmark site, the Arts Building and attached Cloister are perhaps the most architecturally significant. Built between 1964 and 1967, the Arts Building was designed by Nakashima to be a museum and art gallery, while the Cloister was to house visiting craftspeople. The two and a half story Arts Building has walls constructed of concrete block, poured concrete, and stone, large windows on the west and south elevations, and numerous wooden elements in the roof, exterior and interior of the Building.

Architectural and artistic features of note in the Arts Building include the hyperbolic paraboloid roof, the cantilevered floating staircase and the tile mosaic on the west elevation. The hyperbolic paraboloid (saddle-shaped) roof is composed of plywood covered with asphalt. The free-standing wooden staircase has no outside rail and no risers, with the ends of the steps anchored in the adjacent stone wall. The tile mosaic, seen on the front cover, was designed by Ben Shahn, the artist whose works were to be displayed in the Arts Building when it was initially built.

Scope of Work

The work is intended to provide answers to questions raised by the project team about the condition and /or allowable structural grade of specific wood elements in the Arts Building and the Cloister.

The scope of work was intended to focus on the following elements:

1. Edge beams supporting the south and west roof lines
2. Southwest corner post supporting the edge beams
3. Four original load-bearing posts on the south elevation
4. Wood railings on the terrace
5. Plywood roof diaphragm
6. Plywood used in the Cloister soffits

Field Procedures

Ron Anthony, wood scientist for A&A, conducted the assessment of the wood elements of the Arts Building and Cloister on April 6-7, 2016. Cesar Bargues Ballester of the University of Pennsylvania School of Design assisted with the survey. To accomplish the scope of work listed above, the assessment included removing samples for species identification, visual inspection, probing, moisture diagnostics, and deterioration quantification. The methods used are described below.

Species Identification

Identifying wood species makes it possible to determine material properties, such as resistance to decay, and to identify compatible material for repair of historic

From top to bottom:
Figure 1. Sample removal location from the southwest corner post.
Figure 2. Fungal growth on the underside of the north railing.
Figure 3. Probing with an awl to determine the extent of deterioration in the plywood soffit on the Cloister.
Figure 4. Resistance drilling to identify the condition of an original porch post.

35. American Wood Council, 2015, National Design Specification for Wood Construction, Washington, D.C.
36. American Society for Testing and Materials, 2015 Annual Book of Standards, Vol. 04.10. ASTM, West Conshohocken, Pennsylvania.
37. Western Wood Products Association (2011). Western Lumber Grading Rules. Portland, Oregon.

fabric, if necessary. Wood species were identified by removing samples from selected member types of interest to the project team, from which the species or species group were determined under microscopic examination (Figure 1).

Visual Inspection and Probing
Visual examination of the wood allows for identifying components that are missing, broken, or in an advanced state of deterioration. Missing components are those which have been removed or have fallen away because of deterioration, structural failure, or vandalism. If missing components were intended to provide structural support or protection from the elements (i.e., to prevent moisture intrusion), their replacement may be essential to prevent long-term damage to the structure. Visual inspection also allows for the detection of past or current moisture problems, as evidenced by moisture stains on the exposed surface of the wood. Further, visual inspection enables detection of external wood decay fungi or insect activity as determined by the presence of decay fruiting bodies, fungal growth, insect bore holes or wood substance removed by wood-destroying insects (Figure 2).

Internal decay and insect damage are often difficult to detect due to the lack of evidence on the exposed surface of the wood. Probing the wood with an awl enables rapid detection of voids in the wood just below the surface that may or may not be visible (Figure 3). It can also indicate the approximate depth of the deterioration. Visual inspection and probing provide a rapid means of identifying areas that may need further investigation or repair.

Moisture Content Diagnostics
Prolonged exposure to moisture can produce undesirable conditions and long- term maintenance issues for wood in a structure. Excessive shrinkage or swelling, checking, loose connections, and decay are typical problems. Limited moisture diagnostics were conducted to identify potential sources of moisture intrusion that could result in premature deterioration of the wood and to determine whether further investigation of potential areas of decay was warranted.

Deterioration Quantification
In addition to the inspection of wood members using a combination of visual observations and moisture measurements, limited resistance drilling was conducted to determine loss of material due to wood decay or insect attack. Resistance drilling is a quasi-nondestructive technique for determining the relative density of wood (Figure 4). It is best suited for determining internal problems in wood members that do not show obvious signs of deterioration, such as surface decay. Any internal void or early stage of decay at the location drilled can be detected by determining the relative density of the wood. The relative density is printed on a strip of paper as a small diameter needle penetrates the wood. The technique is very reliable for quantifying the extent of voids when used in combination with other techniques to rapidly locate areas of probable deterioration.

Below: Figure 5. Knots and slope of grain (indicated by the seasoning check) on the south edge beam.

Visual Grading
Structural timbers and lumber used in new construction are intended to comply

with the relevant building code for that jurisdiction. For wood construction, structural engineers rely on design values referenced in the building code to determine an acceptable species, size, and grade for a particular load condition. The design values given in the building code for solid wood products are established by the American Wood Council[35] and published as the *National Design Specification for Wood Construction*. The published design values are based on test data and procedures published by the American Society for Testing and Materials (ASTM) that demonstrate the engineering performance of the material.[36] Wood products are graded in accordance with procedures promulgated by one of several forest products industry associations, such as the Western Wood Products Association (WWPA).[37]

For existing buildings the engineer often relies on available species and current standards to determine the adequacy of the wood members to remain in service. Since many historic buildings were built before building codes or design values for wood products were established (and, thus, before grade stamps were used), engineers are often in a quandary when determining what design values are appropriate. The edge beams and southwest corner post do not have any grade stamps. Frequently an assumed species and grade are assigned, only to show that the wood members are structurally deficient. The result is often an overly conservative estimate of design values and unnecessary replacement and repair decisions with the associated unnecessary project costs.

Timber grade is determined by species, size of the member(s), and growth

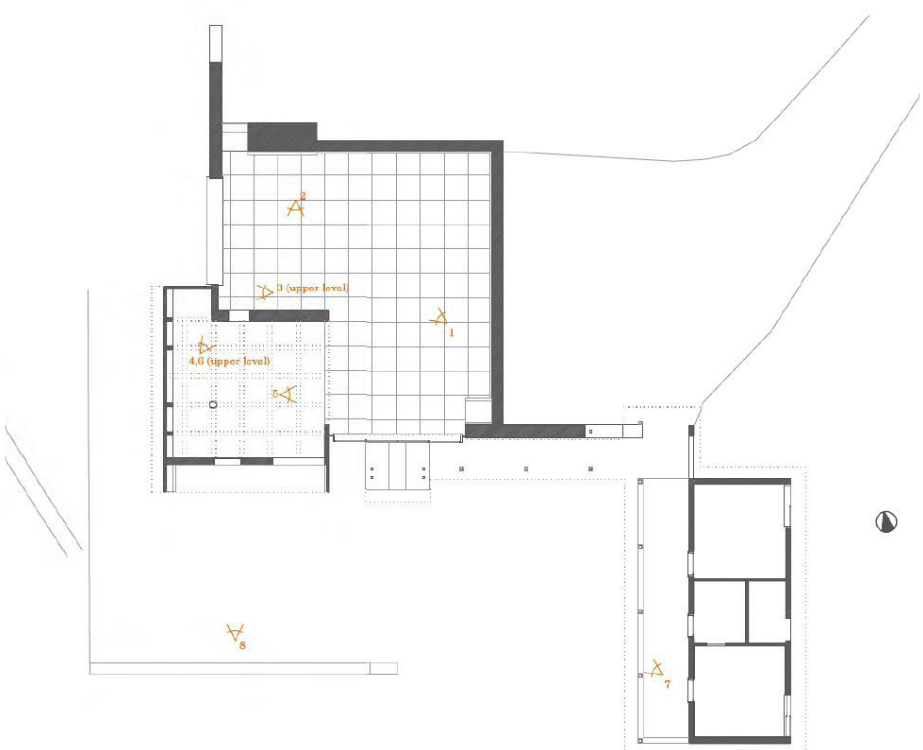


Figure 6. Plan view shoing the Arts Building and Cloister.

Fromt top to bottom:
Figure 7. Inconsistent depth of gravel.
Figure 8. Patches of moss on the roof.
Figure 9. Moss in-situ, with awl for scale.
Figure 10. Moss overturned with the awl in approximately the same position as Figure 9. Note that the gravel is largely disconnected from the root

characteristics such as knots and slope of grain (Figure 5). Knots and slope of grain tend to be the grade-limiting characteristics for lumber and timber in older buildings. Measurement of knots and slope of grain provides an indication of the allowable lumber grade for a given wood species. The visual grade provides essential data for structural analyses to assess the ability of the members to support current or future loading conditions and provides information critical for determining the extent of any necessary repairs. Visual grading was done on the west and south edge beams and the southwest corner post.

Orientation
The Arts Building is oriented with the entrance on the south elevation and a covered walkway connected to the Cloister situated to the southeast of the Arts Building (Figure 6). The hyperbolic paraboloid roof slopes towards the northeast corner of the Arts Building and is supported on the west and south elevations with large timber edge beams that are tapered until they meet at a post at the southwest corner of the Building. A terrace at the second level on the west and south elevations incorporates wooden and concrete railings at the terrace perimeter.

The porch roof of the Cloister uses slender wooden replacement columns to support plywood soffits below the roof covering. Similar replacement columns also support the covered walkway to the Arts Building, except at the landing by the sliding doors, which are original columns.

Findings

Species Identification
Based on microscopic characteristics of the wood, the samples removed from various wood members indicate that several species were used in the construction of the Arts Building (Table 1). This is consistent with George Nakashima’s approach to building construction. The west and south edge beams were identified as Douglas-fir (*Pseudotsuga menziesii*) while the post that supports the edge beams at the southwest corner was identified as eastern white pine (*Pinus strobus*). A sample removed from the lintel on the south elevation was also identified as eastern white pine. The edge beams and lintel were reported to be white oak. Douglas-fir and eastern white pine have been widely used for structural purposes. While old-growth timber of both species is considered to be moderately durable, the age of the Arts Building would likely not incorporate old-growth timber; therefore, these structural members should be monitored to ensure that deterioration is not causing a loss of structural integrity. Other species identified in the Arts Building would not be considered commonly used species and, no doubt, reflect the intent of Nakashima to use a variety of species in his work to present the beauty of wood as a building material.

Table 1. Wood Species Identification, Arts Building

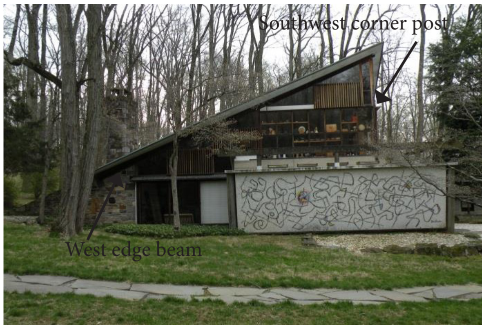
Member	Location	Species
south edge beam	south elevation	Douglas-fir (Pseudotsuga menziesii)
lintel	south elevation	eastern white pine (Pinus strobus)
rib	ceiling rib at east wall	Baldcypress (Taxodium distichum)
southwest corner post	south/west	eastern white pine
north railing	terrace	black locust (Robinia pseudoacacia)
south railing	terrace	Douglas-fir
west edge beam	west elevation	Douglas-fir
original porch posts	south elevation	black locust
roof diaphragm plywood	roof	Douglas-fir and sugar pine (Pinus lambertiana)

Wood Condition – Roof Covering

Although not constructed of wood, the condition of the roof covering directly impacts the condition and longevity of the wood elements below the roof, particularly the plywood diaphragm. An examination of the roof revealed that the gravel depth protecting the membrane was not consistent across the roof. In some areas, the gravel was missing and the membrane was exposed, leading to potential degradation due to exposure to ultraviolet light (Figure 7).

Several patches of moss were growing on the roof (Figure 8). Any biological growth on a roof is a concern due to moisture entrapment that can lead to breakdown of the membrane and roof sheathing due to root penetration, and result in leaks into the interior space. However, other than moisture entrapment, this is not the situation with the moss growing on the Arts Building roof. Several patches of moss that appear to be well-attached to the roof were found to only be loosely connected to the gravel without any attachment to the roof membrane. These patches could easily be overturned without even disrupting the gravel (Figures 9 and 10). The patches of moss should be removed periodically to prevent them from becoming established to the point where they gain roof penetration through the membrane and into the diaphragm below.

The north and east elevations of the Arts Building have wide eaves that show the overlapping plywood sheets making up the roof diaphragm/decking (Figure 11). The top wall plates on the north and the east walls extend slightly beyond the exterior walls, exposing the end grain, although they are well protected from the elements by the overhang.



From top to bottom:
Figure 11. Northeast corner showing the layered plywood used in the shell and the lumber used for the wall top plates.
Figure 12. West elevation.
Figure 13. West edge beam below the eave, as seen from below.
Figure 14. Close up of the south edge beam at the east end. Note the notch detail into the stone is the same as the west edge beam seen in Figure 13.

Left: Figure 15. South edge beam showing the depth of the eave that protects the edge beam.
Right: Figure 16. Insect next on the surface of the south edge beam.

Left: Figure 17. Southwest corner post where the south and west edge beams connect.
Right: Figure 18. Close-up of the connection between the south and west edge beams and the corner post.

Left: Figure 19. Base of corner post.
Right: Figure 20. North wooden railing of the terrace.

Left: Figure 21. North railing at the west wall of the Arts Building.
Right: Figure 22. North railing at the interior face of the concrete railing showing biological deterioration on the side and upper surfaces.

Left: Figure 23. North railing at the interior of the concrete railing, view from below showing biological deterioration on the lower surface.
Right: Figure 24. North railing at the exterior face of the concrete railing showing deterioration. Note the use of a wooden tusk to lock the two railings.

Wood Condition and Structural Grade – Exterior Wood Structural Members of the Arts Building

The roof of the Arts Building is complex in design (the hyperbolic paraboloid roof) but simple in terms of the number and type of members supporting the roof. Three layers of plywood sheathing are used to provide the roof shape with the north and east edges of the roof being supported at the wall top plates and the west and south edges being supported by tapered Douglas-fir beams that span from the wall at the lower edge to the highest point at the southwest corner post (Figure 12).

The lower end of the tapered edge beams are notched into stones at the walls (Figures 13 and 14). Based on observed defects in the edge beams, there are no defects that would preclude them from being classified as Douglas-fir Select Structural, Beams and Stringers, in accordance with the Western Lumber Grading Rules (2011) published by the Western Wood Products Association. For allowable design values, the classification in the National Design Specification for Wood Construction would be Douglas fir – Larch Select Structural Beams and Stringers. The west edge beam has an unusual seasoning check (as opposed to a through-split) near the lower (north) end that is likely due to growth of the tree or milling of the beam and has not appeared to affect the performance of the beam over time.

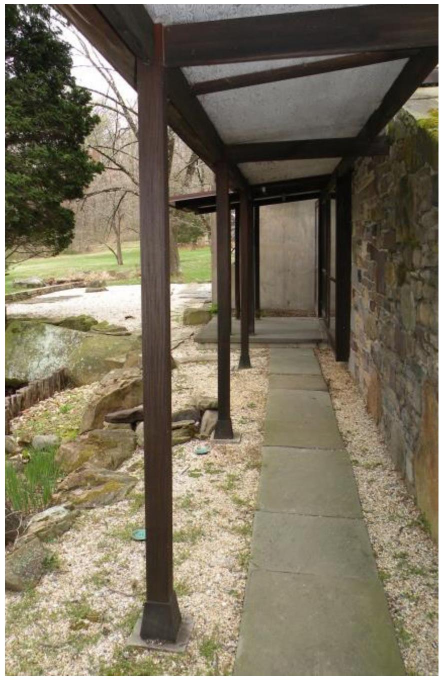
A large eave or soffit extends the roof beyond the edge beams affording some level of protection from the effects of precipitation and, to a lesser degree, ultraviolet light (Figure 15). There is evidence of minor deterioration of some minor wooden elements by insects or insects nests were observed on the Arts Building, including on the south edge beam (Figure 16).

A 4-inch by 6-inch eastern white pine corner post supports the tapered ends of the two edge beams at the southwest corner of the Arts Building (Figure 17). Based on observed defects in the corner post, there are no defects that would preclude the corner post from being classified as Eastern White Pine Select Structural, Structural Joists and Planks in accordance with Standard Grading Rules for Northeastern Lumber (2013) published by the Northeastern Lumber Manufacturers Association, with the corresponding allowable design values published in the National Design Specification for Wood Construction. During

the wood assessment, heavy rain made inspection of the top of the corner post and the connections to the edge beams unsafe to access without use of equipment such as a boom lift. Visual inspection of the connection from below did not reveal any sign of deterioration that would compromise the connection (Figure 18); however, the lack of redundancy in the roof supports suggests that the connection and wood condition be assessed to ensure that the structural integrity of the members has not been compromised.

The base of the corner post is secured in poured concrete but the west face is exposed (Figure 19). Resistance drilling through the west face near the base of the post revealed no internal voids. Additional resistance drilling near the casement

Left: Figure 29. Walkway and supporting posts along the south elevation of the Arts Building.
Right, above: Figure 30. Base of an original post at the landing outside the sliding doors on the south elevation. This post is in good condition.
Right, below: Figure 31. Base of the southeast original post at the landing outside the sliding doors on the south elevation. This post is in fair condition at the base, but in good condition 8 inches above the base.



Left: Figure 32. Close up of the base of an original post at the landing outside the sliding doors on the south elevation. This post has deterioration at the base. Note the metal pin that holds the post to the landing.
Right: Figure 33. Base of a replacement post with wood trim attached.

Left: Figure 34. Cloister showing biological growth on the roof, west elevation.
Right: Figure 35. Plywood soffit of the Cloister, easily penetrated by an awl.

Left: Figure 36. Ant bait adjacent to the Cloister.
Right: Figure 37. Plywood layup visible at the skylight.

window also revealed no internal voids. This post is in excellent condition.

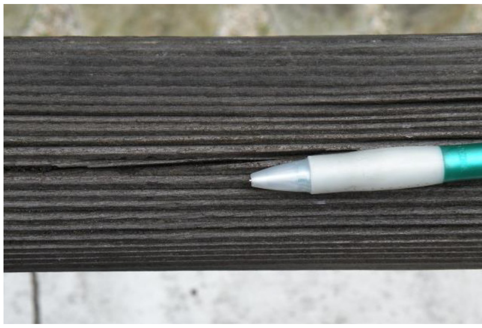
There are two wooden railings on the terrace; a longer one on the south elevation and a shorter one at the north end of the west section of the terrace. The north railing extends from the west wall of the Arts Building through the concrete railing at the west edge of the terrace (Figure 20). The railing is in good condition where it penetrates the wall of the Arts Building (Figure 21). However, it has visible fungal growth and deterioration at the interface with the concrete railing (Figures 22 through 24). The north railing fully penetrates the concrete railing and is secured at the outer face of the concrete with a wooden tusk.

Although there is deterioration where the railing is in contact with the concrete, the good condition noted along the length of the railing and at the west wall of the building is likely due to the use of black locust, a naturally durable wood species. Although black locust is naturally durable, it can succumb to wood decay if moisture is trapped for prolonged periods of time at connections, penetrations through other materials or members, and at the base of columns where water is not adequately drained.

The railing on the south side of the terrace is made of Douglas-fir (Figure 25). The ends of the railing use different connection details to attach the railing to the terrace (Figures 26 and 27). The railing is weathered and has biological growth on the surface, but the growth is not decay. The weathered appearance is the result of long-term exposure to precipitation, ultraviolet light, and wind-blown debris (Figure 28). While the biological growth (moss and lichens) are not deteriorating the wood directly, their presence provides for a favorable environment for wood decay fungi by trapping moisture at the surface. As such, the biological growth could be removed periodically (not using pressure methods). The weathered appearance is often a desirable look for exposed exterior woodwork and does not need to be treated along its length, other than to remove the biological growth. If there is concern about deterioration at the connections, remedial preservatives, such as borate rods, could be inserted to retard the action of wood decay fungi or insect attack.

A covered walkway on the south elevation of the Arts Building connects to the Cloister. The walkway is supported by nominal 4-inch by 4-inch wooden posts (Figure 29). Most of the original posts supporting the walkway and the porch of the Cloister have been replaced, reportedly with Ipe (*Tabebuia spp.* aka *Handroanthus spp.*). Four original black locust posts, in place at the landing with the sliding doors into the Arts Building, have experienced various degrees of minor deterioration at the base. These posts are better protected from the elements (weather) than the walkway posts and are, generally, in good condition with only minor deterioration at the base (Figures 30 and 31).

One original post has more extensive deterioration at the base and is suitable for a hidden repair to prevent further deterioration of the wood (Figure 32). The post does not need to be replaced. The deterioration at the base of this post is likely similar to the deterioration that was present in the walkway posts that led to their replacement. The posts (at least the southeast landing post) are attached to the



From top to bottom:
Figure 25. South railing on the terrace.
Figure 26. East end of the south railing. Note connection details between the notched railing and the vertical post and the base of the vertical post embedded in the concrete toe-kick on the terrace.
Figure 27. West end of the south railing.
Figure 28. Weathered surface color and texture of the upper surface of the south railing on the terrace.

stones with a metal pin.

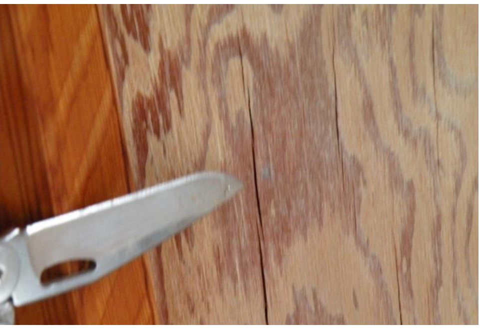
The bases of the replacement posts have been encased with wood trim, although the original posts did not appear to have any trim (Figure 33). The trim may have been attached under the assumption that it would protect the bottom of the posts from moisture. That is not the case. It is recommended that the trim be removed to the original configuration, which will allow for the posts to dry when they get wet. Use of a spacer at the bottom of the post would prevent the end grain of the post from absorbing water under most circumstances.

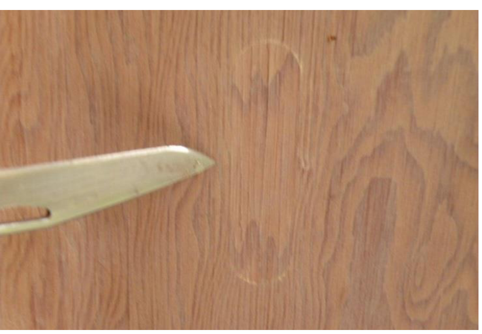
Wood Condition – Exterior Elements of the Cloister
The Cloister is a simple building constructed of concrete block walls and a low-pitched roof. The soffit, or porch roof, on the west elevation is supported by 4- inch by 4-inch wooden posts (Figure 34). The plywood used to construct the soffit is in poor condition due to wood decay where the Cloister roof has allowed for moisture penetration through the roof covering. The visibly deteriorated plywood was easily penetrated with an awl, particularly at the outer edge (Figure 35). In general, due to the poor condition of the Cloister roof, the plywood in the soffit has two conditions: plywood that has deteriorated, and plywood that will deteriorate. The Cloister roof should be repaired and maintained.

One other observation related to the exterior of the Arts Building and Cloister – there has been a history of ant damage in the buildings at the George Nakashima Woodworker National Historic Landmark site. For some period of time, a program based on bait and traps has been in place to limit attack by insects (Figure 36). Based on this wood assessment, the bait appears to be working at the Arts Building and Cloister and should be continued, unless an alternative preventative program is implemented.

Wood Condition – Interior Wood Elements of the Arts Building
The hyperbolic paraboloid roof of the Arts Building relies on a plywood skin for structural stability. The intent at the time of the wood assessment was to remove a small area of the roof covering and membrane to expose the plywood. Due to heavy rain, opening a probe area was not advisable and deferred to a later date when the structural engineer could examine the plywood.

The edge of the plywood diaphragm layup was visible at the skylight near the northeast corner of the Arts Building (Figure 37). The plywood skin consists of three sheets of 5-ply plywood, each sheet approximately 5/8" thick. The face veneers on the upper sheet of plywood are thinner than the inner plies; however, this could be due to different fabricators supplying the plywood for the project. The veneer thickness seemed to vary between and within the three panels but this could be due to either manufacturing or installation, rather than differences in panel types. More information on the diaphragm material and construction would be beneficial in understanding the structural performance of the roof as well as potential durability issues.
It was not possible, by visual inspection, to determine if the three sheets of plywood are bonded together with an adhesive. Verification of the use of adhesives to bond the three layers of plywood is paramount if the plywood



Fromt top to bottom:
Figure 38. Narrow micro-check in surface veneer of the ceiling plywood.
Figure 39. Larger micro-check in the surface veneer of the ceiling plywood.
Figure 40. Boat patch in the surface veneer of the ceiling plywood.
Figure 41. Router patch in the surface veneer of the ceiling plywood.

layup is assumed to behave as a single composite within the diaphragm. While historical documents suggest that the plywood panels were bonded, the practicality of gluing entire panels that are off-set from one another within the three layers is questionable because of limited assembly time before the adhesive would cure and the lack of means to apply pressure necessary to form a structural bond (clamping). Mechanical fasteners (e.g. screws) attaching the plywood panels together were not visible, but assumed to be hidden beneath the wooden ribs on the ceiling below. The spacing of the ribs likely was intended to cover the edge joints of the plywood. End joints between plywood sheets are visible and, in some cases, have opened slightly with visible misalignment.

Considering structural properties, the plywood sample was determined to have Douglas-fir face plies (assumed to be from the Pacific Northwest rather than the lower Rocky Mountains); that qualifies it for classification as a Group 1 species, which dictates material properties. The cross plies are sugar pine, which is Group 4. The veneer grade for the plies is unknown, although the exposed bottom face ply exhibits patches of measurable size and frequency. It is reasonable to assume the top ply is the same grade. It is not possible to determine the grade of the core plies without deconstructing a large section of several panels (which is not recommended). Also unknown is whether the panels conform to Rated Sheathing, their span rating, or the adhesive used and whether is qualifies as Exposure 1 or 2. These, and other, variables affect the material properties.

Based on the information obtained during this project, the appropriate document for the plywood properties is APA Plywood Design Specification Y510. There is a newer version but some of the properties were changed because of recent changes in the panel layup. Based on industry technical data, ¾-inch 5-ply plywood with Douglas-fir face and back veneers and sugar pine cross plies made in the 60s is essentially the same product that would be made in the 90s. Thus, Y510 seems to be a good source document for material properties.

The underside of the plywood visible from the interior of the Arts Building appears to be free of defects and blemishes. However, close examination of the veneer shows that micro-checks of various widths and lengths are present, as well as patches that replaced defects during the manufacturing process (Figures 38 through 41). The micro-checks are the result of either lathe checks that were present in the veneer after it was rotary cut from the log or due to drying after installation. In either case, the micro-checks are of no consequence for either structural performance or general appearance of the interior space. The patches are placed in the veneer to replace defects such as knots during the manufacturing process. Two types of patches were observed. Most common were boat patches (football-shaped) 4.5 inches long and 2 inches wide. Less common were router patches (with parallel sides and rounded ends) 2 inches long and 1 inch wide. Both patch types are difficult to see on the plywood ceiling without close examination due to the precision of installing the patches to try and match the grain pattern and the whitewash coating that masks the patches. Baldcypress ribs extend between the east and west walls (Figure 42). The ribs are spaced 24 inches on center and, as mentioned earlier, cover the end joints of the plywood. The ribs are not continuous, but are connected with a splice

Above: Figure 42. Baldcypress ribs extending between the east and west walls.
Below: Figure 43. Failure at the joist in the rib along grid line 6.

secured with a single screw. Very minor moisture stains are visible, mostly at the perimeter of the interior space; however, moisture content readings indicated that the wood has a moisture content of approximately 10 percent. The rib along grid line 6 has a split at one splice (Figure 43). The split, or failure, appears to be cosmetic and so would not affect the structural integrity of the ceiling and roof.

Summary

The findings of the assessment can be summarized as follows:

- The Arts Building makes use of a variety of wood species, including Douglas-fir (Pseudotsuga menziesii) for the edge beams and south railing on the terrace, eastern white pine (Pinus strobus) for the corner post and lintel, Baldcypress (Taxodium distichum) for the ceiling ribs, and black locust (Robinia pseudoacacia) for the north railing on the terrace and the original porch posts on the south elevation.

- There are patches of moss and debris on the roof that can reduce the service life of the roof covering and structure below.

- The west and south edge beams, and the southwest corner post, are in good condition; generally free of any deterioration.

- No defects were observed that would preclude the west and south edge beams from being classified as Douglas-fir Select Structural, Beams and Stringers.

- No defects were observed that would preclude the southwest corner post from being classified as Eastern White Pine Select Structural, Structural Joists and Planks.

- The north railing on the terrace is in good condition where it penetrates the wall of the Arts Building; however, it has visible fungal growth and advanced deterioration at the interface with the concrete railing on the terrace and should be repaired.

- The south railing on the terrace is weathered and has biological growth on the surface but is in good condition. The biological growth could be removed periodically and remedial preservatives, such as borate rods, could be inserted at the connections to retard the action of wood decay fungi or insect attack.

- Four original posts in place at the landing with the sliding doors into the Arts Building have experienced various degrees of deterioration at the base. The southeast original post has the most deterioration at the base and is suitable for a hidden repair to prevent further deterioration of the wood. The post does not need to be replaced.

- The supporting posts on the walkway between the Arts Building and the

Cloister, as well as the posts supporting the Cloister porch/soffit, have been replaced. It is recommended that the trim at the base of the replacement posts be removed to the original configuration, which will allow for the posts to dry when they get wet. Use of a spacer at the bottom of the post would prevent the end grain of the post from absorbing water under most circumstances.

- The plywood used to construct the Cloister soffit is in poor condition due to wood decay where the roof has allowed for moisture penetration through the roof covering. The Cloister roof should be repaired and maintained. The plywood soffit should be replaced.

- Due to heavy rain, opening a probe area to assess the plywood diaphragm was not advisable and deferred to a later date when the structural engineer could examine the plywood. More information on the diaphragm material and construction would be beneficial in understanding the structural performance of the roof as well as potential durability issues.

- Baldcypress ribs extend between the east and west interior walls of the Arts Building and are, generally, in good condition, except for a joint failure in the rib along grid 6 and minor moisture stains along the perimeter of the interior space.

Table A1. Drilling log for Nakashima Arts Building.

Drilling Number	Area	Member ID	Drilling Direction	Location	Comments
D1	South elevation	SE landing post	W to E	8” above base	no void
D2	South elevation	NE landing post	W to E	8” above base	no void
D3	South elevation	SW landing post	S to N	$8^{1/2}$” above base	no void
D4	South elevation	NW landing post	N to S	8” above base	no void
D5	SW corner post	post	N to S	at casement window	no void
D6	SW corner post	post	W to E	$5^{3/8}$” above base	no void
D7	West terrace	North railing	S to N	2 $^{1/2}$” from wall, 1” from top	no void
D8	West terrace	North railing	S to N	2” from concrete rail, mid-depth	mostly void
D9	South elevation	SE landing post	W to E	2” above base	check in center, visible deterioration at base
D10	South elvation	NE landing post	W to E	2” above base	no void
D11	South elevatoin	SW landing post	W to E	2” above base	no void
D12	South elevation	NW landing post	W to E	2” above base	no void

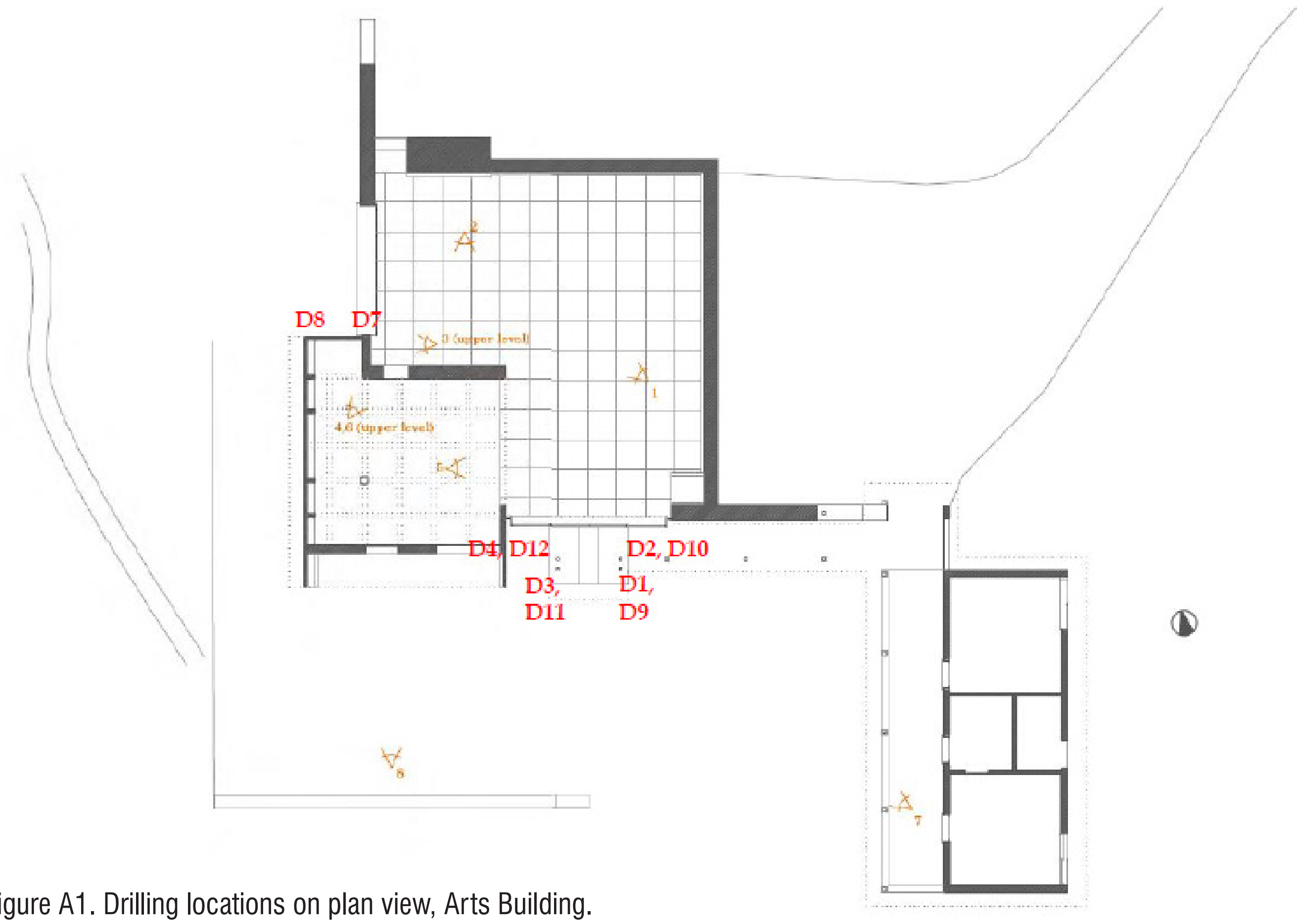


Figure A1. Drilling locations on plan view, Arts Building.

Figure A2. Southwest corner post drilling locations, Arts Building.

4.5. Structural Assessment
David Biggs, P.E., S.E.

Introduction

1. Scope of services:

- Provide an initial structural assessment of the exposed roof structure of the Arts Building based upon visual observations.
- Identify structural issues and needs.
- Present recommendation for the management plan.

2. Two site visits were made along with project architect, Cesar Bargues Ballester on November 12, 2015 and May 9, 2016.

3. Funding was unavailable in the Getty Foundation grant for analytical work or computer modeling. However, I was able to incorporate some analytical work and to interest SAHC into providing a master's student to perform computer modeling.[39]

Background

The Arts Building was constructed from 1964 to 1967. The roof structure is a hyperbolic paraboloid composed of three layers of 5/8 inch thick plywood. The full description and history of the building are provided in the section 5.1. and 3.2. respectively.

The hyperbolic paraboloid roof structure on the Arts Building is a rarity for the United States. There are two additional, slightly smaller hyperbolic paraboloid roofs at the site on the Lumber Storage. The first pre-dates the Arts Building (1958-1959) and the second is dated 1961. George Nakashima clearly experimented with the hyperbolic paraboloid before undertaking the Arts Building.

The development of timber hyperbolic paraboloids is attributed to Great Britain from approximately 1957 to 1975[40]. Those designs included timber boards for roof decking. In the United States, the West Coast Lumberman's Association adopted standards[41] for timber hyperbolic paraboloid roofs. No search was done to determine how many structures exist that were constructed with this standard.

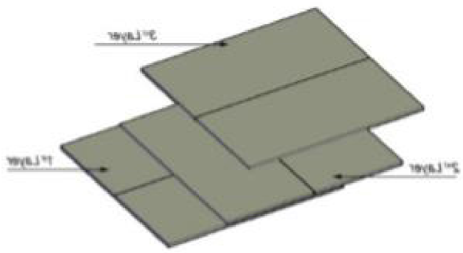
Observations/Comments

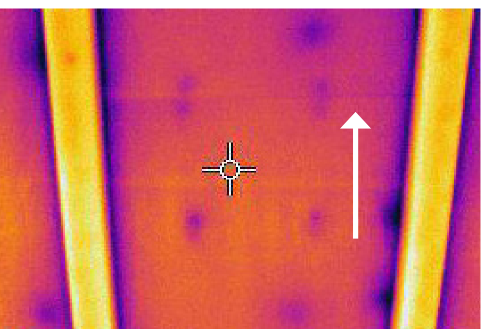
1. Building

a. Roof Structure

• The underside of the plywood roof structure is visible along with wooden ribs (Figure 1). The underside of the roof structure has noticeable sag. Measurements will be provided later.
• Overall, the joints between the plywood panels are tight with few gaps.
• The three layers of plywood have overlapping joints (Figure 2). The design details required nailing between layers. There are no original construction reports of any glue being used.
• Figure 3 shows an infrared thermography scan from the underside provided by

39. A. Troci, *Modeling and Analysis of Plywood Plate Structures*, Master's Thesis for Advanced Masters in Structural Analysis of Monuments and Historical Constructions (SAHC), Czech Technical University in Prague, 2016.
SAHC is an Erasmus Mundus masters course, co-funded by the Erasmus Programme of the European Union.
The objective is to offer an advanced education program on the engineering of conservation of structures, with a focus on architectural heritage.
40. L. G. Booth, *The design and construction of timber hyperbolic paraboloid shell roofs in Britain: 1957-1975*, The Construction History Society, Construction History, Vol. 13. 1997.
41. West Coast, *Construction and analysis of simple hyperbolic-paraboloid shells of West Coast lumber*, West Coast Lumbermen's Association, Portland, Ore., 1900.





From top to bottom:
Figure 1. Underside view of the hyperbolic paraboloid roof.
Figure 2. Plywood layout.
Figure 3. Infrared scan.
Figure 4. Cracked rib.

Cesar Bargues Ballester. The scan shows several nail locations and the joint at the first plywood layer (arrow Figure 3). We can't be certain which layers (2 or 3) the nails belong to without performing a removal.
• The joints of the ribs are screwed together and are generally tight.
• The ribs themselves primarily hide the longitudinal joint between the exposed plywood panels. They effectively offer minimal structural capacity and are ignored in the analyses.
• Minimal structural distress is evident. Figure 4 shows one cracked rib likely due to excessive deflection.
• There are a few locations where previous condensation and/or roof leaks are evident. Reportedly, there are no active leaks.

b. Edge beams and posts
• The edge beams have no noticeable bowing or warping. Although they are exposed on the exterior, no noticeable deterioration was evident. See 5.3. Wood Assessment [42] for an assessment of the materials.
• Some of the posts have slight water deterioration at the bases.

c. Walls
• The exterior walls are unreinforced concrete masonry with a cement plaster coating.
• The buttresses are faced with rubble stone.
• There is horizontal cracking along the exterior of the north wall.

d. Roofing - wetness
• Samples roof cuts were made by a contractor during my second visit to determine if the plywood panels were wet. Roof leaks caused previous damage. There is a concern whether the leaks were actually stopped or whether the areas adjacent to the repairs were ever dried out.
• A significant area near the skylight was wet; the insulation was saturated and the plywood were wet also. Recommendations were immediately made to replace this area of roofing. Temporarily roof vents were installed to assess whether the vents would be an effective way to dry and maintain the plywood under the roofing.

e. Previous repairs

• Reportedly, a section of roof plywood was replaced due to water damage. There is no indication the roof structure was shored during the repair work.

Measurements

1. Survey readings to the underside of the roof were provided by the Architectural Conservation Laboratory.

• Readings were taken to the bottom of several ribs (see table A at the end of this section). Figure 5 shows the plan of where the readings were taken.

• Figure 6 shows a 3D plot of these readings. The readings taken along the walls and the edge beams generally plot as a straight line. To provide the installed alignment of the ribs, straight lines were drawn connecting the rib ends (except near the chimney and the north wall).

2. Variance to theoretical.

• Using the ribs running from the east wall to the west edge beam, the estimated deflection from theoretical can be determined from the data in Appendix A. Straight lines were drawn connecting the rib ends except near the northwest buttress and along the plywood at the north wall.

• Measurements along Rib number 8 indicate the deflection at mid-span is approximately 4.9 inches and at the ¼ point and the ¾ point from east to west are 3.1 inches and 4.2 inches respectively.

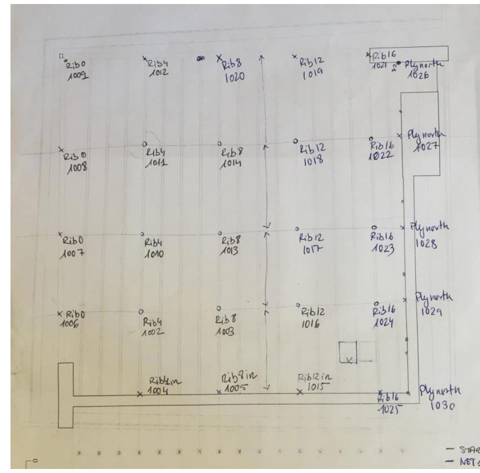


Figure 5. Plan of measurement locations.

3. Comparison to initial deflection reported.

• From an interview with Robert Lovett, there is only one reported deflection measurement that was taken following the removal of the shoring that was used during the roof construction. Reportedly, the deflection measurement (1.25 inches) was taken near the corner of the mezzanine. As best we know, it represents the deflection due to the roof dead lead only.

• Using the current field measurements (from Appendix A), the approximate deflection is 4.2 inches at the corner of the mezzanine. This indicates that the sag that has occurred since construction is approximately 4.2” – 1.25” = 2.95”. The sag is likely due to creep deflection from the dead weight and snow. Based upon modern timber design, creep deflection could be over 2.5 times the dead load.

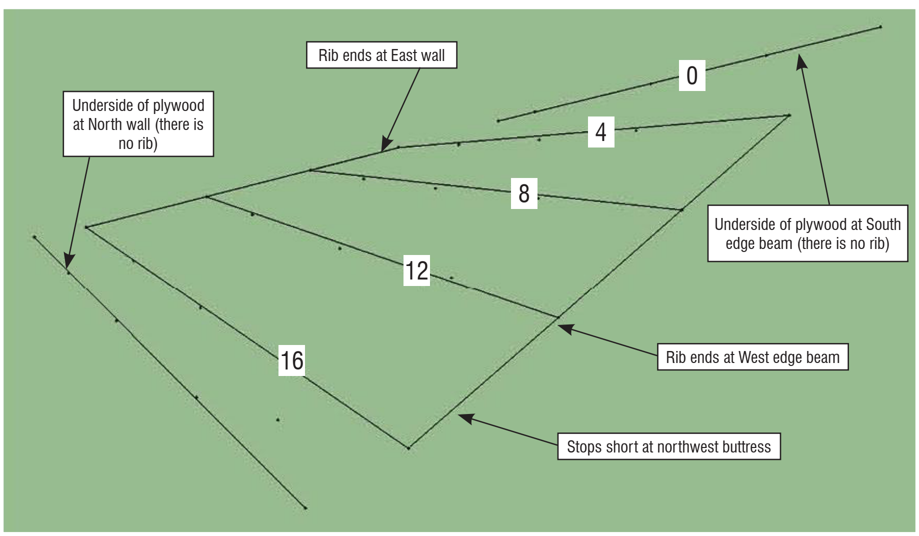


Figure 6. Plot of roof measurements. Numbers indicate rib number according to Reflecte Ceiling Plan (see Naka A-09. The Arts Building: Reflected Ceiling Plan).

The actual creep is estimated at (2.95/1.25) = 2.36 times dead load.

Analyses

1. Original Theory (Noted as Simplified Design Method in the thesis)

a. The theory relative to timber roofs was published in 1955[43] and later in 1957[44]. The original theory was stress-based; it did not address deflections.

b. The theory was based upon a level, symmetrical roof structure with two points

42. Anthony, *Wood Assessment, Nakashima Arts Building, New Hope, Pennsylvania*, Antonhy and Associates for University of Pennsylvania, School of Design, May 2016.
43. E. Reissner, “On some aspects of the theory of thin elastic shells” in *Journal of the Boston Society of Civil Engineers*, Vol. 42, No. 2, April 1955.
44. Newsum, *Standard Hyperbolic Paraboloid Roofs*, Newsum Timber Engineers, 1961

Figure 7. Level, symmetrical hyperbolic paraboloid

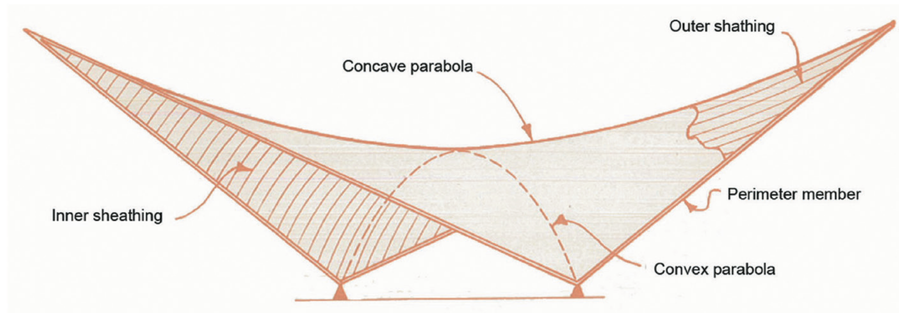
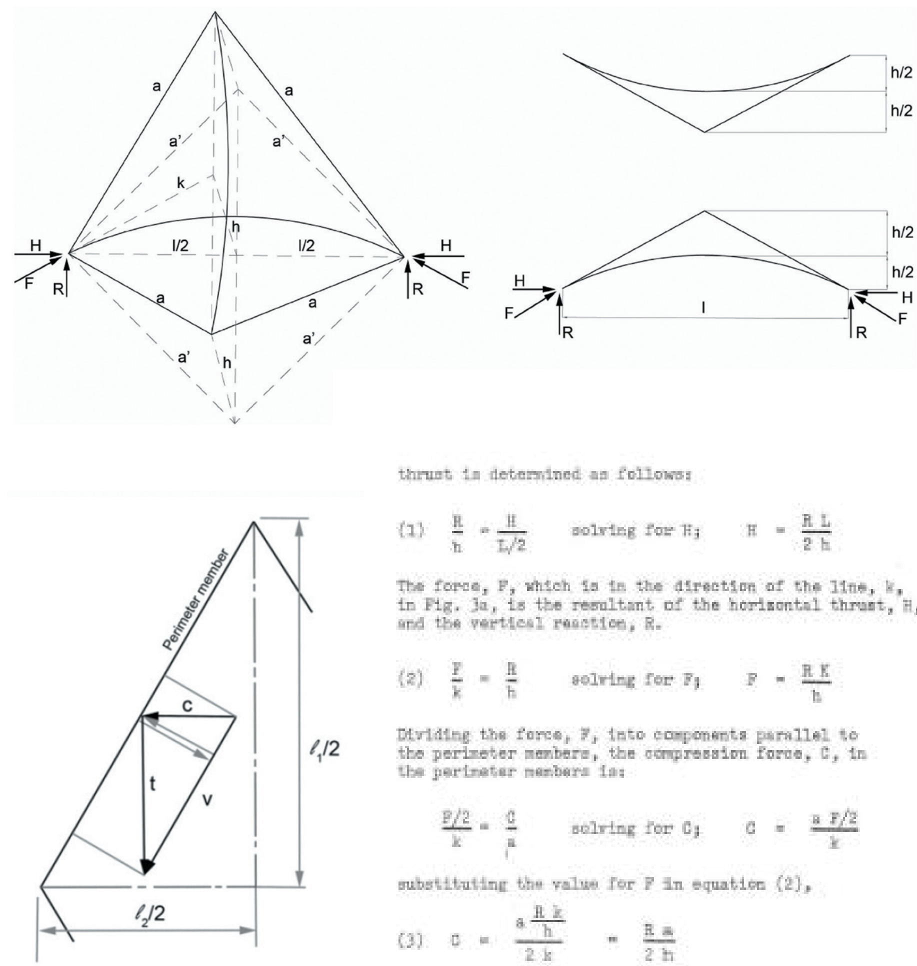


Figure 8. Original theory.
a. lenght onf one side
a’. horiz. projection of lenght a.
C. total compression force in perimeter member.
c. principal compressive force in sheathing per foot.
F. resultant of the vertical reaction R and the horizontal thrust H.
H. horizontal thrust.
h. vertical distance from point of support to highest point of the shell.
k. inclined distance from support to widpoint of length 1.
l_1. length along longitudinal axis.
l_2. length along transverse axis.
R. vertical reaction
t. principal tension force in sheathing per foot.
v. boundary shear force per foot.



thrust is determined as follows:

(1) $\frac{R}{h} = \frac{H}{L/2}$ solving for H; $H = \frac{R\,L}{2\,h}$

The force, F, which is in the direction of the line, k, in Fig. 3a, is the resultant of the horizontal thrust, H, and the vertical reaction, R.

(2) $\frac{F}{k} = \frac{R}{h}$ solving for F; $F = \frac{R\,K}{h}$

Dividing the force, F, into components parallel to the perimeter members, the compression force, C, in the perimeter members is:

$\frac{F/2}{k} = \frac{C}{a}$ solving for C; $C = \frac{a\,F/2}{k}$

substituting the value for F in equation (2),

(3) $C = \frac{a\,\frac{R\,k}{h}}{2\,k} = \frac{R\,a}{2\,h}$

of support as seen in Figure 7. Figure 8 is taken from that work. The roof acts as a membrane. There is tension on the catenary curve between the sloping sides, and compression arches between low to high. The Troci thesis1 explains the structural action in detail.

c. The analysis equations in the literature are for a level roof. The Arts Building is not a level roof, but there is some criteria given for a roof with its shape. Figure 9 is taken from “Standard Hyperbolic Paraboloid Roofs”[6] by Newsum Timber Engineers. It notes that the rise should be 1:2.5. For the Arts Building, this translates to a rise of approximately 14 feet for a 36 foot edge. This compares well to the actual building.

d. In the same Newsum document, tabulated data was given for various shells. Figure 10 shows the table that is based upon boards for the membrane rather than plywood. For a 36 foot shell, the table would require 3 layers of ¾” boards. In the documents for the Arts Building, the roof structure was specified to have 3 - ½” layers of plywood; 3 layers of 5/8” plywood were actually used.

e. Comparing the construction of the Arts Building to the published information of the time, it appears that George Nakashima and his engineer, Paul Weidlinger, had access to the British information during the design of the Arts Building.

f. The original theory only accommodated balance loads from dead load (self-weight) and snow loads. The original theory did not account for unbalanced loads

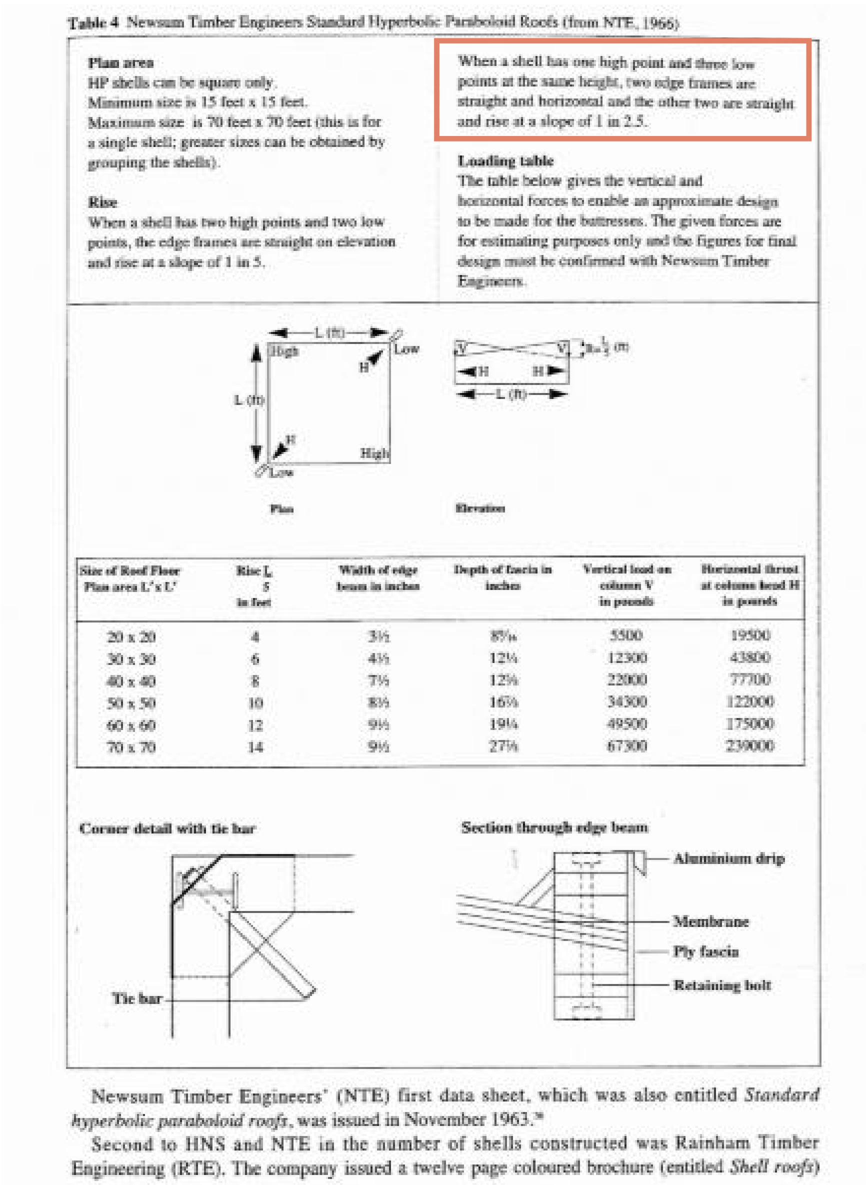


Table 4 Newsum Timber Engineers Standard Hyperbolic Paraboloid Roofs (from NTE, 1966)

Plan area
HP shells can be square only.
Minimum size is 15 feet x 15 feet.
Maximum size is 70 feet x 70 feet (this is for a single shell; greater sizes can be obtained by grouping the shells).

Rise
When a shell has two high points and two low points, the edge frames are straight on elevation and rise at a slope of 1 in 5.

When a shell has one high point and three low points at the same height, two edge frames are straight and horizontal and the other two are straight and rise at a slope of 1 in 2.5.

Loading table
The table below gives the vertical and horizontal forces to enable an approximate design to be made for the buttresses. The given forces are for estimating purposes only and the figures for final design must be confirmed with Newsum Timber Engineers.

Size of Roof Floor Plan area L' x L'	Rise L/5 in feet	Width of edge beam in inches	Depth of fascia in inches	Vertical load on column V in pounds	Horizontal thrust at column head H in pounds
20 x 20	4	3½	8 9/16	5500	19500
30 x 30	6	4½	12¼	12300	43800
40 x 40	8	7½	12⅝	22000	77700
50 x 50	10	8½	16⅞	34300	122000
60 x 60	12	9½	19¼	49500	175000
70 x 70	14	9½	27⅛	67300	239000

Newsum Timber Engineers' (NTE) first data sheet, which was also entitled *Standard hyperbolic paraboloid roofs*, was issued in November 1963.*
Second to HNS and NTE in the number of shells constructed was Rainham Timber Engineering (RTE). The company issued a twelve page coloured brochure (entitled *Shell roofs*)

Fig. 9. Newsum Timber Engineers Standard Hyperbolic Paraboloid Roofs.

MEMBRANE

Side of shell (ft)	Nominal width of boards (in)	Finished thickness of boards (in)	Number of layers	Thickness of membrane (in)	Gauge of nails	Length of nails: 2nd to 1st layer	Length of nails: 3rd to 2nd layer (in)	4th to 3rd layer (in)
15	4	5/8	2	1 1/4	10	1		
20	4	3/4	2	1 1/2	10	1 1/4		
25	4	7/8	2	1 3/4	10	1 1/2		
30	5	5/8	3	1 7/8	10	1	1 1/2	
35	5	3/4	3	2 1/4	10	1 1/4	2	
40	5	3/4	3	2 1/4	10	1 1/4	2	
45	5	7/8	3	2 3/8	10	1 1/2	2 1/4	
50	5	7/8	3	2 5/8	10	1 1/2	2 1/4	
55	5	7/8	3	2 5/8	10	1 1/2	2 1/4	
60	5	7/8	3	2 5/8	10	1 1/2	2 1/4	
65	5	3/4	4	3	10	1 1/4	2	2 3/4
70	5	7/8	4	3 1/2	10	1 1/2	2 1/4	3

Figure 10. Table for Newsum shells.

due to snow and ice, wind loads or support conditions other than those shown in Figure 8.

2. Computer Modeling (Troci's thesis[1])

The thesis is provided for complete details of the analyses. Finite element analysis was used for the modeling. A summary of important information and results is provided in the following sections.

a. Computer modeling of the Arts Building is desirable for several reasons:
- There is a limited amount of analytical information derived from the hand calculations based upon the original theory.
- The original theory does not account for loading conditions other than balanced loading.
- The roof configuration with the inclined corner is not considered in the original theory.
- The original theory does not account for the vertical support of the edge beams and low walls.
- Deflections are not considered in the original theory.

b. Support conditions
- The modeling allows us to simulate different support conditions for the roof structure. Modeling the support provided by the walls, edge beams and posts is possible with the computer as well. Four configurations were evaluated (two without posts and two with posts). Only configurations 3 and 4 (with posts) represent the actual construction..
- In addition, the modeling allows us to include edge conditions in the analysis. The thesis compares the intersection of the roof plywood and the edges as either hinged or clamped.

c. Unbalanced loads
- Once the model is validated so that it adequately represents the existing conditions. The computer modeling can be manipulated to examine any number

of loading conditions, not just the balanced conditions.

- For the modeling, five loading conditions were selected. The loads are listed in the thesis in metric units.

The snow and wind loads match the building code requirements for Pennsylvania.
DL= Dead load = 24psf (pounds per square foot)
SL = Snow load = 30 psf
WL = Wind load = 25 psf

LC1: Full DL and SL uniformly distributed. This
LC2: Full DL + one quarter SL wind swept onto smaller area. See Figure 11 for load contours for the SL only. The winter of 2015-2016 did not produce significant snow fall to get a sense of the possible drifting conditions. The author (Biggs) selected this loading condition as a reasonable expectation for drifting.
LC3: Full DL + half SL wind swept on to smaller area. See Figure 11 for load contours for the SL only. This loading condition is considered the extreme that might be expected.
LC4: Full DL - wind uplift (0.6 x 25 psf = 15 psf) uniformly applied. Since this is a uniformly applied load, the results can be obtained from proportioning LC1.

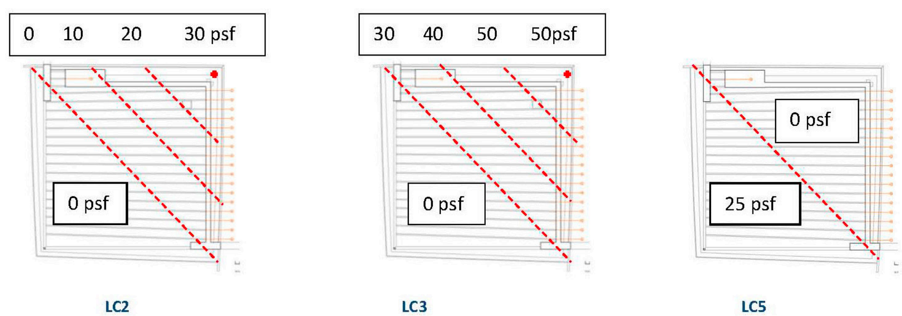


Figure 11. Snow and wind loadings acting downward on roof.

LC5: Full DL + downward wind on upper half of roof (25psf uniformly applied over loaded area). See Figure 11 for loaded area for the WL only. The author selected this as the loading for an extreme wind event.
d. Materials assumptions

Structural Element	Species	Code
South Edge beam	Douglas-fir	Western Lumber Grading Rules (2011)
West Edge beam	Douglas-fir	Western Lumber Grading Rules (2011)
Posts	Eastern white pine	Standard Grading Rules for Northeastern Lumber (2013
Plywood	Ponderosa pine	Plywood Design Specification (1997) - APA

Table 9.1 Species and referring codes of the structural elements.

With input from wood scientist, Ron Anthony4, the material properties for the wood elements of the roof were chosen as shown in Table 9.1 (reproduced from the thesis).

The plywood properties were selected from Table 3 of the American Plywood As-

ALLOWABLE STRESSES FOR PLYWOOD

TABLE 3

ALLOWABLE STRESSES FOR PLYWOOD (psi) conforming to Voluntary Product Standard PS 1-95 for Construction and Industrial Plywood. Stresses are based on normal duration of load, and on common structural applications where panels are 24" or greater in width. For other use conditions, see Section 3.3 for modifications.

Type of Stress		Species Group of Face Ply	Grade Stress Level(1) S-1 Wet	S-1 Dry	S-2 Wet	S-2 Dry	S-3 Dry Only
EXTREME FIBER STRESS IN BENDING (F_b)		1	1430	2000	1190	1650	1650
TENSION IN PLANE OF PLIES (F_t)	F_b &	2, 3	980	1400	820	1200	1200
Face Grain Parallel or Perpendicular to Span (At 45° to Face Grain Use 1/6 F_t)	F_t	4	940	1330	780	1110	1110
COMPRESSION IN PLANE OF PLIES		1	970	1640	900	1540	1540
	F_c	2	730	1200	680	1100	1100
Parallel or Perpendicular to Face Grain		3	610	1060	580	990	990
(At 45° to Face Grain Use 1/3 F_c)		4	610	1000	580	950	950
SHEAR THROUGH THE THICKNESS(3)		1	155	190	155	190	160
Parallel or Perpendicular to Face Grain	F_v	2, 3	120	140	120	140	120
(At 45° to Face Grain Use 2 F_v)		4	110	130	110	130	115
ROLLING SHEAR (IN THE PLANE OF PLIES)	F_s	Marine & Structural I	63	75	63	75	—
Parallel or Perpendicular to Face Grain (At 45° to Face Grain Use 1-1/3 F_s)		All Other(2)	44	53	44	53	48
MODULUS OF RIGIDITY (OR SHEAR MODULUS)		1	70,000	90,000	70,000	90,000	82,000
		2	60,000	75,000	60,000	75,000	68,000
Shear in Plane Perpendicular to Plies (through the thickness)	G	3	50,000	60,000	50,000	60,000	55,000
(At 45° to Face Grain Use 4G)		4	45,000	50,000	45,000	50,000	45,000
BEARING (ON FACE)		1	210	340	210	340	340
Perpendicular to Plane of Plies	$F_{c\perp}$	2, 3	135	210	135	210	210
		4	105	160	105	160	160
MODULUS OF ELASTICITY IN BENDING IN PLANE OF PLIES		1	1,500,000	1,800,000	1,500,000	1,800,000	1,800,000
	E	2	1,300,000	1,500,000	1,300,000	1,500,000	1,500,000
		3	1,100,000	1,200,000	1,100,000	1,200,000	1,200,000
Face Grain Parallel or Perpendicular to Span		4	900,000	1,000,000	900,000	1,000,000	1,000,000

(1) See pages 12 and 13 for Guide.
To qualify for stress level S-1, gluelines must be exterior and only veneer grades N, A, and C (natural, not repaired) are allowed in either face or back.
For stress level S-2, gluelines must be exterior and veneer grade B, C-Plugged and D are allowed on the face or back.
Stress level S-3 includes all panels with interior or intermediate (IMG) gluelines.

(2) Reduce stresses 25% for 3-layer (4- or 5-ply) panels over 5/8" thick. Such layups are possible under PS 1-95 for APA RATED SHEATHING, APA RATED STURD-I-FLOOR, UNDERLAYMENT, C-C Plugged and C-D Plugged grades over 5/8" through 3/4" thick.

(3) Shear-through-the-thickness stresses for MARINE and SPECIAL EXTERIOR grades may be increased 33%. See Section 3.8.1 for conditions under which stresses for other grades may be increased.

Figure 12. Plywood properties.

Structural element	Grade	F_b	F_t	F_v	F_s	$F_{c\perp}$	F_c	G	E
		[kPa]	[kPa]	[kPa]	[kPa]	[kPa]	[kPa]	[Gpa]	[Gpa]
Plywood	EXP 1, 2 or INT	8,274	8,274	827	331	1,448	6,825	0.379	8,274

Table 9.3. Mechanical properties of the plywood (from thesis).

sociation Standard PS 1-95[7] as shown in Figure 12. The highlighted values were converted to SI units and used in the thesis Table 9.3 (reproduced below). These values are subject to change with further evaluation.

F_b: Extreme Fiber stress in Bending
F_t: Tension in Plane of Plies (at 45° to face grain use 1/6 F_t)
F_v: Shear Through the Thickness (at 45° to face grain use 2F_v)
F_s: Rolling Shear in the Plane of Plies (at 45° to face grain use 1-1/3 Fs)
$F_{c\perp}$: Bearing on Face (perpendicular to Plane Plies)
F_c: Compression in Plane of Plies (at 45° to face grain use 1/3 Fc)

G: Shear Modulus Through the Thickness (at 45° to face grain use 4G)
E: Modulus of Elasticity in Bending in Plane of Plies

3.Comparison of original theory to modeling
a. Since the original theory was based upon a level, symmetrical roof with balanced loading, the computer modeling first examined that case.
b. The thesis highlights the differences in results between the original theory (shown in Figure 8) and the computer analyses. Figure 13 shows the results as listed in Table 7.1 from the thesis.
c. The results are within acceptable limits so the model is deemed reasonable. This helps validate the model.

		Simplified solution	**Numerical solution**		**% of difference**
Reaction **F**	[kN]	670,41	669		0,2%
Edge compression **C**	[kN]	466,86	459		2%
Shear stress **rs**	[kN/m2]	813	Max	-512	[-]
			Min	-823	[-]
			Average	-811	0,2%
Normal stress **rr-ss**	[kN/m2]	0	Max	182	[-]
			Min	-25	[-]
			Average	10	1.2%*
* indicates that is not a percentage of difference but the percentage of the shear stress.					

Figure 13. Comparison of original theory to computer analysis for level, symmetrical roof with balanced loading.

4. Modeling of actual roof configuration with balanced and unbalanced loading conditions
a. The actual inclined roof configuration was modeled. Figure 14 shows the results as listed in Table 7.3 from the thesis which compares the computer model to the level structure given in Figure 7.
b. The results indicate that the computer results are up to 15% different than the hand calculations (simplified method).

		Simplified solution	**Numerical solution**		**% of difference**
Reaction **F**	[kN]	670,41	568		15%
Edge compression **C**	[kN]	466,86	417		11%
Shear stress **rs**	[kN/m2]	813	Max	867	[-]
			Min	-688	[-]
			Average	726	11%
Normal stress **rr-ss**	[kN/m2]	0	Max	962	[-]
			Min	-1304	[-]
			Average	146	18%*
* indicates that is not a percentage of difference but the percentage of the shear stress.					

Figure 14. Comparison for level, symmetrical hyperbolic paraboloid.

c. Using the computer results for hinged supports (Configuration 4 in the thesis) for the actual inclined roof:

- The balanced load reaches 93% of capacity as shown in Figure 15

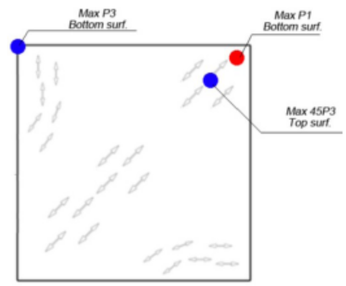


Figure 11.65 - Principal directions and location of maximum stresses LC1

Table 11.28 – Comparison stresses and strengths LC1

Point	Stress	P/S
[Mpa]	[Mpa]	[-]
Max P3	**Fc**	**P3/Fc**
-2,64	-6,83	**0,39**
Max 45P3	**Fc/3**	**3P3/Fc**
-1,83	-2,28	**0,80**
Max P1	**Ft/6**	**6P1/Ft**
1,28	1,38	**0,93**

Figure 15. Maximum stress location for balanced snow load.

- For unbalanced loads, the load combination due to wind produced the maximum stress which is 99% of capacity (Figure 16).=

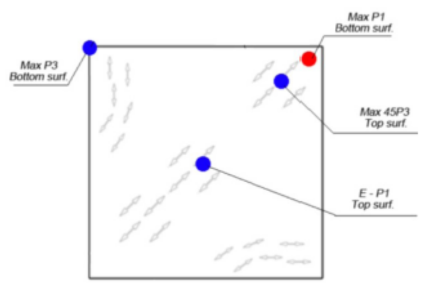


Figure 11.74 - Principal directions and location of maximum stresses LC5

Table 11.34 – Comparison stresses and strengths LC5

Point	Stress	P/S
[Mpa]	[Mpa]	[-]
Max P3	**Fc**	**P3/Fc**
-2,50	-6,83	**0,37**
Max 45P3	**Fc/3**	**3P3/Fc**
-1,80	-2,28	**0,79**
Max P1	**Ft/6**	**6P1/Ft**
1,37	1,38	**0,99**
E-P1	**Ft/6**	**6D/Ft**
1,05	1,38	**0,76**

Figure 16. Unbalanced load combination 5

d. Deflections

- The calculated deflection at mid-span (LC1) for configuration 3 is 0.09 inches (2.4 mm). For configuration 4, the deflection is 0.07 inch (1.8 mm). The values for just dead load would be 24/54 (the dead load to total load ratio) times these values or 0.04 inches and 0.03 inches respectively. These are unrealistically low values given the reported deflection during construction was approximately 1.25 inches.
- The computer results that have greater deflection with clamped edges compared to hinged edges are also unrealistic. This requires further evaluation.
- There are several possibly causes for the deflection issue. First, the assumed stiffness represented by the plywood modulus of elasticity is likely too high. Second, the plywood layers are not acting fully composite. Third, both effects may be acting. Further evaluation is required.

Conclusions

1. General

a. Based upon observations of the existing building, the roof has structurally performed extremely well despite the original design theory being very basic and not accounting for the high end and the post supports.

b. Thanks to the SAHC program, we were able to accomplish significant computer modeling that was not possible within the grant budget.

c. The modeling has some limitations due to assumptions that were made with the material properties.

d. Refinements to the modeling would be possible with improved materials properties and dynamic testing of the roof.

2. Roof

a. Materials

- The roof assessment is based upon material assumptions. No physical testing was possible.
- Additional material assessment should be developed to refine the computer modeling and the assessment.
- Testing is required to evaluate the connection between the layers of plywood.

b. Loadings

- The original design was based upon only a balanced dead load and snow load. The theory assumed a level structure and did not make any adjustment for inclined structures.
- The computer modeling included the balanced load (LC1) and two unbalanced conditions (LC2 and LC3). We were also able to include two wind loadings (LC4 and LC5).
- LC1 and LC3 may represent the code required loadings, but LC2 is considered more reasonable. This could be evaluated by future readings during snow events.

c. Stresses

- The original design theory does not specifically account for the inclined roof configuration built. The original theory did not account for the vertical support of the walls and the posts. The computer analyses indicate these have a significant beneficial effect.
- Computer modeling indicates that the magnitudes of the actual stresses are similar to those determined by the original theory.
- There is insufficient snow data to determine if the building has ever been fully loaded.
- No additional dead load should be added to the roof without reviewing the modeling results.
- The computer results indicate that it would be advisable to provide temporary shoring during heavy snows that accumulate in the flattened area of the roof (along north wall).

d. Deflections

- The original theory did not address deflections.
- Based upon possibly unreliable information, the actual measured deflections

may be approximately one part dead load deflection and 2.4 parts creep deflection.

- The calculated deflections from the computer modeling are highly dependent upon many assumptions including materials characteristics, edge conditions and loadings. The calculated values are inaccurate and require further study.
- Due to lack of time, the computer model was not tuned to the measured deflected values. This requires more time and effort. Tuning requires adjusting the stiffness to the static deflections and the dynamic vibrations and running further iterations of the model.

e.Overload during unbalanced loadings need shoring

- The modeling results provided information about unbalanced loads that was not available from the original design.
- Unbalanced loading LC3 creates slight overload conditions. Temporary shoring should be considered until further studies are performed.

f. Importance of shoring during repairs

- The modeling highlights the need for providing temporary shoring during roofing repairs.
- Reportedly, previous plywood replacement in the northeast corner did not have shoring. It is fortunate that there were no repercussions because the plywood area replaced is one of the highest stressed parts of the roof.

3. Walls

a. The exterior cracking in the north wall appears to be due to horizontal forces from the roof structure. The computer modeling should be expanded to include the walls to validate this assumption.

b. The horizontal cracks in the north wall should be strenghtened.

Right: Table A. Survey measurements by César Bargues Ballester.

Summary

_DESC	Position X	Position Y	Position Z
Network 1_Start	5000.0000	5000.0000	1000.0000
Network2	5000.0010	5202.7184	1000.5618
1R1	5043.7119	4895.9146	1108.3752
1R2	4858.9755	5000.7829	1179.0243
1R3	4935.5916	4955.3229	1151.6713
1R4	4802.1198	5030.7504	1202.4110
1R5	4681.9194	5093.3633	1253.3158
3R1	5066.0933	4938.8588	1107.8680
3R2	4948.8767	5001.6242	1146.8703
3R3	4873.8265	5041.5278	1172.6415
3R4	4804.2228	5078.8651	1197.6986
3R5	4704.5227	5132.7618	1234.6708
5R1	5088.2349	4981.6699	1107.0576
5R2	4972.7220	5041.8368	1138.9505
5R3	4907.0186	5076.0081	1158.3642
5R4	4824.7970	5118.9474	1184.4486
5R5	4731.5919	5168.9584	1215.3110
7R1	5109.5414	5024.3271	1106.5392
7R2	5010.0373	5074.9378	1128.7348
7R3	4914.2118	5123.8401	1152.6568
7R4	4846.4101	5160.1006	1171.2390
7R5	4743.0366	5215.0637	1201.8665
8R1	5114.0617	5043.3900	1103.6368
8R2	5018.3350	5090.6344	1122.1163
8R3	4919.8924	5142.8750	1146.1394
8R4	4859.3159	5178.3679	1164.1333
8R5	4760.0234	5234.3203	1189.6330
9R1	5131.4420	5067.2406	1106.0094
9R2	5033.6368	5116.3850	1123.4755
9R3	4939.2907	5157.9904	1139.5486
9R4	4853.9538	5206.3490	1161.5534
9R5	4770.2884	5253.9436	1181.1748
11R1	5147.2610	5105.2860	1103.3532
11R2	5052.4392	5159.3360	1118.5929
11R3	4970.2441	5199.1409	1131.2931
11R4	4881.5879	5244.1250	1146.7031
11R5	4784.4890	5295.6973	1167.6870
13R1	5175.3606	5152.1079	1104.9475
13R2	5073.7235	5202.2240	1114.0865
13R3	4989.2920	5243.2526	1123.3271
13R4	4913.4393	5280.7653	1133.0178
13R5	4805.4777	5335.1535	1151.1202
15R1	5197.3611	5194.6152	1104.4434
15R2	5091.0618	5239.6424	1106.1720
15R3	4998.0886	5290.7912	1116.4261
15R4	4929.8088	5324.4828	1121.8221
15R5	4826.0313	5375.5079	1134.2240
17R1	5218.9375	5237.9267	1104.2552
17R2	5102.1117	5292.7604	1107.0102
17R3	5023.9737	5323.1487	1105.9160
17R4	4947.4579	5367.1510	1111.9608

Note:
Yellow means network points (fl

Note:
Grey means rib in central positi

Summary

17R5	4861.1402	5404.7620	1115.3633
C1	4868.2044	5431.2858	1110.4742
C2	4913.3455	5407.5724	1110.0805
C3	4998.6509	5363.3989	1108.7799
C4	5081.0406	5315.4854	1104.6491
C5	5226.2402	5247.5092	1105.7102
C6	5170.2950	5276.7819	1106.2763

Note:
Blue means ceiling level (plywo

4.6. Envelope and Interior Assessment
Watson & Henry Associates

Background

The purpose of this consultation is to:

- Observe the building envelope and environmental management of the building;
- Observe the collections stored and exhibited in the building; and;
- Provide preliminary recommendations for:
    1. Monitoring of the environment and envelope performance;
    2. Mitigating the environmental vulnerabilities of the collections; and,
    3. Improving environmental management and the hygrothermal performance of the envelope.

The observations were made on Michael C. Henry's site visits of 24 July 2015, 23 October 2015, 12 November 2015, 02 March 2016 and 23 April 2016. Students enrolled in PennDesign's graduate course HSPV 516 Building Diagnostics and Monitoring accompanied him on the 23 October 2015 site visit. Leah Bright, a graduate student in the Winterthur/University of Delaware Graduate Program in Art Conservation (WUDPAC) accompanied him on the 23
October 2015 and the 02 March 2016 site visits with Professor Joelle Wickens from WUDPAC on the latter.

This section is organized as follows:

- Applicable Guidance
- Overview of the Arts Building and Cloister;
- The Collection and Environmental Vulnerabilities;
- Climatic and Situational Contexts;
- Building Envelope and Non-Mechanical (Passive) Environmental Management;
- Mechanical System for Environmental Management;
- Natural Light Management; and,
- Conservation Issues and Recommendations.

Attached to this letter are:

- Appendix B: Investigating the Preservation Needs of Objects within the George Nakashima Arts Building, by Leah Bright;
- Appendix C: Nakashima Art Studio Daylighting Study, by Shin-Yi Kwan and Janki A Vyas;
- Appendix D: Engineering Weather Data for Trenton/Mercer County Airport; and,
- Appendix E: Large Format Versions of Trend Graphs in this Report.

Applicable Guidance

The following guidance applies to environmental management at George Nakashima's Arts Building and Cloister:

- Secretary of Interior's Standards for the Treatment of Historic Properties 1995;
- New Orleans Charter for the Joint Preservation of Historic Structures and Artifacts;

45. This is an abbreviated description of the building for purposes of orientation in this report; a full description of the building is found in section 5.1.

• The American Institute for Conservation for Historic and Artistic Works Code of Ethics;
• American Society of Heating Refrigeration and Air Conditioning Engineers (ASHRAE)
2015 Applications Handbook, Chapter 23: Museums, Galleries, Archives and Libraries and
ASHRAE 2010 Standard 55: Thermal Environmental Conditions for Human Occupancy;
• APT/AIC Guidelines for Light and Lighting in Historic Buildings that contain Collections; and,
• IESNA Museum and Art Gallery Lighting: A Recommended Practice, 1996.

Overview of the Arts Building and Cloister[45]

The Arts Building and Cloister (40.34N, 74.95W) is located at 1847 Aquetong Road, approximately 1.5 miles south of New Hope, Pennsylvania. The buildings are set at the toe of a wooded slope that rises to the north.

The Arts Building is a one-story cubic volume, roughly 36 feet by 40 feet in plan, obliquely truncated by a hyperbolic paraboloid roof which varies from about 22 feet above the finish floor at the southwest corner to about 9 feet above the finish floor along the east wall. At the southwest corner of the Arts Building, a reinforced concrete box, approximately 9 feet high, projects outward from the south and west elevations. The box, with an inclined west wall, forms an entry space to the building; above the entry space is an interior mezzanine and an exterior porch or gallery on the south and west elevations. The high point of the roof bears on the reinforced concrete waffle slab of the concrete box. Above, and to the sides of the concrete box, the south and west elevations of the Arts Building are glazed walls, framed in wood, terminating in rubble stone wing walls or buttresses that extend beyond the intersecting walls. The north and east walls of the Arts Building are slightly set into the toe of the adjoining slope, with the finished floor below the exterior grade; the north and west walls are concrete unit masonry, and anchor the low edges of the hyperbolic paraboloid roof.

The Arts Building contains the following spaces:
• The entry space, including a wet bar alcove concealed in the north interior wall of the concrete box;
• The main or exhibit space, surrounding the entry space, under the hyperbolic paraboloid roof; and,
• The mezzanine or loft, set on top of the entry space, and accessed from the main space by stair treads cantilevered from the north wall of the entry space.

The Cloister is a simple one story volume roughly 18 feet by 39 feet in plan, set under single slope shed roof and containing four spaces. The west wall of the Cloister is offset eastward from the east wall of the Arts Building; the Cloister extends southward on its long axis. The Cloister walls are concrete unit masonry, perforated by two windows and an exterior door on the east wall and three exterior doors on the west wall.


Left: Arts Building & Cloister from south-west. Right: Arts Building from west. Photos by Michael C. Henry.


Left: Arts Building from Cloister. Right: Arts Building from northeast. Photos by Michael C. Henry.


Left: Cloister from Arts Building. Right: Arts Building along east wall. Photos by Michael C. Henry.


Left: Arts Building toward southwest. Right: Arts Building along north wall. Photos by Michael C. Henry.

The two structures are connected by a canopied walkway, in the plan of an L. The main axis of the pair is rotated about 15° clockwise from the north-south axis.[46] The canopied walk runs along the south wall of the Arts Building and the west wall of the Cloister. The Cloister walls are concrete unit masonry, perforated by two windows and an exterior door in the east wall and three glazed exterior doors in the west wall. The Cloister contains a small sleeping room at the south end, a storage room at the north end, and a bathroom/kitchenette and mechanical room in the center.

46. Although the building is slightly skewed from the north-south axis, the building orientations in this report will reference north, south, east and west as if there was no skew.

47. The records stored in the Cloister were not surveyed for this report.

The Arts Building is interpreted to the public and is used for meetings throughout the year.

The Collection and Environmental Vulnerabilites[47]

The Arts Building contains a variety of works on paper, sculpture, furniture, textiles and objects related to George Nakashima (Attachment A contains a more detailed description) as well as large slabs of wood. The collection of furnishings and objects in the Arts Building are directly associated with George Nakashima and his vision for the building; therefore, they are integral to the experience and interpretation of the building. The material integrity and longevity of this collection is as important as conservation of the building. A fundamental element in minimizing the rate of deterioration of the collection is to address the environmental vulnerabilities of the collection through preventive conservation and management of the interior environment.

Appendix B contains the report Investigating the Preservation Needs of Objects within the George Nakashima Arts Building by Leah Bright.

Table 1 of Bright's report categorizes the material types in the collection and the primary environmental risks and sensitivities associated with each material category, as summarized below:

Material	Examples	Risks/Sensitivities						
		Relative Humidity						
		Fluctuations	Min-Max Range	High Max	Light	UV	Pests	Physical forces
Wood	Furniture, slabs	✓			✓	✓		
Textiles	Rug				✓		✓	
Metals	Sculptures		✓					
Small assemblies paper	Dolls	✓	✓				✓	
Large works on paper	Drawings, prints		✓		✓	✓		
Complex composites	Musical instruments	✓					✓	
Organic	Baskets	✓	✓		✓		✓	
Inorganic	Ceramics							✓

Bright also identified specific concerns with selected objects, including: an Asian lacquer box (light damage); the 1959 Ed Fields rug (light damage); and, the Harry Bertoia Bush and Sonambient sculptures (corrosion and particulate accumulation).

Management of the interior environment and natural light in the Arts Building for preventive conservation of the collection is discussed in this report in the sections Environmental Management Performance and Management of Natural Light.

48. 7000 grains of water weigh 1 pound.

Climatic and Situational Contexts

Climate

The Arts Building and Cloister is located in the upper Delaware River valley. Published data from the National Climate Data Center (NCDC) for the period 1973 to 1996 characterizes the climate at the Trenton/Mercer County Airport (40.28N, 74.82W), approximately 7.5 miles southeast, by the following statistics (Appendix D):

- Summer median extreme high temperature:
  97°F (dry bulb), 117 grains water[48]/pound of dry air;
  Summer 1.0% occurrence, high temperature:
  90 °F (dry bulb), 105 grains water/pound of dry air;
- Summer median high humidity ratio:
  83 °F (dry bulb), 142 grains water/pound of dry air;
  Summer 1.0% occurrence, high humidity ratio:
  82 °F (dry bulb), 128 grains water/pound of dry air;
- Winter median extreme low temperature:
  2 °F (dry bulb), 3 grains water/pound of dry air;
  Winter 99.0% occurrence:
  13 °F (dry bulb), 5 grains water/pound of dry air;
- Median daily dry bulb temperature range:
  18 °F.

The Trenton/Mercer County Airport dataset does not include precipitation, but the dataset for the Allentown Airport (40.65N, 75.43W) indicates the following precipitation for the same period:

- Mean precipitation:

≥4.0 and <5.0 inches per month:	May, July, August, September;
≥3.0 and <4.0 inches per month:	January, March, April, June, October, November, December; and,
>2.5 inches per month:	

The Arts Building and Cloister is located in ASHRAE/ANSI International Climate Zone 4A (Mixed Humid) and may be seasonally characterized as cold-damp to hot-humid.

Heating loads dominate from October through April, and cooling loads from May through September; Mean Annual Heating Degree Days (65°F base) are 4848 and Mean Annual Cooling Degree Days (65°F base) are 1102.

About 10% of the total annual infiltration heating load (160,513 BTU/cfm) is attributable to latent heating (humidifying to 30% RH). Infiltration cooling loads dominate June through August, with about 64% of the total annual infiltration cooling load (21,299 BTU/cfm) being attributable to latent cooling (dehumidifying to 60% RH). There is a small, but important, dehumidification load during the heating month of September.

Winds occur throughout the year, with prevailing winds from the:

•Northwest and West	December, January and February;
•North, Northwest and West	March, April and May;
•North, Northwest, West and South	June, July and August; and,
•North, Northwest, West and South	September, October and November.

Atmospheric moisture may be very difficult to control if infiltration and exfiltration rates are large. Outside air infiltration at window and door openings may also be a significant source of particulates. Although air exchange can be effectively reduced when the building is closed, opening and closing of doors can result in a high exchange rate of air and moisture vapor.

Situational Context

The soils in the vicinity of the Arts Building and Cloister are identified by the Natural Resources Conservation Service (NCRS) as Mount Lucas Silt Loam, extremely stoney, with 8 to 25% slopes (MmD) north of the buildings and 0 to 8% slopes (MmB) south of the buildings.

The NRCS characterizes the profile of Mount Lucas Silt Loam as:

• Silt loam:	0 to 9 inches deep;
• Clay loam:	9 to 38 inches deep;
• Gravelly sandy loam:	38 to 60 inches deep; and,
• Lithic bedrock:	48 to 99 inches deep.

As a class of soils, the Mount Lucas Silt Loam is considered moderately well drained, with a water transmission capacity (Ksat) ranging from moderately low to moderately high (0.06 to 0.60 inches per hour). The depth to water table ranges from 6 to 36 inches.

The NRCS notes that the Mount Lucas Silt Loam has the following limitations for buildings:

- Very limited for buildings with basements;
- Somewhat limited for buildings without basements;
- High risk with respect to steel corrosion; and,
- Moderate risk with respect to electrochemical deterioration of concrete.

Source Moisture Control

The hyperbolic paraboloid roof of the Arts Building drains to a single gutter hung on the north and east eaves; at the west end, the gutter discharges to a small pond at the north end of the west wall and at the south end, the gutter discharges to a pond opposite the walkway canopy.

The slope on the north side of the Arts Building terminates at a stone surfaced area along the north and east walls. Water runoff from the slope and overflow from the gutter will penetrate the gravel and saturate the soil unless intercepted by subsurface drainage along the wall. The Cloister roof and the walkway canopy drain to an at-grade stone splash along the south and west sides of the walk.

Moisture saturation of the soil near the two buildings can contribute to rising damp in porous masonry walls and evaporation of soil moisture into the building interiors.

Water stains and water damage to the wood framing at window glazing are evident throughout the south and west walls of the Arts Building. These are the result of:
- Condensation on the interior face of the glazing;
- Rain water leaks at the joint between the glass and the frame; or,
- Both of the above causes.

Building Envelope And Non-Mechanical (Passive) Environmental Management

George Nakashima's Arts Building and Cloister is understandably recognized for its distinctive hyperbolic paraboloid roof and its expression of traditional Japanese architectural design, but the Arts Building is also significant for Nakashima's incorporation of the principles of bioclimatic design.

The applications of bioclimatic design, contemporarily espoused by Victor Olgyay[49] and Baruch Givoni[50] that are evident in the Arts Building include:
- Orientation for passive solar heating in winter.
  Slightly skewed east of south, the south and west glazed elevations provide the opportunity for passive solar gain in winter with thermal storage being effectively accomplished by the slab-on-grade concrete floor, the concrete mezzanine, and the west and south masonry walls. Thermal losses through the glazing are reduced by insulated glazing units in most of the window openings;
- Orientation and geometry to minimize winter heating loads.
  The low exposed heights of the north and east walls minimize thermal envelope loads in winter, and the hyperbolic paraboloid roof effectively deflects winds from the north;
- Shading devices on the south and west walls.
  Roof eaves on the south and west elevations and the walkway canopy reduce solar gain in summer when the sun angle (altitude) is high. Interestingly, the deep shelving units set along the south and west elevations also act as shading devices. Exterior wood grilles and relocatable interior shoji panels on the south and west elevations can reduce unwanted solar gain and natural light;
- Radiant cooling through the roof.
  The white gravel ballast on the minimally insulated roof assembly reduces radiant heat gain in summer, acting as a "cool roof"; and,
- Enhanced natural ventilation.
  Operable casement windows near the high point of the south and west elevations, large sliding door openings at or near floor level on the south and west elevations and at the south elevation of the mezzanine and the slope of the ceiling, combine to promote effective natural ventilation in summer. Furthermore, the two small water features near the south and west walls could provide evaporative cooling of incoming outside air when relative humidity is low enough for effective evaporation.

The following observations of the Arts Building suggest that the optimum hygro-

49. Olgyay, Victor. Design with Climate: Bioclimatic Approach to Architectural Regionalism. Princeton University Press, Princeton, NJ. 1963.
50. Givoni, Baruch. Man, Climate and Architecture. Elsevier Science, Ltd, Amsterdam and New York. 1969.

From top to bottom:
Arts Building, drainage at north wall.
Arts Building, glazing/frame joint.
Photos by Michael C. Henry.

thermal performance of the building envelope may be limited by:
•Excessive air infiltration at the sliding doors, due to large gaps between the frames of the sliding units and the adjoining fixed framing at the jambs, head and sill;
•Use of single glazing, rather than insulated glazing units in the sliding doors, a compromise that presumably was made to reduce the weight of the sliding doors; and,
•Discontinued seasonal use of the relocatable shoji panels.

Mechanical System for Environmental Management

In addition to the non-mechanical features for environmental management of the Arts Building, George Nakashima's Arts Building and Cloister have the following mechanical system:
• Hot water boiler and circulating pumps in the Cloister, serving both buildings, and fueled by heating oil supplied from an external fuel oil storage tank located on the north end of the Cloister;
•Hot water baseboard heating in the Arts Building, consisting of single piping along the east and north walls, dual pipes along the west wall the main space and dual pipes on the west wall of the mezzanine, all controlled by a simple thermostat located under the mezzanine stair;
•Hot water radiant floor heating in the entry of the Arts Building, controlled by a simple thermostat on the south wall; and,
•Hot water baseboard heating in the Cloister, controlled by a simple thermostat.

The following observations of the mechanical system are notable:
•The mechanical room in the Cloister that contains the oil-fire boiler contains exposed combustible wood construction without fire-resistant separation from the rest of the building. A small piece of asbestos cement board fastened to the wood framing directly above the boiler is ineffective protection in this respect;
•The boiler may be nearing the end of its service life;
•The condition of the heating piping, including pipe wall thickness, corrosion and water quality, is unknown;
•The boiler sits on a small concrete slab, lower than exterior grade, but higher than an adjoining crawl space under the Cloister. A water or fuel oil leak at the boiler could flood the crawl space; a fuel oil leak would require a substantial environmental clean-up; and,
•The fuel oil tank is a single wall tank exposed to the weather as well as internal condensation from temperature cycling. The condition of the fuel oil tank, including wall thickness or internal/external corrosion, is unknown. There are no provisions for spill/leak containment of fuel oil at the tank. Spillage during delivery, or a leak from the tank, would require environmental clean-up.

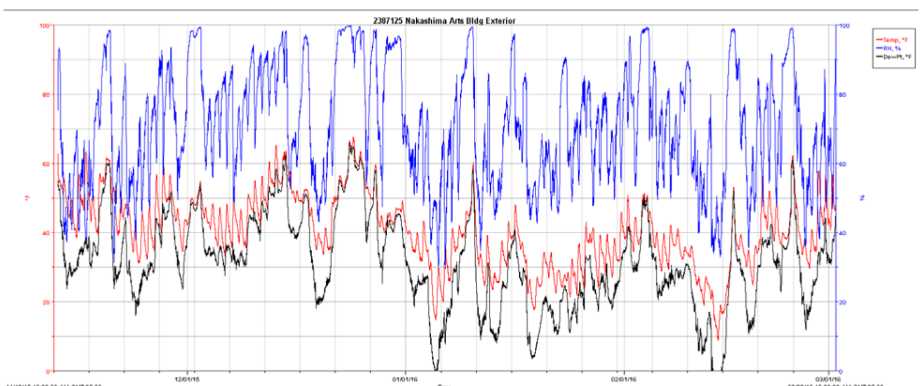
Environmental Management Performance

Background
César Bargues Ballester and Michael C. Henry deployed two HOBO® dataloggers at the Arts Building on 12 November 2015 as follows:
•A U23-001 temperature and relative humidity datalogger (SN 2387125) installed

on the underside of the north roof eave, near the chimney;[51] and,
• A U12-012 temperature, relative humidity and light intensity datalogger (SN 928636) placed in the opening in the north interior wall of the entry, near the Harry Bertoia “Bush” sculpture; this datalogger appears to have been inadvertently relocated to the closed alcove containing the small sink and domestic water heater in the alcove in the north wall of the entry space. Based on the data, the relocation occurred at 3:15 PM EST on 17 December 2015.[52]

On 02 March, Michael Henry redeployed dataloggers for the interior:
• The U12-012 temperature, relative humidity and light intensity datalogger (SN 928636) was returned the opening in the north interior wall of the entry, near the Harry Bertoia “Bush” sculpture;
• A U12-012 temperature, relative humidity and light intensity datalogger (SN 828445) was placed in the closed alcove containing the small sink and domestic water heater in the north wall of the entry space.

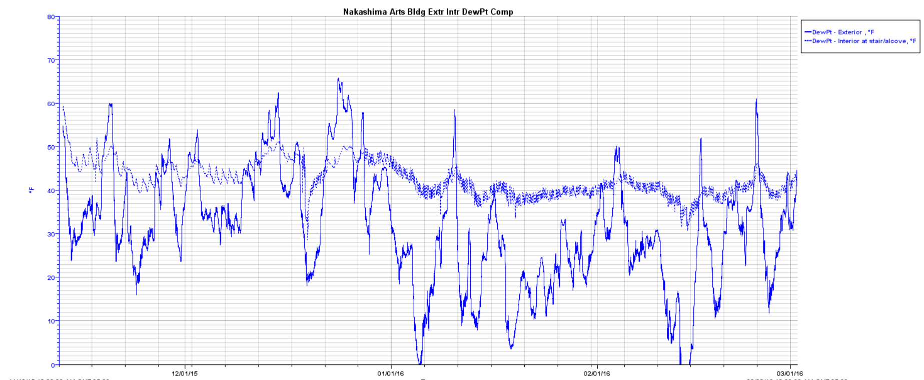
Overview of Environmental Conditions during Winter
Environmental performance during winter months is illustrated by the following two trend graphs of temperature, relative humidity and dew point temperature data for the exterior datalogger and the interior datalogger for the interval from 12 November 2015 through 02 March 2016.
The following trend graph compares the exterior and interior dew point tempera-



51. Datalogger SN 2387125 belongs to the PennDesign Architectural Conservation Laboratory.
52. Dataloggers SN 928636 and 828445 belong to Watson & Henry Associates.

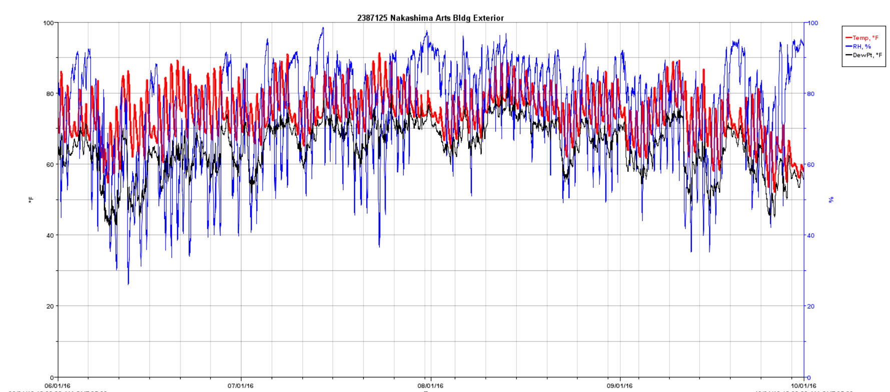
tures for the 12 November 2015 to 02 March 2016 interval. Although the Arts Building does not have a humidification system, the interior dew point temperature in the Arts Building is remarkably consistent, despite the wide fluctuation in exteror moisture vapor and the potential for air and moisture vapor infiltration at the sliding doors. The consistency of the interior dew point temperature may be attributable to one or more of the following:

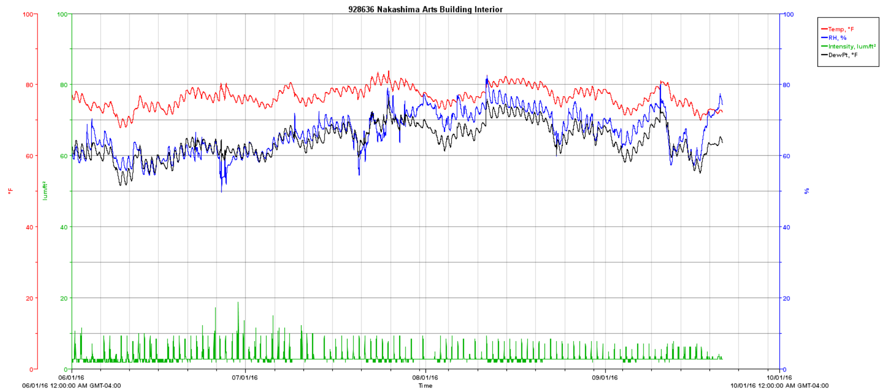
- A moisture or vapor leak from the heating system piping;
- A moisture or vapor leak from the hot water heater or hot water piping serving the small sink in the alcove;
- Evaporation of soil moisture through the concrete floor or through the north and east masonry walls;
- Moisture buffering by the hygroscopic building materials; and,
- Moisture buffering by the large wood slabs in the Arts Building.

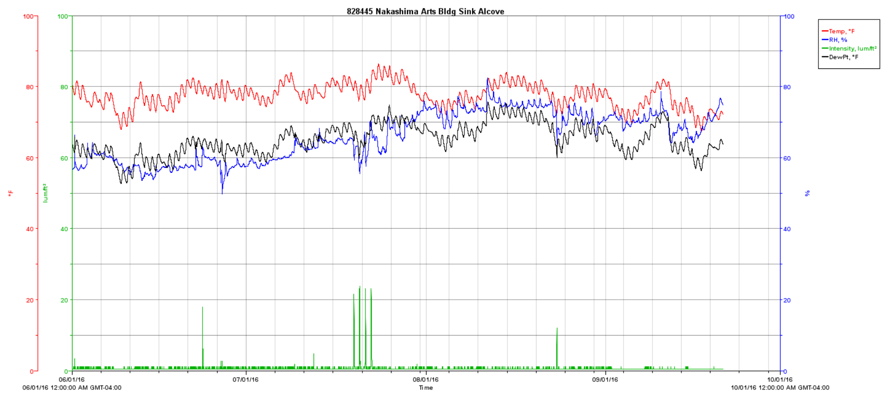


Overview of Environmental Conditions during Summer

Environmental performance during summer months is illustrated by the following three trend graphs of temperature, relative humidity and dew point temperature data for the exterior datalogger and the interior dataloggers for the interval from 12 November 2015 through 02 March 2016.

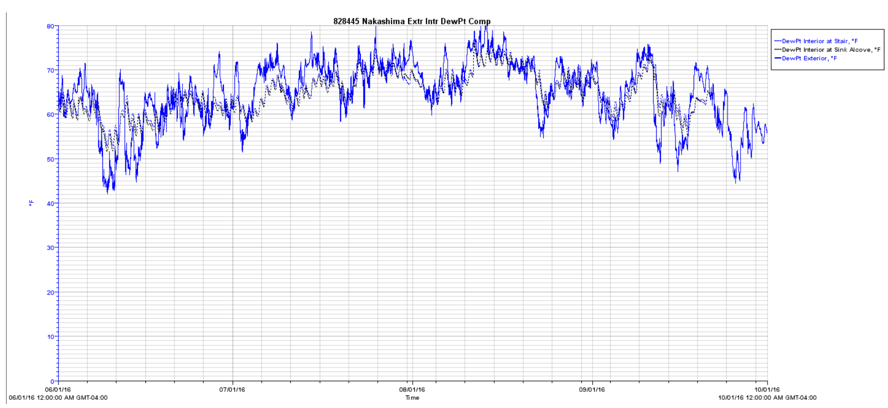






The following trend graph compares the exterior and two interior dew point temperatures for the 01 June 2016 through 01 October 2016 interval. In contrast to the winter interval, the interior dew point temperature in the Arts Building during summer tracks closely with the exterior dew point temperature, with a smaller difference between interior and exterior moisture levels. Close tracking of the interior and exterior dew point temperatures during summer may be attributable to one or more of the following:

• Infiltration of moist exterior air in summer has a greater effect on interior conditions that other potential moisture sources;
• Evaporation of soil moisture through the floor slab and the north and east walls is diminished due to higher interior mositure vapor levels in summer;
• Moisture buffering by the hygroscopic building materials is limited by the higher interior relative humidity in summer; and,
• Moisture buffering by the large wood slabs in the Arts Building is limited by the higher interior relative humidity in summer.

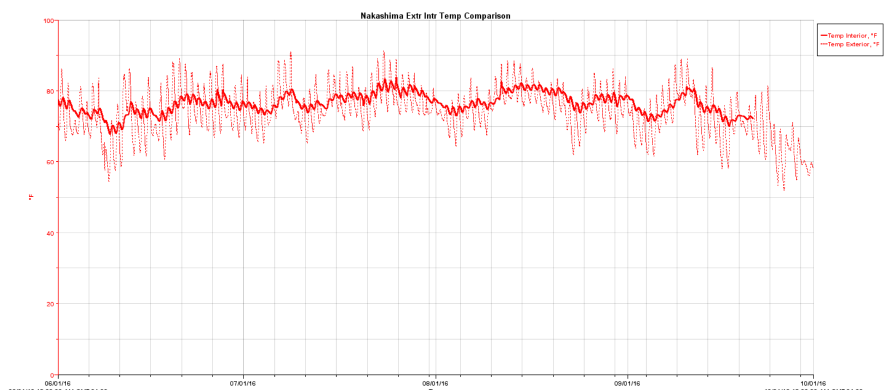


Since the Arts Building is not air conditioned, temperature conditions during the summer are of interest. The following trend graph compares interior and exterior temperatures in the Arts Building for the summer interval from 01 June through 01 October 2016.

Statistics for the data for the period from 01 June to 01 September 2016 are:

Nakashima Arts Building Interior/Exterior Temperature Comparison 01 June to 01 September 2016		
	Interior	Exterior
Maximum	83.8 °F	91.4 °F
Average	76.9 °F	75.2 °F
Minimum	67.7 °F	54.6 °F
Standard Deviation	2.77 °F	5.95 °F

On a daily basis during summer, the interior temperature tracks closely with the average daily exterior temperature, but the thermal mass of the building, which is concentrated in the slab-on-grade construction, the concrete box of the entry space and the north and east walls, effectively buffers the wider temperature fluctuations of the exterior.



Environmental Management Performance and Collections Risks
For buildings containing culturally significant objects, such as museums, the guiding technical guidance for environmental management is found in the 2015 ASHRAE Applications Handbook, Chapter 23, Museums, Galleries, Archives and Libraries.

Preliminary analysis of the environmental monitoring data collected for the Arts Building during the two intervals spanning from 12 November 2015 through 23 April 2016 strongly suggests that the interior relative humidity in winter and early spring seasons approaches ASHRAE Class B/A criteria for collections environments.[53] This is remarkable for a building without humidification in the mid-Atlantic and Zone 4A Mixed-Humid climate.

53. ASHRAE Class of Control B presents "Moderate risk of mechanical damage to high vulnerability artifacts; tiny risk to most paintings, most photographs, some artifacts, some books; no risk to many artifacts and most books." ASHRAE Class of Control C presents "Small risk of mechanical damage to high vulnerability artifacts; no mechanical risk to most artifacts, paintings, photographs, and books."

However, the trend graph for the summer interval from 01 June through 01 October indicate that interior relative humidity in the Arts Building occasionally approaches and exceeds the ASHRAE A23 relative humidity limit of 75%RH; this occurred during the interval from 11 August through 20 August. Sustained excursions above 70%RH can result in mold germination.
Full assessment of the environmental risks to the collection in the Arts Building will require a complete and uninterrupted set monitoring data for twelve months and analysis of the data set using eClimateNotebook® (https://www.eclimatenotebook.com/).

Environmental Management Performance and Human Thermal Comfort
ASHRAE Standard *55 Thermal Environmental Conditions for Human Occupancy* provides an adaptive comfort standard (ACS) that addresses warm indoor temperatures in naturally ventilated buildings without air conditioning, such as the Arts Building. The adaptive comfort standard takes into account occupant clothing and activity level, interior temperature and relative humidity, air movement and exterior conditions.

Application of the ASHRAE Standard *55 Comfort Model* to a limited number of interior conditions at the Arts Building indicates that the interior conditions in summer are acceptable to 90% of a typical population of visitors in summer clothing and relaxed, standing activity; however, 10% of the same population will probably report being somewhat warm and dissatisfied.

Full assessment of the occupant thermal comfort in the Arts Building during summer will require analysis of the summer data set using the ASHRAE Standard *55 Comfort Model* software.

Management of Natural Light

Natural light enters the Arts Building through the south and west glazed walls and is an important aspect of the non-mechanical environmental management of the building, especially in winter when the building is partially heated by the infrared component of sunlight entering the building; however, as noted in Leah Bright's report (Attachment A), exposure to high levels of natural light and ultraviolet radiation from sunlight can damage materials and fade colors.

Light can cause spot heating and localized surface desiccation of hygroscopic materials, resulting in strain gradients that lead to cracking. Thermal energy from light can elevate material temperatures, accelerating chemical deterioration. Lastly, natural light and ultraviolet radiation can reduce the elasticity of materials and applied finishes.

The Illuminating Engineering Society of North America (IESNA) has published guidance for light exposure of artifacts in museums and art galleries, IESNA Museum and Art Gallery Lighting: A Recommended Practice, 1996. Table 3.1 provides the following guidance:

TABLE 3.1
Recommended Total Exposure Limits in Terms of Illuminance Hours Per Year to Limit Light Damage to Susceptible Museum and Art Gallery Artifacts

Note: All ultraviolet radiation (400 nm and below) should be eliminated.

Types of Materials	Maximum Illuminance (Neither value should be exceeded)	Lux-Hours/Yr
Highly susceptible displayed materials: textiles, cotton, natural fibers, furs, silk, writing inks, paper documents, lace, fugitive dyes, watercolors, wool, some minerals.	50 lux	50,000
	Note: Approximately (50 lux) × (8 hours per day) × (125 days per year). Different levels (higher or lower) and/or different periods of display (4 hours for 250 days) may be appropriate, depending upon material. If in doubt, consult a conservator.	
Moderately susceptible displayed materials: textiles with stable dyes, oil paintings, wood finishes, leather, some plastics.	200 lux	480,000
	Note: Approximately (200 lux) × (8 hours per day) × (300 days per year). Lower levels may be appropriate, depending upon material. If in doubt, consult a conservator.	
Least susceptible displayed materials: metal, stone, glass, ceramic, most minerals.	Dependent upon exhibition situation.	

It is possible to monitor the light exposure and intensity and exposure at a specific location in a space, but this type of monitoring is best suited for artificial lighting where light distribution, intensity and exposure duration are uniform and consistent. However, monitoring natural light intensity and exposure is much more challenging than artificial light due to diurnal and seasonal variations in sun altitude and azimuth. For natural light (daylight), computer modelling and simulations can provide a better understanding of the light intensity and exposure of specific collections in a space, including the identification of the specific locations of seasonal “hot spots” of high intensity.

To evaluate the interior light levels from daylight through the south and west elevations of the Arts Building, PennDesign students Janki A.Vyas and Shin-Yi Kwan performed a daylighting simulation using DIVA software (Attachment B).

The daylighting simulation included daylight through windows without, and with, the shoji screens in place.

The table in the follwoing page summarizes the seasonal daylight intensities (illuminance) graphically identified by the Vyas-Kwan daylighting simulation.

Note that Leah Bright’s spot readings of light transmission through windows, without and with a shoji screen, showed that the shoji screens provided a greater reduction in light transmission that predicted by the computer simulation (Attachment A, page 10-11).

Although the daylighting simulation was not calibrated with spot readings, the model and the spot readings show that significant reductions in illuminance could

Comparison of Illuminance Values in the George Nakashima Arts Building without and with *shoji* screens using DIVA daylighting simulation software				
Location/plane	Seasonal Peak Illuminance (lux)		Occurrence	
	Without *shoji* screens	With *shoji* screens	Date	Time
Main space south wall	1919	762	21 March	12:00 PM
	2992	1568		3:00 PM
	3105	1476	21 December	12:00 PM
	1509	625		3:00 PM
Main space west wall	446	260	21 March	12:00 PM
	1566	905		3:00 PM
	754	444	21 December	12:00 PM
	1318	573		3:00 PM
Main space east wall	1102	659	21 March	12:00 PM
	3406	2182		3:00 PM
	1382	802	21 December	12:00 PM
	3343	2075		3:00 PM
Main space north wall	1641	1258	21 March	12:00 PM
	3819	2113		3:00 PM
	1747	1262	21 December	12:00 PM
	11424	4038		3:00 PM
Mezzanine (Loft) south wall	2610	1368	21 March	12:00 PM
	3182	1968		3:00 PM
	2244	1225	21 December	12:00 PM
	1556	1093		3:00 PM
Mezzanine (Loft) west wall	3436	1418	21 March	12:00 PM
	3040	1431		3:00 PM
	8890	3232	21 December	12:00 PM
	1742	1102		3:00 PM

be achieved by reinstating seasonal placement and relocation of the shoji screens.

Summary

The Nakashima Arts Building and Cloister present a number of challenges in preventive conservation of the building fabric and the collection. Interior environmental management in winter appears to rely heavily on the passive solar heating through the south and west glazing; however, penetration of daylight into the building is greatest during the heating seasons and the illuminance levels during the heating seasons present the greatest risk to the collection. Active seasonal deployment of shoji screens would mitigate light damage to the collection.

Assessment of the efficacy of the recommendations is essential, and can only be accomplished through rigorous monitoring of environmental conditions and the rate of deterioration of the architectural fabric and the collection.

GEORGE NAKASHIMA
ARTS BUILDING AND CLOISTER
CONSERVATION & MANAGEMENT PLAN

PART II

1. What Is a National Historic Landmark?

Left: Study to determine the effect of lighting in the loft. William Whitaker, 2017.

The George Nakashima House, Studio and Workshop site was designated a National Historic Landmark (NHL) in 2014. Additional recognition includes its inclusion on the National Register of Historic Places in 2008, Historic American Building Survey (HABS No. PA-6783) in 2011, and placement on the 2014 World Monuments Fund Watch List. Completed in 1967, the Arts Building and Cloister and surrounding lanscape is an integral part of this complex.

In the United States, the National Historic Landmark Program was designed to officially recognize heritage resources, including districts, sites, buildings, structures, or objects, in public or private ownership, that possess exceptional value in commemorating or illustrating the nation’s history. Typically, a heritage resource receives designation if it:

- is a location with a strong association with a turning point or significant event in American history,
- is the best location to tell the story of an individual who played a significant role in the history of the United States,
- is an exceptional representation of a particular building or engineering method, technique, or building type in the country,
- provides the potential to yield new and innovative information about the past through archeology.[1]

Heritage resources, including associated activities must be preserved for the benefit of present and future generations. Therefore, places of cultural significance listed as National Historic Landmarks often warrant a cautious attitude to change. This includes Preservation, as the most appropriate primary treatment approach, and Restoration, as additional action when needed. To clarify these terms, and others used throughout this document, the following definitions have been adopted from the Secretary of Interior’s Standards for the Treatment of Historic Properties as well as accepted international criteria such as Venice ICOMOS charter and the Madrid Document:

Cultural Significance is defined by aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related placed and related objects.

Heritage Value is the aesthetic, historic, scientific, cultural, social or spiritual importance or significance for past, present and future generations. The heritage value of an historic place is embodied in its character-defining materials, forms, location, spatial configurations, uses and cultural associations or meanings.

Authenticity is the quality of a heritage site to express its cultural significance through its material attributes and intangible values in a truthful and credible manner.

Integrity is a measure of the wholeness and intactness of the built

1. https://www.nps.gov/nhl/learn/intro.htm

heritage, its attributes and values.

Character-defining Elements are the materials, forms, location, spatial configurations, uses and cultural associations or meanings that contribute to the heritage value of an historic place, which must be retained to preserve its heritage value.

Conservation is all the processes of looking after a heritage site so as to retain its cultural significance.

Maintenance is the continuous protective care of the fabric and setting of a place, and is to be distinguished from repair.

Reversibility implies that an intervention can essentially be undone without causing changes or alterations to the basic historical fabric. In most cases reversibility is not absolute.

Retreatibility implies that the application of a specific treatment does not preclude continued maintenance, the implementation of other options and future treatment.

Preservation is the act or process of applying measures to sustain the existing form, integrity, and materials of an historic property. It includes the maintenance and repair of existing historic materials.

Restoration is the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period.

Reconstruction includes the recreation of vanished or non-surviving portions of a property for interpretative purposes.

Rehabilitation is the act of altering and adding to a historic resource to meet continuing or changing uses while retaining the property's historic character.

Intervention is change or adaptation including alteration and extension.

2. Assessment of Cultural Significance

As an integrated environment by George Nakashima

George Nakashima (1905-1990) began his professional career as an architect before committing to a life as a woodworker. Nakashima's earlier work connects with his time at Antonin Raymond's office in Tokyo. There, Nakashima absorbed Raymond's synthetic approach and practice through projects like the Raymond's Summer Studio (1933) and the St. Paul's Catholic Church (1934-1935), both in Karuizawa. In 1936, on behalf of Raymond's office, Nakashima traveled to India to supervise the construction of a dormitory of disciples of Sri Aurobindo. His work at the ashram became a pivotal moment in Nakashima's life both outwardly and inwardly that shaped his spiritual and philosophical approach to woodworking and architecture.

All the above experiences proved influential to the creation of a style unique to him. Economic struggle in the US and racial upheaval caused by the war affected Nakashima, as well as his contemporaries. Nakashima was in his 40s when he made a seminal contribution to woodworking in the United States, the free-edge furniture, which brought him both national and international recognition.

His shift to furniture making did not preclude Nakashima from architecture.[2] Perhaps, it enhanced his conviction on the integration of architecture, furnishing and landscape. His career resulted in a handful of designs, which were mostly concentrated in New Hope. The Arts Building and Cloister was his most personal work and his last interpretation of modernist structural theory through the combination of Japanese and Pennsylvanian traditional building techniques. The special treatment of the facades and the thoughtful incorporation of bioclimatic principles adds another layer of significance to the building.

On a smaller scale, Nakashima's unrelenting aspiration to enhance the wood's natural beauty by means of intense skill is recognizable through built-in furniture as well as architectural elements at the site, and particularly in the Arts Building. Examples are manifold: the Conoid Bench installed on the loft and the monumental lighting fixture. Interrelationships with the furniture are abundant, from the cantilevered stairs leading to the loft which resonates with Nakashima's earlier Milk House table to the joinery on the exterior walkway pots.

As an ideal space for an ideal community

In George Nakashima's complex on Aquetong Road, each building displays a specific idea. Unlike the pragmatic nature of the other buildings –the residences, workshops, showroom, and others- the Arts Building and Cloister embodies Nakashima's search for enlightenment and understanding of beauty, art, and spiritual transcendence.

At the time the Arts Building was built, Nakashima was involved in the design and construction of sacred spaces, including Christ the King Church in Katsura,

2. As he published in the 1961 catalog, activities included "architecture and construction on a private basis, church and monastic furnishings, and consultation."

Japan, and Christ in the Desert in Abiquiu, New Mexico. Nakashima's ties with Catholic monastic communities are fundamental to understanding the impulse behind the Cloister, and even behind the Arts Building, which has been compared to a church in recent conversations with the Nakashima family.

Dedicated on May 7, 1967, the building was inaugurated as the Minguren Museum, influenced by Nakashima's friendship with Masayuki Nagare, who introduced him to the Minguren Group in Japan. The Minguren vision resonated with him and the spirit of community he was nurturing in New Hope.

The Arts Building and its setting was used to foster cross-cultural interchange as well as spiritual enrichment through a process of socialization not possible previously. This is exemplified by the annual Marion's Dogwood O-Hana Mi (blossom viewing), concerts and talks by disciples from the Sri Aurobindo Ashram, Catholic gatherings, as well as by the events organized by the Foundation.

At the same time, highlighting its flexible use, the Arts Building was intended as a retreat for the woodworker indulged in quiet contemplation. In many instances, he engaged other craftsmen as an education process.

Landscape features include ponds, stone arrangements, self-seeded trees and species planted by Nakashima. Although partially modified, the landscape contributes to a secluded ambience that reinforces the idea of retreat and place of peace, opposite to the constant activity in the shops.

As a building housing a specific collection

The program for the building was simple, but its significance increased through its association with a collection of art, folk art, furniture prototypes, and wooden specimens collected by Nakashima.[3] The idea of creating a gallery space for Ben Shahn's prints shaped the interior treatments of the north and east walls. The posthumous installation of the large scale mosaic mural, "Poet's Beard", on the west inclined concrete wall reinforced the initial significance as a space of display.

The window niches in the loft area, still house a lively display of folk art and objects acquired by Nakashima during his trips to Japan and India during the late 1960s, including objects with specific connections to the Minguren group, as well as gifts from close friends, including Ben and Bernarda Shahn, Stanley and Nita Brogren, and Father Peter Sidler among others. This assemblage tells us about the long lasting professional and personal relationships Nakashima nurtured throughout his life.

Finally, besides the Conoid Studio, the Arts Building is one of the only locations where Nakashima's furniture can be seen together with the raw wood that inspired it.

Degree of wholeness and intactness

3. George Nakashima. *The Soul of a Tree: a Woodworker's Reflections*, 32

It is important to note that the Arts Building and Cloister possesses high integrity in its design, setting, materials, craftsmanship, and feeling. As seen in Volume I, alterations have been very few and, except for a handful of less significant interventions, include repairs and replacement in kind. Changes have been primarily the result of a more intuitive and practical approach, such as the substitution of the dome skylights, the addition of a wooden log to support the deflected waffle slab, or replacement with other wood species.

The cultural significance of the place (understood as the integration of landscape, buildings and collections) has been negatively affected by:

- Visual impacts and additions that divert the role of the landscape from its original intent,
- Reactive responses to failure and accretive change through replacement of architectural elements, and
- Significant elements of the collection are not tied to the building.

3. Statement of Significance

• A significant work of architecture associated with one of the most outstanding woodworkers in the United States.

The Arts Building and Cloister is of national significance through its association with George Nakashima (1905-1990) “one of America’s most eminent designer-craftsmen and a significant force within the American Craft movement of the mid-twentieth century.”[4] Nakashima himself, designed and participated in the construction of the building and furnishings.

• A rare interpretation of modernist ideas with vernacular traditions in the eastern United States

The compound is demonstrative of Nakashima’s unique interpretation and combination of modernist structural and environmental design theory with traditional Japanese and local vernacular building and landscape techniques, which stem from his apprenticeship and earlier experiences.

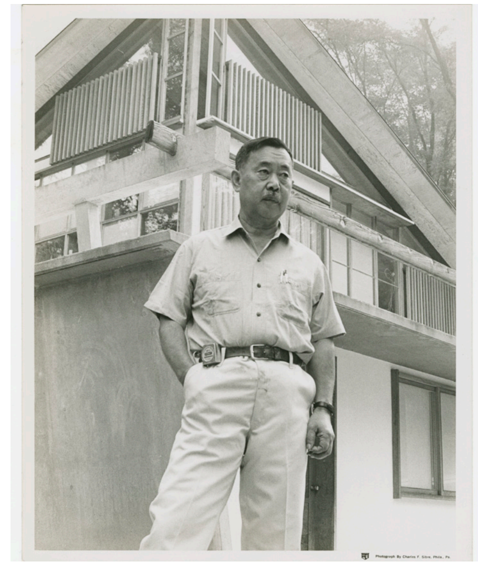
This is an architecture that blends traditional materials such as wood and stone, with new manufactured materials such as plywood, structural concrete block, and poured concrete. George Nakashima’s integration of interior space, architecture, and landscape, shaped the distinctive character of the Arts Building and Cloister, orientation, setting and views. There is a clear connection between furniture and architecture through aesthetic and functional principles as well as fine craft.

• An outstanding example of a hyperbolic paraboloid roof expressed in plywood

The use of the hyperbolic paraboloid roof closely relates to the rise of warped roofs in post war America and represents a rare example of the use of structural plywood representing an evolution of experimental architecture practiced at Nakashima’s property.

• Continued use as an ideal space for an ideal community.

The Arts Building and Cloister provides a distinct experience from the rest of the woodworking and residences complex, as it embodies the interrelationship between the art and craft as well as Nakashima’s sense of beauty, transcendence, and community. This connection is evident by the original name of the building Minguren (“People’s Tools Guild”) and the collections, which comprise: specimens of wood, furniture prototypes, art, artifacts and objects that offer an insight in Nakashima’s interest, source of inspiration, and ties, including the exterior mural mosaic, a humble tribute to his friend artist Ben Shahn. Spiritual values are especially evident in the cloister-garden design, which links the building with the monastic Benedictine life, and the isolated location on a slope at the edge of the property.



George Nakashima standing in front of the Arts Building. Author: Charles F. Sibre, Phila, Pa. ca. 1968. Source: George Nakashima Woodworker Archives

4. David Kimmerly and Catherine C. Lavoie. *George Nakashima Woodworker Complex. National Historic Landmark Nomination* (November 2007 (NR documentation); October 2012; Designation April 2014), 14
5. Mira Nakashima, *Nature, Form & Spirit: The Life and Legacy of George Nakashima*, (New York: Abrams, 2003), 190

4. Character Defining Elements

There are a number of elements and qualities of the building and setting which are essential to George Nakashima's concept of place and must be retained and conserved in accordance with this CMP:

a. The isolation of the building in its setting as a counterpoint to the woodworking and residence activities.
b. The hyperbolic paraboloid plywood shell roof, shed roofs, interplay of glass and wooden structural elements, massive masonry, openings, grills, and finishes.
c. The orientation and exterior relationship between the Arts Building and the Cloister, including the canopied walkaway and arrangement of plantings, large stone, stones, pavements, and the Pond.
d. The visual relationship between spaces, and between interior and exterior, particulary to the large area and pond on the south elevation, as well as the tree tops through the window walls.
e. The palette of materials chosen by George Nakashima for the exterior and interior spaces.
f. Coffered ceiling, skylights, and stone floor in the Cave.
g. The exhibition walls, the fireplace, and the vinyl flooring pattern and grid.
f. Cantilevered steps, built-in furniture and balcony rail in the loft.
i. Elements in the collection of exceptional significance such as the Minguren IV table, the Tatami Platform, and the English Oak Light Sculpture.

Notes for the management of future adaptation

In the Arts Building and Cloister, the architectural fabric has an exceptional degree of integrity.This compels a cautious attitude toward any change. However, drawing on the assessments presented in Part I of this CMP, it is possible to draft a hierarchy that would accomodate original and new uses of the space.

Setting

Visitor Pathway	Less significant
Driveway and Car Park	Less significant

Arts Building Interior

Cave	
Closet	Less significant
Wooden post / column	Intrusive
Plaster treatment in display niches	Intrusive
Storage furniture and bookshelves	Intrusive

Cloister Interior

Storage room	Less significant
Boiler room	Less significant

5. Guidance and Recommendations

This section provides guidance prepared in response to the many conservation and management issues identified through sections of the CMP. It takes into account the full range of character-defining features from landscape to collections conservation needs, the building and its environment, use and management. Conservation is not limited solely to physical intervention, but includes consideration of all recommended measures that will affect the associated spiritual values of the place.

5.1. General Policies

Acceptance, Review and Diffusion

Policy 1 Adoption of the CMP

Accept the statement of cultural significance and endorse the principles and recommendations contained within this CMP as a starting point for any further intervention and planning in the Arts Building and Cloister.

This CMP is the principal working document guiding conservation, use, and management for the Arts Building and Cloister, including its setting. After a donation by Marion Nakashima in 2003, the Foundation exclusively owns the Arts Building and Cloister. The Foundation is part of the Minguren Condominium, who owns the Pool House, the Swimming Pool, the Reception House, as well as the land comprising the woodworking complex and residences. It is recommended that a Management Plan for the entire site be prepared in the near future.

Policy 2 Review of the CMP

Review the CMP on a regular basis, usually every five years or at any time a major intervention is proposed.

The CMP needs regular review to ensure that the policies and recommendations remain relevant and that the information contained within it is up to date. Monitoring of the CMP implementation can be done internally or by a preservation specialist whenever necessary. Review and amendment of the CMP require appropriate professional advice.

Policy 3 Diffusion of the CMP

Make the CMP available to any parties with a well-founded interest in the place, including relevant and legal stakeholders as well as professionals able to share specialist knowledge and experience.

Overarching Principles

Policy 4 Significance Guides Conservation and Planning

Establish whether there is sufficient information to understand the impact of potential modifications and consider the effects of any intervention/change on each aspect of the cultual significance of the place.

Policy 5 Manage in Accordance with National and International Heritage Standards

The proposed conservation plan is based on an appropriate routine of management and maintenance. Any alteration or repair on the building should have an awareness of all necessary legislation requirements as well as national and international standards, such as the Secretary of Interior's *Standards for the Treatment of Historic Properties*.

Policy 6 Retreatability & Reversibility

The application of a specific treatment does not preclude future interventions and continued maintenance, such as cleaning, consolidating or renewal of sacrificial materials. When choosing between different treatments or interventions, consider the potential reversibility or retreatability of changes without damaging or altering the original fabric.

Policy 7 Material Compatibility

Intervene as little as possible and retain as much of the original fabric as possible. The introduction of new materials should be compatible with original materials and should not compromise their continued performance. Replacement of original fabric should be made using in-kind materials and good craftsmanship.

Policy 8 Outcome Monitoring and Evaluation

Monitor and assess regularly the impact of any maintenance, repair, conservation, and restoration work to determine its effectiveness. This allows managers to collect information to implement remedial measures as well as amend the CMP objectively.

In the event that the unexpected is revealed during the implementation of recommendations, involvement of experts and evaluation of alternatives is advisable in order to minimize harm. If a permanent solution or recomendation to identify problems cannot be implemented, propose temporary remedial measures to prevent the problems from escalating. Temporary solutions should be effective, timely and reversible.

Policy 9 Consultation

Implement the necessary statutory and stakeholder consultation process whenever work is planned. Engage consultants with demonstrated expertise in the preservation field to implement the recommendations contained in this CMP or other future actions on the place, including training programs.

Policy 10 Legislation and Statutory Control

Determine conformance with codes and ordinance requirements, foundation bylaws as well as condominium bylaws.

Policy 11 Building Management

Ensure setting, building and collections management roles and responsibilities are clarified, clearly defined and assigned.

Research and Recording

Policy 12 Updates

All new significant information disclosed or uncovered between CMP updates will be recorded and retained in an accessible database.

“Records inevitably reflect the state of knowledge prevailing at the time they are made, and the completion of even a detailed record does not preclude re-examination of the building, or its record, at a later date. New evidence may come to light and may need recording. Recording of any features uncovered should be consistent with any recording undertaken prior to work commencing and used to update, and if necessary reinterpret, earlier findings.”[6]

Policy 13 Work record and material archives

Work to the building will be properly documented so that the evolution of the building, as well as intervention success or failure is understood in the future. This includes recording and archiving parts of significant elements and materials that will be removed or altered prior to and during the work.

Inescapable negative impact or loss of fabric demands mitigation to reduce any detriment to the cultural authenticity and integrity of the place and setting. This is key to creating cumulative knowledge to inform future stewardship, as well as to understanding how and why cultural significance can be altered. An individual record for any work project should include project worksheet, sketches, photo documentation prior, during and after completion, written description, who carried out the work and when, cost, as well as supplementary technical information and samples of materials used whether maintenance, repair, or conservation work.

6. Historic England, *Understanding Historic Buildings: A Guide to Good Recording Practice*,9

Policy 14 Record production and maintenance

The maintenance of these records should be assigned to a single individual. Contractors and interns will transfer relevant information to this individual. This record will be incorporated to an accessible database and will inform CMP updates.

Policy 15 Further Research

The research projects identified in the recommendation contained in this CMP will be carried out. In addition, relevant research and collaborative agreements as well as links to other organizations will continue to be developed.

Cyclical Maintenance

Policy 16 Maintenance as a Strategy for Preservation

The conservation of the Arts Building and Cloister must be founded on appropriate routine management and maintenance.

Policy 17 Maintenance Plan

Prepare a financially sustainable Cyclical Maintenance Plan and Manual tailored to the needs of the Arts Building and Cloister as well as related landscape. Maintenance is defined as routine, cyclical, non-destructive actions necessary to slow the deterioration of a historic place. The Maintenance Plan will entail periodic visual inspection, routine cleaning, minor repair and refinishing operations, replacement of sacrificial materials, as well as predictable actions like shoveling in the winter, or unclogging gutters during the fall. Review the plan on a regular basis.

Policy 18 Visual Inspection

Program visual inspection of the building on an annual basis. Supplement this routine with actions following a major or unusual weather event. Periodic survey should include checking the condition of mortar joints, exterior renders, wooden elements, plywood soffits, as well as the water disposal system. In the interior, plasters, masonry, window and door frames, as well as the plywood ceiling.

Policy 19 Cleaning

Test any cleaning method prior to application to determine whether or not single or repeated application may cause harm to the historic fabric, and ultimately to the cultural significance of the place.

Policy 20 Renewal

Periodical renewal of sacrificial materials such as sealants, wooden stops, waterproofing membranes, is advisable unless any damage is caused and could not be recovered over time.

Policy 21 Maintenance Record

Record in a logbook visual inspections, maintenance and minor repair work including who carried out the work, as well as the cost.

Conducting Works & Maintenance

Policy 22 Roles and Responsibilities

Determine if works and maintenance will be undertaken internally or externally, or both. Identify and maintain an up to date list of approved contractors, preferably those with experience on the place. Provide one individual with responsibility for coordinating efforts and with capability to make decisions as a project manager.

Policy 23 Training and Intern Program

As an educational opportunity in conservation and preservation of George Nakashima's legacy, special care needs to be taken in sharing know-how and providing specialist training on conservation and repair, both internally in good craftsmanship, as well as through the engagement of external consultants with proven expertise in practical conservation techniques. To this end, identify specific training needs and ensure external consultants are adequately briefed about the values and significance of the place.

5.2. Landscape Management Plan
Nicholas Pevzner

This section presents a treatment strategy for the long-term preservation and management of the Arts Building and Cloister landscape. The treatment strategy is composed of four main parts:

1. Manage vegetation for historic character and vegetation health
2. Curate and restoring views
3. Restore non-living elements to historic condition and arrangement
4. De-emphasize non-historic features

Landscapes are dynamic and constantly evolving, and cannot be frozen in time. That said, vegetation was planned to convey a particular design intent with regards to the other static elements of the gardens and paving. While it is natural for vegetation to grow and eventually die, the decision of whether, and when, to replant is important to choreograph Nakashima's design intent.

Policy 24 Manage Vegetation for Historic Character and Vegetation Health

Managed planting areas:

• In places where vegetation is clearly missing, throwing off the geometry of the design intent (as in the West Gravel bed near the West Pond, where a tree is clearly missing based on the shape of the gravel beds), it should be replaced, in consultation with historic photographs for species selection and growth form.

• Where vegetation matches the historic conditions, but has merely grown larger, and taller but is otherwise recognizable and in good health, it should be preserved and supported. Support might include assistance for root health and vigor, for example through applications of compost tea or other soil amendments to the root zone. The health of trees in this category should be monitored to track the progress of decay in otherwise healthy-looking trees, so that limbs don't unexpectedly drop onto the Arts Building or other contributing features of the Arts Building landscape, potentially causing damage. Assessment of health should be done by a trained arborist, and can include decay detection techniques such as minimally invasive increment boring or tomography.

• If a tree is deemed to be in poor health, decayed, and in danger of collapse or death, consideration should be given to how the replacement of that tree will affect the larger character area. When choosing a replacement tree, evaluation should be made of light and shade conditions, and how it will interact with neighboring vegetation to reshape the overall character area.

• For areas of more finely wrought landscape design, such as the garden around the main Pond (Pond Planting), the spatial relationship of all the vegetation in the character area, taken together, should inform planting choices. If the older Eastern red cedar tree were to go into decline, show signs of disease, or die, the entire main Pond garden should be reconsidered in light of historic design intent. This could mean the planting of a new Eastern red cedar sapling, a new evergreen shrub near the Arts Building sliding doors, and a new medium-sized deciduous tree next to the saddle-shaped "large rock," to reflect the vegetational spatial arrangement visible in historic photographs of the Pond.

• Where self-seeded vegetation has taken root and achieved a significant dimension — especially when it would have already been present in George Nakashima's lifetime, as in the flowering dogwood at the western edge of the South Patio — the vegetation should be left to grow as long as it doesn't threaten the material integrity of the permanent landscape elements or the Arts Building itself. Even though this vegetation does not conform to original design intent, cutting it now in its advanced state would leave an unsightly stump, which would require subsequent removal, and which could upset existing stones and gravel.

• Any new saplings that subsequently take root spontaneously amid the stones, groundcover vegetation patches, gravels, or planting areas in the Arts Building landscape should be evaluated against historic photographs, and removed at an early stage if found to be out of compliance with historic design intent.

Wooded Verges:

• Even-aged stands of woodland are problematic from a forest management perspective, since disease, weather events, or old age can decimate an entire even-aged stand. Therefore, it is recommended that attempts be made to diversify the age of the existing forest, by planting seedlings and nursing them past the period of vulnerability to deer browsing. For wooded areas such as the South-side Wooded Verge, East-side Wooded Verge, or North-side Wooded Verge, it is recommended that any naturally self-establishing saplings be protected against deer browsing with deer-proof fencing, and new saplings added to diversify the age of the currently existing woodland.

• Hearne Hardwoods Inc., based at 200 Whiteside Dr., Oxford, PA maintains the forest and trees surrounding the Arts Building and Cloister today. John Curlew, the Assistant Logger at Hearne Hardwoods, worked for George Nakashima and has been working on the property in an on-call capacity ever since. It is recommended that John Curlew be consulted regarding forest and woodland health, as part of a groundcover restoration or forest age diversification effort.

Policy 25 Curate and restore views

Part of the management plan for the wooded verges includes not only the health of the woodland, but the woodland's role in directing or screening views. In the case of the South-side Wooded Verge, the clearing of forest that accompanied the construction of the neighboring house resulted in high porosity and visibility of the neighboring house and property from the Arts Building and South Patio.

The design intent of the South View was intended to include the pond in the foreground, and was intended to terminate in the wooded backdrop. The construction of the neighboring house (with associated clearing of a majority of the woods on that side) is a visual imposition on the intended view from the Arts Building, and is certainly non-contributing.

The Foundation has been planting pine trees and bamboo for a number of years in an attempt to screen out the house. The bamboo is a highly aggressive species and can "escape," becoming very difficult to control if left unchecked. Pine trees are not typically associated with the surrounding oak-mixed hardwood forest, although a related forest type — the "Hemlock (white pine) – red oak – mixed hardwood forest" does include pines in its composition.

• A more holistic visual screening strategy should be considered, which extends the character of the native Pennsylvania woodland and enhances the ecological health of the forest verge while minimizing use of invasive vegetation.

• Of particular note are native deciduous woodland species that hold onto leaves throughout most of the winter (trees that exhibit marcescence), since these species increase the visual screening effect in winter. Some American beech (Fagus grandifolia) trees are already present in the South-side Wooded Verge, and the beech population should be expanded to provide additional visual screening that is in keeping with the native woodland species mix. Additionally, shrubs with marcescent qualities, such as American hophornbeam (Ostrya virginiana), American hornbeam (Carpinus caroliniana) and Spicebush (Lindera benzoin) can be added to the understory to aid in visual screening year-round.

• The South-side Wooded Verge and the East-side Wooded Verge, if given new saplings and understory shrub planting, should simultaneously be protected by a deer exclosure fence to ensure the survival of the new planting and the visual screening effect that it is intended to provide—based on the state of the Wooded Verges today, it is clear that deer browsing is decimating understory vegetation and young saplings. If painted black, the exclosure fence will be visually unobtrusive, while enabling the survival of the newly planted vegetation despite the high population of deer around the property.

• Looking in the another direction, the West view from the South Patio is another important view of the Arts Building landscape. Included as part of the West view is the Seasonal Pond. Currently the Seasonal Pond appears as an isolated element within the larger mowed lawn at the south of the property. The pond is very close to the South Patio and is a visual point of interest, but it may feel visually more integrated into the larger landscape if taller grass vegetation is allowed to extend further around the seasonal pond, interacting more with the taller vegetation of the hay meadow beyond. The line of mowed lawn vs. hay meadow should be reconsidered as part of a re-evaluation of the view from the South Patio to the west.

Policy 26. Restore non-living elements to historic condition and arrangement

Non-living elements in the Arts Building landscape are not continually growing, although some may still be in flux from forces of deterioration and weathering.

• For stones that have migrated or are missing, attempts should be made to restore these primary structuring elements, in consultation with historic photographs. Of primary note is the area between the South Patio and the Pond Planting: attempts should be made to locate the missing stone(s) of the retaining wall border between the two zones, and to reset them.

• For wooden posts lining the edges of the main Pond, which are currently in an advanced state of decay, a conservation management plan should include a methodology for evaluating posts on an ongoing basis. Firstly, the wood species of the current, original posts needs to be determined. Next, source material for the posts needs to be located, and the depth of existing posts determined through an evaluation of existing posts. Finally, posts should be as necessary to maintain their historic appearance as part of the pond perimeter.

• For gravels, because the mixing of gravels between zones results in a blurring of the design intent, a regime of raking and separating gravels on a periodic basis is needed. As part of a conservation management plan for the landscape, gravels that appear to have migrated from their designated zones need to be periodically raked up, sieved to separate them from soil and other extraneous material, and replaced in their appropriate zones. The gravels are underlain by landscape fabric, which prevents weed growth in the gravel areas. Whenever landscape fabric becomes exposed and visible above the gravel, it needs to be re-pinned every 12" with landscape fabric pins or staples.

Policy 27 De-emphasize non-historic features

• Lastly, as part of the conservation management plan, attempts should be made to minimize and de-emphasize the visual presence of non-historic and non-contributing features, such as electrical outlets, pumps, termite control systems, and other extraneous features, so as to not detract attention from the historic Arts Building and Cloister landscape.

5.3. The Building Compound: Material Conservation
Cesar Bargues Ballester

Based on visual inspection and condition assessment, the project team identified a series of conservation issues and alterations to the building that have been summarized in the first volume of this CMP. The following is a list of policy and recommendations.

Exterior of the Arts Building

Policy 28 Form and Character of the Hyperbolic Paraboloid Roof

The original form, fabric, structure and finishes of the hyperbolic paraboloid roof, including the eaves, must be retained. Any repair, sensitive adaptation or replacement must respect and consider the original design intent and character of the roof.

After investigation with an IRT Camera, Roof probes revealed the presence of moisture entrapped on the northeast lower end of the roof. While not damaged, the exposed surface of the plywood deck was visibly wet, and the fiberboard insulation completely deteriorated. Although the asphalt lining is in overall good condition, exposed areas show alligatoring.

Reportedly, alterations to the roof focused on the north and east eaves. It included the redesign of the water disposal system, replacement of deteriorated plywood, flashing, and installation of a new built up roofing finished up with gravel.

Recommendations	Priority
• Remove moss as well as litterfall and cover exposed areas of asphalt lining with historically matching ballast stone.	Annual
• Visual inspection of the roof after major weather events.	Annual
• Repair the northeast area affected by the entrapped moisture.	1
• Replace in kind the rotted areas of plywood on the north and east eaves.	1
• Remove current white opaque finish in eave soffits and recoat with a historically appropriate translucent finish.	3
• In the event of a significant intervention, consider restoring the water disposal system as it appeared at the time of construction and was envisioned by George Nakashima.	3

Concerning the plywood deck, areas of rot are visible in the Arts Building eaves. A section in front of the chimney stack is highly deteriorated. The following recommendations are also applicable to the Cloister porch plywood soffit. Moisture damage to this element can be indicative of failures in the roofing system.

Recommendations	Priority
Keep in sound condition exterior finishes through routine maintenance and reapplication.	Annual
Minimize the potential for damage by periodically inspecting the condition of flashing, waterproofing systems, and keeping gutters clean of debris and tree litter.	Annual
Confirm and remediate causes of moisture infiltration affecting Arts Building eaves and Cloister roof.	1
Remove unsound areas on the north and east eave of the hyperbolic paraboloid roof as well as the Cloister porch and replace them with matching plywood: species , grain, and other visual characteristics. Complete replacement in kind is recommended when deterioration affect large areas and can compromise the performance of the assembly.	1
Edge of panel products are more susceptible to water uptake and release than are their faces, due to the end grain exposure of the veneers Edge-seal the plywood sheets with a compatible, non-visible, material.	2
Plywood that has minor external damage from impacts can be repaired using wood putty. Prior to repair, be sure to use compatible putty by testing to assure proper matching once cured and stained. Superficial scratches can be sanded, sealed and finished.	3

Concerning flashing and gutters, failing sealants and cracks are visible on the eaves, as well as impact damage on gutters.

Recommendations	Priority
Check flashing and sealants around the base of the chimney, hyperbolic paraboloid roof eaves, window seat canopy, walkway, and Cloister roofs. Look for areas where water can infiltrate. Check interiors and soffits to see evidence of water infiltration. Recaulk and repair flashing accordingly.	Annual
Current sealants on the flashing installed upon the eaves show cracks, deterioration and brittleness. Remove and apply new appropriate sealant. Reattach loose fasteners, be sure nails are chemically compatible.	1
Repair cracked flashing sheets and consider a system to allow thermal expansion aesthetically and functionally sensitive to the original installation. Avoid standing seams.	2
Assess the remaining service life of the roofing system and adequacy of current gutters.	2
In the event of a major intervention, consider restoring the water disposal system as it appeared at the time of construction and was envisioned by George Nakashima.	3

Carpenter bee holes are evident on the lower face of the fascia. Also, woodpeckers have caused severe damage.

Recommendations	Priority
Determine and apply an appropriate insecticide and plug up the carpenter bee holes in the fall months.	Annual
Replace sections of the fascia that are rotted with the same wood species. Check the condition of fasteners and reinstall missing plugs.	1
Limit the use of epoxy resings to minor reapir and hidden areas. Consider Dutchmen and face repair for large and exposed areas.	1

On the south and west elevations, the interplay of wood, glass and infill panels is a character-defining feature of exceptional significance. Nakashima's final scheme included the installation of cypress grills on the exterior and interior shoji screens in selected locations. The concept of the grills is visible in the ealier hand drawings. The west elevation is visible from the Conoid Studio and Chair Department, from the driveway leading to the Pool House, and from the approaching visitor pathway. Openness allows visitors to contemplate the rhythm of the ribs and the plywood ceiling from a distance. On the west elevation, the canopy over the window seat is a deviation of the design intent.

Policy 29 Character of the South and West Elevations

Retain the configuration of grills, glass panes, and infill panels as designed by George Nakashima. (See Policy 39 View to the Landscape)

The edge beams are in excelent condition. The lower ends of the tapered edge beams are notched into stones at the walls. Reportedly, these lower ends were bolted to the stone masonry. Rust stains on the south wall may be indicative of rusting fasteners.

Recommendations	Priority
Confirm the joint components and identify corroding metals that can compromise the assembly and the structural performance.	1
Evaluate the cause of the corrosion process and evaluate possible repair in collaboration with a structural engineer.	1

To a greater or lesser degree, the interface between infill panels and concrete surfaces shows a gap running vertically. This condition allows moisture infiltration and heat loss, particularly on the south elevation.

Recommendations	Priority
Inspect wall panels for moisture infiltration or damage and repair accordingly. Repair should be made using same materials and techniques. Consider the possibility of improving the insulation keeping the same thickness.	Annual
Monitor and investigate active movements of the assembly. Evaluate and determine the use of a joint sealer, such as 790 silicone building sealant, and rope for filling in the gap. Ensure color and texture matching.	1

In many instances, wood stops are deteriorated compromising the tightness of windows and sliding doors. Insulated glass and single panes are in good condition. At the Arts Building, two impacts have been detected in the south sliding door.

Policy 30 Replacement of Glass

Replacement of individual glass panels should match the color, reflectivity, and translucence of the existing glass. If it becomes necessary or feasible to replace or improve current panels to achieve better thermal properties or UV protection, consider historical character and perception.

Recommendations	Priority
Inspect condition of sealing in junctions between window and door frames and the walls. Missing, deteriorated or cracked filler must be removed and replaced. Material of current sealants is unknown. Ensure that the replacement is elastic enough to accommodate movements.	Annual
Inspect condition of any fixtures and fittings, such as hinges, knobs, locks, catches and operator handles, particularly on the window casements. Check materials and condition of the framework, including wood stops and lead flashing. Replace deteriorated wood stops with same species. Consider the addition of hidden caulk to improve performance.	Annual
Prepare and implement a plan for routine cleaning to remove dust, dirt and spider webs that can build up into a crust. Evaluate and determine a cleaning methodology. Use the mildest method moving to a more invasive one if required without question.	Annual
Develop and deploy a system for monitoring condensation and water infiltration as per Environmental Engineering recommendations.	1
Source glass as per Policy 30 and replace pane deteriorated by impact damage.	2
Locate potential risks related to use and visitation, as well as future causes of deterioration, and identify measures for mitigation.	2

UV induced damage is visible elsewhere on the wooden elements. Reportedly, Nakashima craftsmen have usually finished the architectural wood elements with boiled linseed oil thinned with turpentine. Over time, this finish has darkened considerably.

Recommendations	Priority
Determine and evalute a gentle method to remove mildew from wooden elements.	Cyclical
Subject to the respect of the original finish, evaluate improving the specification to combat known causes of deterioraton. Determine and evaluate a preservative method to prevent further UV induced damage to wooden elements.	Cylical

On the north and east wall, the current rendering is original except for localized repairs. Horizontal cracking, hairline cracks following the perimeter of the masonry units, carbonate calcium deposits, efflorescence, as well as surface loss through disaggregation are visible on the north wall to a greater extent. Thermal imaging survey showed a thermal bridge on the interface between the rendered CMU masonry wall and the chimney stone masonry stack, as well as areas of the CMU wall slighty colder than otehr forming vertical bands.

Recommendations	Priority
Conduct routine cleaning. Identify and evaluate an appropriate method of cleaning for attached soiling, crust and stains.	Annual
Provide reinforcement as per structural engineer recommendations, and expand the structural model to determine wall stability, as well as causes of induced stresses and cracking. If repair is necessary, preserve as much as possible of the existent stucco.	1
Determine if raising damp is occurring as per environmental engineer recommendations.	1
On both the east and north elevations, confirm the presence of a French drain and assess its performance. Below grade, install a new waterproof membrane covering the wall foundation and consider the creation of an impermeable barrier, such as flashing, that will stop water infiltration through capillary rise, or evaluate the implementation of an electro-osmotic pulse technology.	1
Ensure the wall assembly is enough dry before remedial work is applied. Remove mineral deposits and brush off superficial efflorescence. Evaluate and determine a tailored poultice technique for salt removal.	2

7. Gravimetric analysis is provided in the Arts Building and CMP Vol. 1, Appendix F

Hairline cracks (less than 1/32") and crazing does not require treatment. Inactive cracks larger than 1/32" and affecting all the coat thickness must be filled with a color-matched lime mortar, slightly weaker than the surrounding material. Cracks may need to be cut out by shaping an inverted crack able to receive and provide a key for the new mortar. Protect mortar while curing.	2
Consolidate areas with superficial damage through disaggregation.	2
Use compatible materials and technique similar to the installed to repair bigger areas and chipped corners. Analyze current material and evaluate replacement mortars. In all repair work, evaluate mock ups and ensure color matching and texture. Consider the use of mineral silicates to blend previous repairs.	2

Hairline cracks and failing joints on the buttresses were noted during visual inspection, along with biogrowth (mosses and lichens). Several stones showed flaking and superficial delamination.

Recommendations	Priority
Evaluate, determine and apply a biological growth removal treatment to retard deterioration. Water washing, PH neutral and biodegradable cleaners, such as D/2 Biological Solution, are preferable to highly hazardous acid cleaning methods that can etch permanently the masonry, particularly the stones of calcareous nature.	Annual
Rake deteriorated mortar joints and point with a historically appropriate replacement mortar.[7] Before approval and application, prepare different mortar samples to match in color and texture the original mortar.	1
Confirm the causes of efflorescence occurring on the south stone masonry. Check gutters and flashing to be sure there are no failures in the water disposal system. Repair accordingly. Determine and evaluate a tailored poultice for salt removal.	2

Overall, exposed concrete is in excellent condition. On the exterior, a significant alteration was the installation of a fiberglass membrane to prevent rainwater leaking into the interior space. On the interior, a waffle slab forms a low ceiling for an entrance hall or "Cave." Daylight, filtered by *shoji* screens, comes through five skylights on the west elevation and a window on the south elevation.

Policy 31 Concrete Volume

Maintain the legibility of the primary concrete and wooden elements of the volume accomodating the terrace and the main entrance to the Arts Building, including interior character-defining features such as the waffle slab. Intrusive elements and paints are not acceptable.

Policy 32 Exposed Concrete Surfaces

When repair of exposed concrete elements becomes necessary, care should be taken to maintain quality control of color and texture to match existing fabric.

Recommendations	Priority
Evaluate and determine a cleaning methodology for routine removal of bio growth and soiling, as well as calcium carbonate deposits on soffits. Consider if the subtrate will be damaged, safety and hazards to the environment and workers. While protected areas retain original surface, signs of superficial erosion and mechanical impact are visible on exposed surfaces.	Annual
Brush off carbonate deposits on the concrete soffits and joists in the cave. Monitor presence of new crystallization afterward.	1
Evaluate and determine a cleaning methodology for removing iron stains and carbonate leachng crusts from the concrete soffits and joists in the cave.	2
Remove hooks from concrete elements and evaluate an alternative hanging system if necessary.	2
Consider the removal of the fiberglass membrane as well as epoxy paints on the terrace. Engage an architectural conservator to evaluate condition of exposed surface and explore alternative treatments to restore original appearance and finish. In the event this was not possible, explore ways to deemphasize the current coating.	3

Canopied Walkway and Exterior of the Cloister

In Soul of a Tree, George Nakashima recognizes the importance of the post in the traditional Japanese architecture. He illustrated three types of work: menkawa, shi-ho-masa, and shibori. The *menkawa* is “a post with four planed sides; the four unplaned surface are left with the natural contours.” The *shi-ho-masa* is a “four sides straight grain” post. The *shibori* is the natural trunk of a tree, which could be cultivated, with a characteristic mottled underbark.

In the canopied walkway, the 4x4 inch black locust posts were prepared after the *menkawa* post. Nakashima’s design choice resonated with his free-edge furniture. This craft highlighted the beauty of the natural form of the selected species, while confering simplicity to the structure. The replacement with other species and appearance, while functional, deviated from the original intent.

Policy 33 Character of the Canopied Walkway

Recognize the significance of the *menkawa* posts as expression of George Nakashima’s ideas. Remaining original posts should be maintained and the overall unity recovered.

Recommendations	Priority
Inspect condition of flashing, sealants, and waterproofing membranes. Keep it clean of biogrowth and litterfall.	Annual
Repair or replacement of deteriorated members should use the same species. Follow table provided by wood scientist or identify species when unknown. The Center for Wood Anatomy Research, USDA Forest Service, Forest Products Laboratory, in Madison, WI can identify and confirm a maximum of five wood samples	1
Limit the use of epoxy resins to minor repair and hidden areas. Consider Dutchmen and face repair for larger and exposed areas.	1
In the event of major intervention or deterioration, consider replacing current machine made Ipe posts with Black locust as per wood scientist recommendation.	3
Check and confirm rot extension in rafters supported by IPE post number 2 and 3 (See drawing sheets NAKA A-.02 and NAKA C.05). If this is the case, determine and evaluate the area of repair, proper joint and reinforcement if necessary. Repair wood should match species, grain orientation, moisture content, growth characteristics and section orientation. Exposed elements do not accept partnering timber or supplemental elements, except as a temporary shoring.	1
Treat the plywood deck as per above recommendation (see page 24).	2
In the event of a major intervention, consider restoring the water disposal system as it appeared at the time of construction and was envisioned by George Nakashima. (See Arts Building and Cloister CMP Vol. 1 Section 6).	3

Exposed Waylite block masonry reinforces the idea of simplicity recognizable both in the exterior and in the interior of the Cloister. Hairline cracks in the masonry are likely the result of shrinkage of both the block and mortar, the block being the major contributor. Hairline cracking does not constitute damage and does not compromise the structural integrity of the masonry. Cracking also occur on the interface between block and concrete lintel above window openings.

Policy 34 Exposed Concrete Block Masonry

Respect the restrained character of the exposed concrete block, and retain the exterior and interior exposed surfaces.

Policy 35 Potential Improvement of Storage Room

Should it be an improvement of the storage space to meet comfort or environmental requirements; it would be advisable careful consideration of the treatment, its reversibility, and compatibility with architectural detailing by George Nakashima visible on the place.

Recommendations	Priority
Evaluate, determine and apply a cleaning method to remove stains caused by dirt and moderate biological staining.	Annual
Evaluate, determine and apply a biological growth removal treatment to retard deterioration.	Annual
Monitor step cracking on southern corner. If settlement occurs investigate footings, evaluate, and implement remedial measure.	2
If major work is undertaken, consider the removal of the cementitious sill built in summer 2016. Follow the general policies to propose an alternative solution.	3

The exterior lighting fixtures are original to the Cloister. The wall sconces are similar to Thomas Lighting SL875-3. Light corrosion products, spider webs, and dust accumulates on the surfaces of the exterior lighting fixtures.

Policy 36 Exterior Lighting Fixtures

Original functional design and simple form of the outdoor wall sconce should remain. Should it be replaced, select the most efficient light bulb that maintain the quality and color of light provided by the original lighting system.

Recommendations	Priority
Conduct routine cleaning to remove dust, spider webs, and dauber wasp next that can build up a crust that requires a more invasive cleaning. Evaluate and determine a conservation-based methodology to clean corrosion products.	Cyclical

The seven by twenty-three feet mosaic mural, “Poet’s Beard”, manufactured by Gabriel Loire after Ben Shahn’s gouache, has exceptional significance. This work memorializes Ben, close friend of the Nakashimas and was intended to be seet at a distance.

Policy 37 Ben Shahn’s Mosaic Mural

Because of its exceptional contribution to the cultural significance of the place, retain and respect “Poet’s Beard” as integral to George Nakashima intent and the Arts Building. Refer to the Collections Management Policies in 6.4.

Recommendations	Priority
Engage an art conservator or graduate student research to conduct a comprehensive condition assessment and evaluation of preferred treatments, including consolidation of deteriorated tesserae and selection of architectural adhesives.	1
Gabriel Loire Atelier is still active (loire@wanadoo.fr). Consider obtaining their advice and sourcing materials in kind for future repairs.	2

Interiors

At the time of the completion of this document, an external party executes routine cleaning of the interiors. Reportedly, cleaning products and methods are gentle.

In the Cave, the stone slab flooring shows missing and failing joints, as well as stains as a result of catering activities, are visible. In the Gallery, concerning the vinyl flooring, current tiles show some loss of adhesion to the concrete slab in the Arts Building and to the plywood substrate in the Cloister. Shrinkage as well as minor damage was noticed. Wooden surfaces show moisture stains and UV light damage. In the Loft, the concrete floor shows stains as a result of the 2016 campaign to clean and oil the walnut flooring. Allback Organic Linseed Soap slightly diluted with water was used to remove original finish. The new finish was achieved with Sutherland Welles Polymerized Tung Oil and Sutherland Welles Finishing Varnish. Reportedly, for any following refinishing project only the tung oil will be applied.

Recommendations	Priority
Rake loose joints and point with an historically appropiate lime-cement mortar. Ensure texture and color match.	1
Conduct a test to determine asbestos content in the vinyl flooring.	1
Consider the risks associated to the use of an open-hearth fireplace and the adjacent materials.	1
Test alkalinity and measure the vapor transmission rate through the concrete floor slab as per the Environmental Engineering recommendations (ASTM F-1869 and F1907-04).	1
Evaluate and determine the best method to reinstall the current tiles (without disturbing asbestos if present). Consider implications in the interior environment.	2
Determine the type of stains on the concrete floor, oil or varnish, and evaluate a conservation-based cleaning system for removal.	2
Determine and evaluate a cleaning methods for stains visible on the stone slabs.	2
Materials adjancent to surfaces to be cleaned must be protected before, during, as well as after job is undertaken.	Cyclical
Existent vinyl tiles show signs of tear and wear after almost 50 years of use. It is likely the material is near the end of its life expectancy. A strategy should be formulated to guide tile replacement, including their procurement or recreation. Replacement should be in kind, ensure color matching and texture, improved fire resistance and resilience would be acceptable.	3

Policy 38. Interior Lighting Fixtures

Improve lighting as per Collections Assessment and Policy Recommendations

Recommendations	Priority
Conduct routine cleaning to remove grass stains, dust, spider webs that can build up a crust that requires a more invasive cleaning.	Cyclical
A strategy should be formulated to guide fixtures replacement, including their procurement. This strategy should include consider-ation of reinstatement of original Isamu Noguchi designs in the Arts Building.	1

In detailing the west and south elevations, George Nakasima incorporated strategies for control of natural light. This includes roof overhangs and cypress grills on the exterior, as well as Shoji and curtains inside. It is a carefully considered composition of traditional Japnese elements and his own design aesthetic. In so doing, he is establishing precise relationships with the landscape both in daytime and night time.

However, in order to improve the environment for the collections and interior surfaces, consideration for additional strategies for natural light control are important, especially for effects from direct sunlight exposure.

Policy 39. Views to the Landscape

Maintain views out from the space. Consider the impact of modifications to the existing strategies for the control of direct sunlight.

Recommendations	Priority
The curtains in both the mezzanine and the lower level are arguably an integral part of the design in their respective locations, as elements to control light intake and privacy. Their condition is good, but lower areas need to be rewoven. Check condition of hangers and rehang.	1
Repair deteriorated paper on shoji screens.	2

5.4. Structural Wooden Elements
Ron Anthony

1.Repair or replacement of deteriorated members should use the same species.
2.The patches of moss on the roof should be removed periodically to prevent them from becoming established to the point where they gain roof penetration through the membrane and into the diaphragm below.
4.The biological growth on the south railing of the terrace should be removed periodically. Remedial preservatives, such as borate rods, could be inserted at the connections to retard the action of wood decay fungi or insect attack.
5.The base of the four original posts in place at the landing with the sliding doors on the south elevation do not require repair; however, the southeast post has more extensive deterioration at the base and is suitable for a hidden repair (if desirable) to prevent further deterioration of the wood. The post does not need to be replaced.
6.More information could be obtained on the Arts Building roof diaphragm material and construction through one or more roof probes. The information would be beneficial in understanding the structural performance of the roof as well as potential durability issues.
7.The supporting posts on the walkway between the Arts Building and the Cloister, as well as the posts supporting the Cloister porch/soffit, have been replaced.
It is recommended that the trim at the base of the replacement posts be removed to the original configuration, which will allow for the posts to dry when they get wet. Use of a spacer at the bottom of the post would prevent the end grain of the post from absorbing water under most circumstances. Consider replacing the posts with new posts made of black locust.
8.The Cloister roof should be repaired and maintained. The plywood soffit should be repaired.

5.5. Structure
David Biggs

1. Additional roof testing should be undertaken to provide additional data to tune the computer model.
a.Materials. Non-destructive testing should be considered if physical samples can't be obtained.
b.Dynamic monitoring should be undertaken. This requires installing sensors (accelerometers) on the roof structure and inducing vibrations by having someone jump on the roof. From this, the natural frequencies and mode shapes can be obtained and correlated to the computer modeling. The computer model could then be "tuned" to the actual vibration characteristics.

2. Additional modeling would improve the results.
a.Since exact material properties are uncertain, the computer model could be evaluated based upon variations in material properties.
b.The modeling should be refined to include the masonry walls and timber edge beams more exactly.

c.Determine the natural frequencies and mode shapes of the roof to harmonize the computer model with field testing.
d.Professor Kabele at the Czech Technical University in Prague has graciously offered another SAHC master's student during May to July 2017 to continue the computer modeling. The current model should be reviewed and modified for consistency with the measured deflections and to determine how the edge conditions are affecting the deflections.
If the dynamic monitoring is provided, the dynamic modeling can be added and further tuning completed.
If time allows, a spreadsheet might be provided that provides guidance on temporarily supporting the roof during large snow events or repairs.

3. Roof Shoring
a.Repairs
The modeling stress results could be consulted for determining possible shoring locations during future repairs.
b.Unbalanced snow loads
• If possible, evaluate the actual snow loads during future major snow events. This may be impractical if the site is not available in the winter.
• Compare the actual conditions to assumed loadings.

4. Wall strengthening
a.The large exterior cracks in the walls should be repointed.
b.The horizontal cracks in the north wall should be strengthened. This might include adding vertical strips of frp adhered to the wall, internal reinforcement or both. The rendering would need to be replaced.

5. Roof repairs - wet roof
a.The roof membrane must be kept dry.
b.Repair the roofing at the northeast corner where wet insulation and plywood were found.
c.Evaluate the effectiveness of the roof vents installed on May 10, 2016.

6. Miscellaneous
a.Repair any exposed wood deterioration in the posts and beams.
b.Repair the cracked rib.

5.6. Environmental Management and Hygrothermal Performance
Michael C. Henry, AIA, PE, PA#026615E

Based on observation of the buildings and the collection and based on the environmental data collected to date, several potential conservation issues related to environmental management and hygrothermal performance of the building have been identified, along with recommendations for their resolution.

Natural Light Damage to the Collection and Interior Architectural Materials/ Finishes

Damage from exposure to natural light was noted in the collection (Attachment A) and the architectural materials, notably the wood framing for the wall glazing . The illuminance levels for the collection and architectural surfaces that were estimated by the daylighting simulation (Attachment B) exceed the recommended levels necessary for protection of museum collections.

Natural light levels in the Arts Building interior should be reduced, and the combination of shoji screens and exterior wood grilles can provide an architectural solution to this problem, consistent with Nakashima's original design of the building.

Recommendations

1. Install and monitor prototype shoji screens for the south and west elevations to reduce natural light levels. Design the shoji screens to allow air circulation between the room and the glazing surface in order to prevent microclimate-induced condensation (see Moisture Damage at Windows, below).
2. Monitor light levels at selected locations in the interior, with and without the prototype shoji screens for 12 consecutive months and analyze the data to validate/confirm the results of the daylighting simulation (Attachment B); and,
3. Based on 1 and 2, develop and implement an operational strategy for seasonal deployment of shoji screens and exterior wood grilles for natural light reduction at the glazed south and west elevations.

Ultraviolet Radiation Damage to the Collection and Interior Architectural Materials/Finishes

Damage from exposure to high levels of ultraviolet radiation was noted in the collection (Attachment A) and the architectural materials .

Recommendations

4. Apply ultraviolet filtering adhesive film to existing glazing in the south and west elevations; and,
5. Require that replacement glazing (single glazing or thermal insulated glazing units) incorporate stable, long-term ultraviolet filtration.

Environmental Management Performance for Collections and for Comfort

Preliminary analysis of basic environmental monitoring data from November 2015 through October 2016 has informed understanding of the environmental response and comportment of the Arts Building and the range of interior conditions that the collections in the building experience.

The preliminary analysis of the data suggests that interior conditions in winter may satisfy ASHRAE A23 Class A/B criteria, while conditions in summer are likely to satisfy ASHRAE A23 Class B/C criteria. Data for the transition seasons of spring and fall have not been analyzed, but these seasons are likely to be problematic with respect to the range of short term fluctuations. Sampling of summer data suggest that interior conditions in the naturally ventilated Arts Building meet the criteria for adaptive thermal comfort of occupants set out in ASHRAE Standard 55.

The basic monitoring and preliminary analyses conducted for this report have not been comprehensive in scope, but have been sufficient to identify needs for future monitoring and analysis, including diagnostic monitoring of conditions in significant architectural fabric such as the roof assembly.

Recommendations

6. Formalize the environmental monitoring program using web-based monitoring systems such as HOBOLink® and HOB RX3000 loggers by Onset Computer Company, Inc. (http://www.onsetcomp.com/). Include the records storage space in the Cloister in the spaces to be monitored;
7. Expand the monitoring program to acquire exterior data such as solar radiation, wind direction, rainfall and temperature and relative humidity;
8. Incorporate diagnostic monitoring of conditions in the roof assembly and soils into the program to assess potential for damage from moisture migration through the building fabric; and,
9. Analyze environmental monitoring data using eClimateNotebook® (https://www.eclimatenotebook.com/) to determine environmental risks to collections.

Relative Humidity in Winter and Implications for Source Moisture Control

As indicated by the trend graphs, the dew point temperature in the Arts Building during winter is consistently higher than the exterior dew point temperature, which is surprising, considering the infiltration of dry outside air that is possible through gaps in the sliding doors and windows. The moisture content of the interior air in winter strongly suggests that there is a moisture source sufficient to offset the dilution from infiltrating dry exterior air; however, the effect of this source of moisture is suppressed in summer, when interior and exterior moisture vapor track more closely due to infiltration of humid outside air.

If the source of moisture is the soil abutting the north and east walls of the building or below the floor slab, the soil moisture evaporating from the north and east masonry walls or through the floor slab will have implications for longevity of the wall assemblies or the floor finishes , apart from its beneficial effect in elevating interior relative humidity in winter. Excess soil moisture may result from runoff from the adjoining site slope or from overtopping of roof gutters along the north and east walls, or from both.

Recommendations

10. Continue monitoring interior and exterior environmental conditions for 12

consecutive months and analyze the data with respect to this issue;
11. Check the drainage capacity of the existing gutters on the north and east eaves for adequacy, taking into account projects for increased rainfall intensity and frequency due to climate change. If necessary, increase the size of the gutters. Establish a program to check the gutters monthly and remove accumulations of tree litter;
12. Conduct a moisture survey of the north and east walls using a capacitance-type building moisture meter and infrared thermography to determine if rising damp is occurring;
13. Measure the vapor transmission rate through the concrete floor slab (ASTM F-1869 and F1907-04) at an exposed area of the concrete floor slab near the northeast corner of the exhibit space to determine if soil moisture is evaporating through the slab;
14. Consider installing dataloggers and soil moisture sensors along the north and east sides of the building to determine if variations in soil moisture content correspond with rain events and variations in interior dew point temperature;
15. Check the existing foundation drain along the north and east wall for functionality and/or blockage; install a clean-out in the piping to facilitate regular flushing and root clearing. If necessary, design and implement an improved drainage system to intercept storm water runoff from the north site slope and divert the runoff away from the Arts Building and the Cloister; and,
16. Determine if soil moisture and evaporation toward the interior in winter has a detrimental effect on the floor finishes and the concrete masonry walls.

Relative Humidity in Winter and Implications for Hyperbolic Paraboloid Roof Assembly

The hyperbolic paraboloid roof assembly is described as (from interior to exterior):

- Three layers of 5/8 inch thick plywood panels, in alternating orientation, screwed and possibly glued;
- One or two layers of Celotex® insulation board;
- Asphalt impregnated roofing membrane; and,
- Marble stone ballast.

The plywood roof deck was supported by shoring during construction; when the shoring was removed, the deck reportedly deflected, which would likely result in the formation of air spaces between the plywood sheets.

The trend graph for the period from 12 November 2015 through 01 March 2016 indicates that for the interval from 01 January through 01 March, the interior dew point temperature averaged 40°F (31°F to 48°F range) and the exterior temperature averaged 35°F (9°F to 62°F range). This raises the possibility of migration of interior moisture vapor through the roof assembly with condensation or frost forming where the dew point gradient and the temperature gradient intersect, with the resultant moisture enabling concealed deterioration of the plywood. Locations of particular concern would be the northeast corner of the roof, where thermal bridging from the uninsulated projecting eave would lower the temperatures on the interior side of the north and east walls.

Recommendations
17. Confirm the dimensions and materials of the roof assembly and, using confirmed information perform a transient hygrothermal analysis using WUFI® (Wärme Und Feuchte Instationär) software to determine the potential for condensation or frost within the roofing assembly;
18. Continue monitoring interior and exterior environmental conditions for 12 consecutive months and analyze the data with respect to this issue; and,
19. Based on the above, determine a maximum allowable value for interior relative humidity and dew point temperature in winter above which there is risk of condensation or frost in the roofing assembly.

Moisture Damage at Window Glazing
Moisture damage at interior wood window framing in the south and west glazed walls and moisture damage to collections displayed in the shelving in the south and west glazed walls at the loft are caused by either condensation on the glazing or by leaks of wind-driven rain at the glazing/framing joint, or by both.

Glazing condensation in winter may be resolved by source moisture control, provided that the resultant winter relative humidity is not less than the ASHRAE Class B limit of 30%RH or the Class C limit of 25%RH. Glazing condensation in winter may be exacerbated if interior shoji screens are redeployed to illuminance levels at the collection, since installation of the shoji screens may create a cool microclimate at the interior surface of the glazing.

Determination of the actual cause(s) moisture damage is necessary to identify actions to resolve the issue and effectively reduce the rate of deterioration of the original wood framing as well as the collection.

Recommendations
20. Continue monitoring interior and exterior environmental conditions for 12 consecutive months and analyze the data with respect to this issue;
21. Develop a method for observing or monitoring the wood framing near glazing to differentiate moisture originating from condensation or from rain leaks; and,
22. Install and monitor prototype shoji screens for the south and west elevations that are specifically designed to allow air circulation between the room and the glazing surface in order to prevent microclimate-induced condensation (See also Natural Light Damage to the Collection and Interior Architectural Materials/Finishes).

Indeterminate Service Life of the Boiler and Risks of Fuel Oil leaks in the Mechanical System
The remaining service life of the boiler has not been determined; if the remaining service life is less than five years, consideration should be given to replacing the fuel-oil fired boiler with a high efficiency propane or natural gas boiler.

The condition of the exterior, single-wall fuel oil tank and associated piping is unknown. Internal corrosion from condensation may have compromised the wall thickness of the tank, increasing the risk of a future leak. Since there is no spill/leak containment at the tank, a leak would contaminate the soil requiring environmental clean-up. There are no provisions for fuel oil containment at the boiler; a fuel oil leak in the tubing supplying the boiler would contaminate the adjoining crawl space. If fuel oil is to remain the primary energy source for the boiler, then the risks of fuel oil spills and leaks must be reduced.

Recommendations
23. Evaluate the remaining service life of the boiler; before replacing the boiler, evaluate the comparative efficiencies and costs of an alternate fuel source and boiler, such as propane or natural gas; and,
24. If fuel oil is to remain as the energy source for the heating system, replace the existing single wall fuel oil storage tank with a double-wall, UL-listed fuel oil storage tank with rain shield, similar to http://www.roth-usa.com/products_dwt.cfm. Construct a concrete pad for the new tank in accordance with the tank manufacturer's instructions, extending the pad at least 12 inches larger in each direction than the footprint of the tank.

Indeterminate Risks of Water Leaks in the Mechanical System
The condition of the hot water piping in the heating system is unknown; internal corrosion from water chemistry or from galvanic corrosion between ferrous and copper piping, valves and fittings, may have compromised the wall thickness of the piping system, increasing the risk of future leaks, including leaks where piping is concealed.

Recommendations
25. Perform a hydrostatic test on the piping system to determine if there is any pressure loss due to leaks;
26. Remove two samples of piping from the system piping to check for internal corrosion or loss of wall thickness; and,
27. Resolve any problems identified by the two actions above.

Need to Reduce Fire Risk
The space in the Cloister that contains the oil-fire boiler contains exposed combustible wood construction without fire-resistant separation from the rest of the building. A small piece of asbestos cement board directly over the boiler is ineffective in this respect;

The Arts Building and Cloister are not protected by fire detection and alarm system; a fire in the Cloister could spread rapidly to the Arts Building.

Recommendations
28. Install fire resistant finishes over all exposed combustible construction in the boiler room in the Cloister;
29. Install an aspirating smoke detection system, similar to a VESDA (https://xtralis.com/p.cfm?s=22&p=244) for earliest possible fire detection throughout the Arts Building and Cloister.

5.7. Use, Collections and Interpretation
William Whitaker

This report presents research and findings related to the collections housed in George Nakashima's Arts Building and Cloister, particularly an assessment of their significance and use.

The purpose of this survey is to:

- Review historical records, conduct oral histories, and to examine artifacts housed in or associated with the building.
- Provide documentation for assessing the significance of the collection and its integrity.
- Provide policy recommendations for conservation and management planning.

Collections housed in and around the Arts Building and Cloister include Nakashima designed furniture, art objects, folk art, and exceptional slabs of raw wood, as well as a mosaic mural designed by Ben Shahn. This report discusses the collections in the context of the building and their use over time, with particular emphasis on groupings of objects, their placement in particular locations, and how objects served Nakashima's vision for the use of the building.

The report is divided into sections that correspond to areas of the building and the adjacent site. These include the Western approach, the logia, the "Cave", Gallery, Loft, and Cloister. Additional sub-area are discussed, particularly elements in the main space of the Arts Building, the so-called Gallery. Thematic topics open up discussion of considerations relevant to the interiors, including: object labels and didactic texts; hanging artwork; and lighting.

General conservation policy recommendations are highlighted at the beginning of the report. Recommendations for specific locations in the Arts Building and adjacent landscape follow descriptions of individual areas. Lastly, the report provides a set of basic recommendations for administrative and collections management policies and for the physical care of the collections.

The following individuals contributed their insights: Mira Nakashima, Kevin Nakashima, Jonathan Yarnall, Jonathan and Jeb Shahn, Jerry Everett, Soomi Amagasu, Miriam Carpenter, Alexis Rosa Caldero, Heather Isbell Schumacher, and Cesar Bargues.

Introduction

Perhaps more than any other structure associated with George Nakashima's life and work, the Arts Building and Cloister embodies his highest aspirations as a woodworker, as an architect, and as an artist. It is his most personal building; a testament to his lifelong quest for enlightenment and understanding – of nature, of art and of the human spirit– and of his "stubborn efforts…to create beauty and truth in objects and environment."[7]

In its design, the Arts Building and Cloister stands apart. It is selectively positioned and selectively used and the objects associated with its conception and use over time are equally selective. At the same time, it is inextricably bound into an inter-related structure of landscape, architecture, and use. This is not a building conceived by Nakashima for daily life or routine work. It is a place of inspiration and retreat rooted in his personal experience of living and working at a Hindu monastery in south India in the late 1930s. "The monastic life is essential for understanding to be achieved," he said, and it was the discipline inherent in that experience that formed the basis for his own approach to design.[8]

For Nakashima, the Arts Building and Cloister provided a location to gather his most significant slabs of wood. In the beautiful light of this building, a growing understanding of the singularity of a piece was developed. Some of his selections remain to this day, others, as was intended, were transformed by his artistic vision. Examples of his furniture design are also to be found here; early prototypes and masterworks alike. This is one of the only locations where his furniture can be seen together with the raw wood that inspired it.

The building is a venue to celebrate the artistic achievement of his close friend Ben Shahn, among others, and the location he chose to concentrate a display of his collection of folk art and other works that "inspired" him.[9] He invited three Catholic priests, a Zen monk, and a Hindu holy man to discuss the state of the human spirit in this space and together with his wife Marion, celebrated the coming of the Cherry blossoms every spring in the landscape surrounding it. The tent-like space was great for parties and served as an ideal setting for peaceful gatherings too. In fact, the notion that the Arts Building and Cloister should "remain a place of peace" is foremost in the minds and hearts of his family.[10]

With his death in 1990, change came. A building that received and channeled his many energies quieted somewhat. But the community of woodworkers endured and now thrives again. This younger generation still convenes with wood, but rarely use the Arts Building to do so now (it is far easier to store and track slabs in the ample Pole Barn with lifting assistance provided by a forklift). Every once in a while, however, they come across a slab with George's chalk marks on it, revealing a glimpse into how he "read" a piece of wood and conceived of its transformation.[11] His spirit is there. Maybe, in the Arts Building, something of the man endures as well and can be rediscovered in the delicate and considered relationships between objects, building, landscape, and a life spent therein.[12]

7. Soul of a Tree, p.xiii.
8. Curran, Vince. "The Spiritual Pilgrimage of an Ealry 'Hippie'", in T*he Cahtolic Standard and Times*, 13 December 1968.
9. Soul of a Tree, 32
10. Interview with Mira Nakashima, 9 November 2016
11. Interview with Alexis Caldero, 7 January 2017
12. Paraphrasing remarks by John Yarnall, 9 November 2016

Conservation Policies – Summary

The Assessment of Cultural Significance found that the Arts Building is culturally significant as an outstanding work of architecture, and this significance is enhanced through its association with the collection of art, folk art, furniture, and wood slabs, selected and formed by George Nakashima, as well as through the building's integrity of use.

General Policies

Policy 40

Maintain the experience of seeing and interacting with Nakashima's collections within the Arts Building and Cloister. It is a significant collection within a highly significant building, and each contributes to the other.

Policy 41

The active and flexible use of the interior and related furniture for display, meeting, performance, and contemplation, were an inherent part of the original concept and should be recognized and maintained as significant to the Arts Building experience.

Policy 42

Recognize the distinct character of the collections assembled and displayed by Nakashima within the Arts Building.

Policy 43

Maintain the active use of the building by the next generation of woodworkers.

Historic documentation reveals a constant state of change in the display of the furniture, wood slabs, and the folk art objects during Nakashima's lifetime. These objects, and the playful jostling of the relationships between them, are a direct channel to Nakashima's creative explorations and a means of generating new insights and deepening understanding of his art and work from the point of view of today. A connection between the use of the Arts Building and the next generation of woodworker could be encouraged though their involvement in curatorial selections and decisions about displays, providing a means of energizing objects and relationships with contemporary life and practice.

Vulnerabilities

The cultural significance of the building, with respect to use and the objects housed within, is vulnerable from:

1. The need to accommodate an increasingly valuable and fragile collection with the concomitant pressures of continued use, storage, handling, and security.
2. Disassociation or removal of significant objects from the building and the parallel loss of knowledge about the history, provenance, and description of individual objects.
3. The use of the gallery space for the storage and display of non-contributing collections or for other items that have no direct connection to the significance of the building and, thereby, diminish integrity.
4. A specific disassociation of use of the building and collections by the next generation of woodworkers.

Arts Building from Cloister, looking Northwest. November 2015.

General Description

George Nakashima's Arts Building and Cloister was dedicated on May 7, 1967. It was conceived at a time when the architect / woodworker was intensively involved in the creation of a number of sacred spaces for Catholic denominations, including Christ the King Church in Katsura, Japan and Christ in the Desert in New Mexico. In these commissions, Nakashima explored his deep commitment to create "an ideal space for an ideal community."[13] This experience is fundamental to understanding the Arts Building and Cloister.

The Arts Building is composed of three principle areas: the Cave, Gallery, and Loft. Entrance is through the so-called "Cave," a space for a special exhibit of the work of Nakashima's close friend Ben Shahn. This somber space opens into the luminous Gallery. The Gallery includes a number of sub-areas; the platform, fireplace and niche, as well as the staircase. The Gallery serves as a venue for meeting, performance, and contemplation, as well as a display area for extraordinarily slabs of wood and for Nakashima's own designs. The Loft is located above the cave and is accessed by a dramatic, cantilevered stair, and filled with his early works and prototypes, as well as a compelling collection of folk art and objects from early America, Japan, and India. A sliding door provides access to an outdoor balcony for landscape viewing.

Western Approach

The experience of the collections associated with the Arts Building begins on the exterior of the building. Approaching from the West, the large-scale mosaic mural, "Poet's Beard," was fabricated and installed in 1970 based on a sketch made by Ben Shahn prior to his death. This work is intended to be seen at a distance and was done, as Nakashima expressed in a letter to the mosaic's fabricator Gabriel Loire, "in the way of a memorial to Ben, whom we all loved."[14] Above the mosaic, a lively rhythm of five Shoji screens occupy select window niches, marking both the ties to, and the reinterpretation of, the architecture and craft traditions

13. Nature, Form and Spirit, 218
14. Letter, Nakasima to Gabriel Loire, dated 26 January 1970. George Nakashima Collection, James A. Michener Art Museum Archives.
Gift of Mira and Kevin Nakashima.

Above: “Poet’s Beard” and window niches (January 2017)
Below: Window niches without Shoji screens (March 20160

integrated into Nakashima’s design approach. Juxtaposing these translucent niches are nine transparent niches that invite engagement though the compelling display of objects in silhouette; a first glimpse of Nakashima’s collection of Japanese, Indian, and American folk art. The ambiance of the approach, especially in the afterglow of sunset, is subtle and meaningful. Interior lighting plays a key role in creating this effect.

At some point in the recent past, the Shoji screens were removed from the niches and positioned in the south elevation. A free-standing light fixture designed by Nakashima, called a Kent Hall lamp, key to providing illumination of the niches, was also relocated, likely due to the growth of the collections housed on the loft. These changes have a negative impact and should be reversed. Fortunately, the elements survive intact and are easily restored to their proper position.

Policy 44

The configuration of Shoji screens in the loft window niches and the contrast with the open displays of folk art is very significant and needs to be maintained as a character defining feature.

Policy 45

Reposition the Kent Hall lamp to its original location on the loft. Study and integrate its placement as a fixed element into any larger strategy for improving lighting in the building if this is pursued.

Loggia

Nakashima family portrait (July 1967). Kevin Nakashima stands on “Keyhole” next to his parents Marion and George.

Progression towards the Arts Building interior proceeds through a series of refined landscape features to the loggia (a detailed description and assessment of the landscape can be found in the Cultural Landscape Report). The loggia is austere in its character, contrasting smooth, fair-faced concrete and white painted surfaces with the beauty of the rare-wood entry door. Set in the ground to the right of the door is a sculpture entitled, “Keyhole,” contributed to the site by the artist, Masayuki Nagare in 1965; its rough textured, volcanic stone character resonant with that of the door. This piece was the first art object installed at the site (it appears in photos dating from February 1967) and was originally created for as an element in Nagare’s large installation “Stone Crazy” for the Japan Pavilion at the 1964 New York World’s Fair. Nagare became a close friend of Nakashima’s; introduced him to the Minguren Group in Japan (which he became a member of and christened the building in their honor); guided him in his first travels back to Japan after World War II; and assisted in organizing a series of exhibitions that successfully introduced Nakashima’s work to the Japanese market.

Policy 46

To maintain the display of “Keyhole” as Nakashima and Nagare intended.

15. See Appendix I. Arts Building: C. 1980. A Reconstructed Inventory.
16. Prescott, Kenneth. *The Complete Graphic Works of Ben Shahn*; NY, Quadrangle, 1973, 54
17. Ibid, 70,59, & 58

It should be noted that the piece is set directly on the ground and is subject to movement and disruption simply by touching it. Further, the piece is not secured against theft; improving stability and security are a high priority.

The "Cave"

Entry into the Arts Building is through a low-ceilinged space that Nakashima consistently referred to as the "Cave." A cave has monastic references (as a hermit's retreat for example) that certainly resonated with Nakashima's aspirations for the use of the building as a spiritual retreat. This vestibule-like area was carefully designed, furnished, and hung, to create an ambiance appropriate to the building's purpose; as a place of calm engagement and reflection; as an assembly of Nakashima's most significant specimens of wood; as a collection of folk art objects and artworks that inspired him; and as a reference collection of exceptional and early examples of his furniture design.

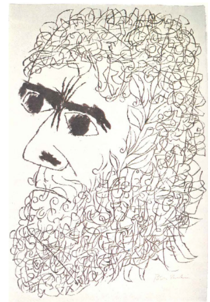
The character and integrity of the cave space, in terms of the objects displayed there, has been altered dramatically in ways that significantly deviate from Nakashima's preferences and intent. Changes have occurred through the disassociation of key objects from the building (through commercial sale or by movement to other buildings), the installation of works which that do not conform to his original intent (such as Nakashima's awards and examples of his early, Beaux-arts era student work), and by the adaptation of the space to include archival and collections storage and some open-access shelves (encompassing rare books, woodworking tools, and other personal possessions, such as suitcases). The latter, in particular, diminishes the quality of the visitor experience while raising special concerns for collection safety and security.

Historically, the dominant feature of this area was an installation of at least six framed serigraph prints by Ben Shahn – all housed in custom-made Nakashima frames. Shahn's prints surrounded visitors in this space and most, if not all, were installed in May 1967 and remained in situ (with possible minor shifts) until the late 1990s – almost a decade after Nakashima's death. It is assumed that Shahn and Nakashima collaborated on the placement of these works and that the hang was intended to convey a special meaning or resonance.15

For example, Shahn's *Maximus of Tyre* (1963) is the first work to be viewed upon entry. The piece portrays a figure with a mighty hand and an outstretched arm as "powerful symbols of Divine liberation."[16] Further, the placement of Shahn's *Poet* (1960) – installed in the dominant niche to the left upon entry – captures the intensity, focus and commitment of the artist (in this case one who expresses in words rather than wood). This work is presented-altar like-on a rough plaster background flanked by two, cast-iron candlesticks from Japan; top-lighting adds to the altar-like effect. Of additional significance is the relationship between Shahn's print, *Poet* and his design for the mural, *Poet's Beard* installed on the exterior wall of the Arts Building. Did the placement of one inspire the design of the other? Or vice versa?

Poet is flanked by Shahn's *Ecclesiastes* (1966) and *Gandhi* (1965) in niches to the left and *Branches of Water or Desire* (1965) in a niche the right.[17] The niches were originally papered panels of a Japanese bark paper and two other different

From top to bottom:
"Cave" interior with awards and student work (January 2017)
"Cave." Shahn's "Poet" (left) & "Maximus" (right; ca. 1980)
"R" bench with wood plank lean-to display, 2001
"Cave" interior, w/ non-contributing collections storage (January 2017)

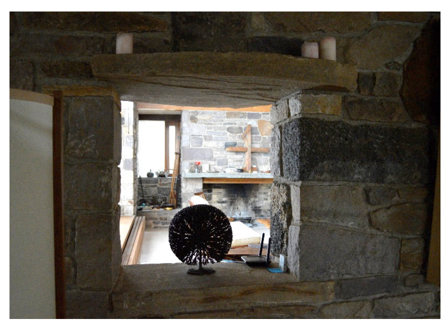



From left to right: Ben Shahn. “Maximus of Tyre,” “Poet,” “I Think Continually…” (shown in situ, May 1967), and “Gandhi.”

patterns (Nakashima’s use of this traditional, folk art, is a display in and of itself). Note should also be made of the horizontal planks that support the framed works which, in their configuration, make reference to elements found in sacred spaces, particularly retables or reredos.

Associations with social justice and civil rights can be seen in Shahn’s *Gandhi* and *I Think Continually of Those Who Were Truly Great* (both 1965). The latter, positioned alone in the soft light of the south facing shoji-screened window, had a poignancy resonant with the work itself – dedicated to 10 martyrs of the civil rights movement killed in Alabama during 1963-65. The Nakashima family’s own experience of injustice and persecution at the hands of the U.S. government in WWII may underlie the special placement of this piece.

The Cave housed three pieces of Nakashima furniture specifically created for the space, including an American Walnut “R” bench and a Chest made from French Walnut (both eight feet in length), with the latter surmounted by a table lamp. The “R” bench is currently housed in the Conoid Studio. The chest was sold to Etsy Stowell in the late 1980s (by Nakashima himself), and while there is a table lamp housed in the Arts Building (on display in the loft area), it does not match—but is close in character to—the one shown in historic photographs.

From left to right:
Internal opening (January 2017)
West to east axis, with large niche at center (January 2017)

The internal opening in the rubble stone wall, elegantly proportioned and detailed (incorporating a pair of volcanic stones given by Nagare in the spring of 1964 as construction began), is a significant element related to Nakashima’s original organization. This element serves to provide visual relief and natural light to the cave space. It also energizes the visitor’s arrival, reinforcing the south to north direction of entry while setting up an important shift in axis, traveling west to east. The placement of collections within this opening, as well as in the space beyond, must be strictly controlled to maintain a high standard of appearance that does not become cluttered or distracting.

Nakashima contrasted strong, geometrical elements—as seen in the coffered ceiling of the cave and the related, vertical piers defining the wall niches—with irregular elements, like the random flagstone floor and rubble wall. The placement of furniture and objects in this space must be carefully controlled, for both visual continuity and artistic integrity. Subtleties of materials and scale must be appreciated and understood, contrasts of light and dark (as well as color) embraced, and the logic of the part (in this case the "cave") to the whole maintained.

Turning eastward, toward the "gallery," visitors were energized by a display of an extraordinary twelve foot tall plank of English walnut silhouetted against a luminous space. Perpendicular to this piece is an improvised, "light sculpture," assembled from one English Oak Burl slab and the "mate" of the English walnut slab. These elements have a powerful presence, spiritual perhaps, that would be intensified in in the late 1970s as Nakashima gathered his most prized slabs together in the Arts Building. Since the mid-1970s, slabs have come and gone from the Arts Building, some selected by Nakashima remain as unique testaments to his artistic spirit and vision.

Above: Silhouetted English walnut plank and "light sculpture), 1967

Below: Existing conditions (January 2017)

Policy 46

Restore the "cave" to its former use as a focused display of Ben Shahn's works with an integrated selection of furniture by Nakashima. Solicit return by donation or purchase of the original 8'-0" French Walnut Cabinet. If this is not possible, consider reconstruction or purchase of a similar cabinet.

Policy 47

To respect the internal opening as a significant element related to Nakashima's original organization and the need to provide visual relief and natural light to the cave room. Care should be taken in the placement of collections in this opening and the space beyond so the view does not become cluttered.

Policy 48

To recognize the coffered ceiling as a character defining feature that must be maintained. Mounting lighting or other interventions that diminish integrity must be avoided.

Policy 49

The closet in the cave is not a significant space, and alteration would be acceptable.

Policy 50

To restore the display of extraordinarily wood slabs within the cave and as part of the transition to the gallery as a highly significant, character defining element.

Gallery with Minguren IV table, Conoid Chairs, “light sculpture”, loft with cantilevered stair and platform (May 2016)

Gallery

The principle space of the Arts Building is the Gallery. It is an “L” shaped room measuring approximately 30 feet by 30 feet. The north and east walls of the space are defined by solid masonry—a structural necessity related to the dynamic, hyperbolic paraboloid roof. The up-swoop of the roof opens dramatically on the south and west facades. Intricately detailed windows combining shoji screens, vertical louvers, and deep niches for object display, animate the space. The cave, surmounted by the loft, is inset in the south west corner of the plan.

The gallery is a flexible space that has been used for the display of works of art on paper (Ben Shahn Print Collection exhibition, May 1967 to ca. fall 1973), for the display of a selection of Nakashima’s most valued slabs of wood (ca. 1974 to c. 2003), and in recent years for a combined display of the remaining wood slabs and a group of monumental, watercolor renderings that Nakashima made in the late 1920s as a student of architecture at the University of Washington, M.I.T. and the American School at Fontainebleau.

Integral with these displays are groupings of furniture that Nakashima designed and made specifically for the Arts Building, as well as individual examples brought to the space on a semi-permanent basis or for short term periods. Nakashima intended the Arts Building to serve, in part, as a showroom for his furniture designs and this remains a significant use of the building. Furniture is moved and reconfigured in support of events held in the Arts Building. Some pieces were designed to uniquely support those events and uses and are of exceptional value. These include the: Tatami Platform, 8’ American walnut “R” bench, large English walnut bench (with extraordinary slab), and Minguren IV dining table.

In documenting the use of the building, it is clear that the works of art, furniture, and extraordinary wood slabs are enriched by the building and vice versa.

The most significant change to the use of the space involves the storage of four very large didactic text panels created for the “Full Circle” exhibition in 1989 and

Right: Tea Ceremony w/ Tatami platform
and “R” bench Aug. 1969
Left: “Renata and Hans,” Arts Building
reception, May 1973

Indian Classical Music concert with Tatami
and bench, May 1977

Left: “Hanami” flower viewing, May 1968
Right, above: Catholic Art Conf., GKN
seated at Minguren IV Table, 1969
Below: Nakashima Family, Minguren IV
table & lamp, July 1967

Current conditions (January 2017)

stacked along with the wood slabs. While housed in Nakashima frames, these are quite intrusive and serve to confuse visitors who start to read the text. In addition, the East wall (as well as a wall in the Cave and an area above the stair), have been given over to a display of Nakashima's Beaux-arts era student work. Beautiful such as they are, consideration should be given to restoring the display of wood slabs. These have been concentrated in the corner without any space to view or appreciate their wonder.

Policy 51

Maintain the gallery foremost as a space that celebrates the display of important furniture by Nakashima alongside a selection of large, wood slabs that were especially valued by Nakashima. The space should also be available for meetings, performances, and contemplation.

Policy 52

Recognize that the use of Nakashima's furniture in the gallery as significant and that fixed, museum-like display should be avoided.

Policy 53

Recognize that the Tatami Platform, 8' American walnut "R" bench, large English walnut bench (with extraordinary slab), 12' tall English walnut "light sculpture," and Minguren IV dining table are of exceptional value to the use of the space and the appreciation of Nakashima's art and should be maintained as elements integral to the building.

Policy 54

The periodic rearrangement of the gallery is welcomed, as it provides fresh opportunities for the display of the collection and the understanding of the building. However, the constraints imposed by the building should still be respected.

Policy 55

Colonization of the Arts Building gallery as a long-term storage space is inappropriate. The exception is the use of the space for activities related to the fabrication of a Peace Altar.

Platform

Located in the southeast corner of the gallery, the platform measures approximately 40 inches square, raised about 10 inches off the floor to conceal a water pump. The location has long been reserved for the display of metal sculptures by Harry Bertoia. A sounding sculpture acquired by the Nakashima's in 1974 was installed in this location and replaced a more diminutive work by Bertoia, entitled "Dandelion" (acquired before 1964 and now displayed in the internal opening of the cave wall).

The platform is intended to be an austere display, a focal point visible from both the Gallery and from the Cave (as an element in the arrival sequence). The view should be carefully composed and considered. As it is currently installed, the platform presents a jumble of unconnected objects. On the platform, visitors see the Bertoia, but also a black lacquer box and telephone. Ben Shahn's "Gandhi" is hung on the stone wall, but awkwardly blocked from view by the Bertoia. Flanking this haphazard group, is a hanging wall shelf with free edge (marked on the bottom, "Krosnick"), repurposed as a display for a hanging scroll (It has been turned vertical and tucked in between the wall and sliding door frame). This significantly diminishes the quality of the view from the Cave (as does the location of a stack of walnut slabs opposite it).

Platform, existing conditions (January 2017)

Policy 56

Recognize as significant the austerity of the platform and to restore the composition to a more appropriate display.

Fireplace and Niche

Like the platform, the fireplace and related niche were conceived to be carefully composed ensembles. In the fireplace niche, preference was given to folk art and traditional Japanese flower displays or Ikebana. Early views show a grouping comprising one hand carved wooden candle holder (made by Santiago Riva, of Santiago, Spain for St. Martin's Church in New Hope) set on the window ledge, a flower arrangement in a decorated pot on the lower ledge, a cast iron pot hanger (called a jizai-kagi, or adjustable pothook used in many Japanese farmhouses) hung from the beam above, and a pane of antique European stained glass (depicting a beastie) that hung at the top of the operable window in the niche. These elements remained in place until repairs to the beam above required their removal. These were not reinstalled.

Above: Fireplace niche (May 1967
Right: Existing conditions. Minguren I coffee table in foreground (January 2017)

The rubble stone wall area over the mantle was initially used for the display of artwork by Ben Shahn. An original work by the artist, in the form of Japanese calligraphy, hung here from 1967 to about 1977 when it was relocated to the Reception House and installed in a carefully conceived composition near the dining table. The stone mantle initially shows use as a location for the display of a single cast iron pot (possibly used as an ashtray), but later, additional folk art collections began to be assembled there. Recently, Nakashima's grave marker, made by his grandson, Ru Amagasu, was put on display.

This fireplace and niche are visible from the entry through the interior opening. It is important that this space be maintained with an austerity of character.

Policy 57

Restore the display of folk art in the fireplace niche, recognizing it as a significant element. The display should be austere.

Fireplace Seating Group

The grouping of furniture by the fireplace was created in the mid-1970s during the transition from use of the gallery as a display space for works of art on paper (the Ben Shahn Print Collection) to a space dominated by the display of wood planks and Nakashima designed furniture. The key element in this ensemble is the magnificent, oak burl Minguren I coffee table (1968), a masterwork by Nakashima.

Photographs dating from the mid-1970s to mid-1980s confirm that the Minguren I coffee table was displayed with a pair of Lounge Chairs with Arms, one left and one right. These chairs were made specifically for the Arts Building and installed in 1968.[18] A Settee with no arms (made in 1956) completes this grouping (and was likely moved from the Showroom). In addition a lounge chair without arms, made in 1966, is often seen in the vicinity of this group and can be counted as a contributing element.

Currently, this grouping has been altered to include two Conoid Cushion Chairs as well as by the inclusion of a Nakashima designed rug produced by Edward Fields. The Lounge Chair with Arm (left) is now located in the Showroom building. This change has the effect of compromising the visual continuity of the original grouping, which allowed for better viewing of the Minguren I coffee table and, from a seated position on the Settee, the displays of wood slabs beyond. The connection between the raw slabs of wood and the finished coffee table is significant.

Policy 58

Recognize the display of furniture related to the fireplace as a significant element that should be restored. Recognition should be given to the possibility that the Minguren I coffee table may be requested for loans to exhibitions and that this should be allowed.

Sliding Doors to Verandah

The view out the sliding glass doors in the south façade, through the verandah, to the large stone (an inspiration in the siting of the building) is significant. A variety of chairs (including a pair of Conoid Cushon chairs) have been placed flanking the doors, but never blocking the view.

Policy 59

The view from the interior of the gallery to the large stone near the pond is significant and should be maintained.

Staircase

A major element of the interior of the Arts Building is the staircase comprising wood slab treads dramatically cantilevered out of the masonry rubble wall. The element is a tour-de-force of Nakashima's design sensibilities; the interrelationship

From top to bottom:
English oak burl Minguren table with Lounge Chairs with Arms
Conoid Cushion Chairs (left; Jan. 2017)
English oak burl Minguren table with Lounge Chairs with Arms
Conoid Cushion Chairs (left; Jan. 2017)

18. Both are marked on the underside of the seat, "Arts Bldg."

of furniture examples on view in the showroom space, particularly Conoid Chairs in teak, Rosewood, and oak, should be maintained.

The display of framed artworks on the masonry wall directly above and below the staircase at different periods has been unsatisfactory. There space is inadequate for viewing from a curatorial as well as a life-safety point of view.

Policy 60

The staircase is of exceptional significance and should be maintained without alteration.

Policy 61

The staircase should not be used as a place for display.

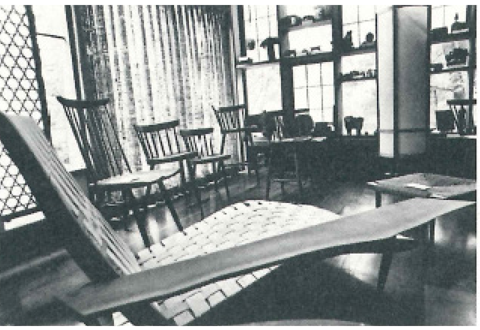
Loft

Where the Cave space is darkened and somber, the Loft is light-filled and exuberant. Nestled under the uplifting roof, the Loft provides display space for furniture, folk art and objects. Direct access to the outdoor balcony is provided through a sliding door; an especially beautiful prospect from which to view the landscape and spring bloom. Views to and from the gallery level are significant as well—the back-lit folk objects are a compelling and carefully conceived focus.

Visitors reach the loft via the cantilevered staircase. The South and West wall of the Loft are exterior to the building (the North and East overlook the Gallery). The west wall comprises a series of 21 window niches, 5 of which house shoji screens placed in a dynamic composition. Tucked within the niches is a lively display of folk art and objects. The southern wall features an exceptional shoji screen, permanently installed. This panel, distinctive for the hexagonal pattern, was made in Takamatsu, Japan by Kiyoshi Konishi – a founding member of the Minguren Group. The floor surface is part concrete (about a third) and part wood (two thirds) and slightly raised. Early, first-of-a-kind, examples of Nakashima's furniture are exhibited here (over 20 pieces).

Nakashima created two significant pieces of furniture for the Loft area, including a built-in Conoid Bench with Double Back and adjacent to it a built-in Side Table. Research has revealed that the original Side Table was replaced, although when and why this occurred has not been documented. The initial furniture display included these pieces, a Desk Lamp, Long Chair (which remains on view), and a Kent Hall Lamp (currently used in the Cave). The Kent Hall Lamp (named after a design he created for Columbia University) provides illumination and scale to the loft area and plays a significant role in providing even uplight for the ceiling and in the backlighting of the folk art displays. The latter being an integral element in the approach to the building at night.

Nakashima actively engaged with the display of the Folk Art and Objects. He clearly enjoyed revising the installation and exploring new combinations and juxtapositions. The bulk of the objects on view were acquired during his trips to Japan and India during the late 1960s, through gifts from close friends (including Ben and Bernarda Shahn, Stanley and Nita Brogren, and Father Peter Sidler to name a few), and from family collections. There are a number of items with



From top to bottom:
View to loft from gallery (ca. 1980)
Furniture and folk art display (1979) – note Kent Hall lamp
Current display of 18 pieces of Nakashima furniture (Dec. 2016)
Furniture and folk art display (December 2016)

specific connections to his Minguren group colleagues. Period photographs and descriptions reveal his preference for a playful jostling between individual objects over more formal thematic or geographical displays. His installations are dense, but never crowded.

The objects housed and displayed on the loft are particularly vulnerable when the building is opened for events and public uses. The furniture, often first-of-a-kind prototypes, are not as robust as those housed on the gallery level where use is encouraged. In addition, the folk art and objects are displayed on open shelves, raising concern for their safety and security if left unsupervised. Today, the display has become overburdened by objects, many of which were added in the years after Marion Nakashima's death.

Policy 62

Maintain the loft foremost as a space that celebrates the display of early prototypes and designs by Nakashima and as the primary location for the installation of his collection of folk art and objects.

Policy 63

The periodic rearrangement of the loft furniture and folk art displays is welcomed, particularly as a strategy to continue Nakashima's intent and preferences for their exhibition and to reduce the density of the currently display. Constraints imposed by the conservation and security needs of individual objects should be respected, but solutions should not compromise the original design intentions for the building.

Policy 64

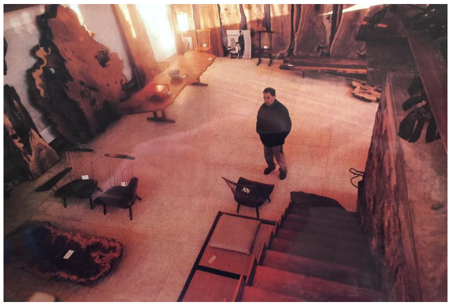
Recognize that the built-in Conoid Bench with double back, adjacent built-in Site Table, and Kent Hall Lamp are of exceptional value to the use of the space and should be maintained as Nakashima situated them.

Mock-up of loft furniture and folk art display based on 1979 photography. Note position of Kent Hall lamp.

The Arts Building gallery interiors are also determined by a series of other considerations:

Didactic Texts and Object Labels

Nakashima's initial exhibition of the Ben Shahn Print Collection provided visitors with a printed checklist. Didactic labels appear in photographs during the late 1970s on selected furniture and with some of the folk art exhibits. Object labels are now associated only with the display of folk art. Given the domestic character of the space (and Nakashima's preference that furniture should be experienced), it may be surmised that the use of object labels—particularly for the furniture—proved to be unsatisfactory. Labels for selected examples of the folk art were made by Soomi Amagasu are quite handsome and are printed on fine paper using Nakashima's favorite font. These are supported by a small wooden block made by Nakashima's grandson, Ru Amagasu.



Gallery interior ca. 1982 with object labels on furniture and with selected objects
Label made by Soomi Amagasu in 2002

Policy 65

The use of object labels should be carefully studied and strictly controlled to maintain the domestic character of the space and to avoid visual clutter.

Hanging Artworks

Several different solutions for hanging framed works of art were used in the Arts Building that are distinctive and worthy of maintaining. In the cave, Nakashima created custom designed frames for works by Ben Shahn that were self-supported at their bases on furniture or special shelve units (there is insufficient information to determine if these works were "tethered" to the wall for safety; but current examples suggest this as a possibility). This is an unusual system of display that recalls carved altar screens (reredos or retables).

Right: Shahn's "I Think Continuously…" at Mira's (Jan. 2017) and "Cats Cradle" as displayed in Conoid Studio

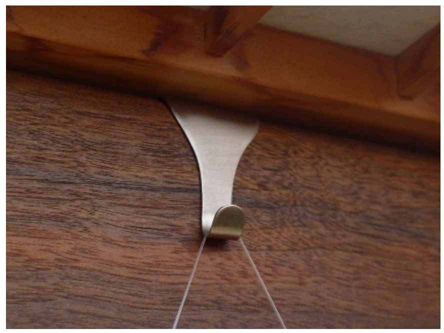
Nakashima took care to protect the material integrity of wall surfaces, especially in the Gallery. Here, a distinctive band of darkened plaster denoted a zone for hanging. Works hung in this area were center aligned at an approximate center height of 66 inches using a steel cable hanging system. This hardware consisted of a custom-made wooden hanger (made by Nakashima) that "hooked" to the top of the wall. This hook was carefully positioned to maintain the vertical alignment of the cable which was extended down to the desired hanging height and attached to the frame. Currently, an off-the shelf system of stainless steel hooks is used in the Cave area.

Nakashima also used conventional hanging hardware and even hung art on curtains and shoji screens for the Ben Shahn Print exhibition.

The recent installation of framed works made use of a wire hanging system, but this deviated from Nakashima’s preference in the askew angling of the wires. In addition, large screw-type hooks were fastened to concrete and wooden ceiling beams at a number of locations.

Policy 66

Ensure that the installation of collection displays do not leave the fabric of the gallery with a progressively increasing collection of drilled holes and minor alterations that affect its visual appearance and integrity and that new installations conform to Nakashima’s preferences, reuse of existing fittings and the overall approach to hanging should be maintained.



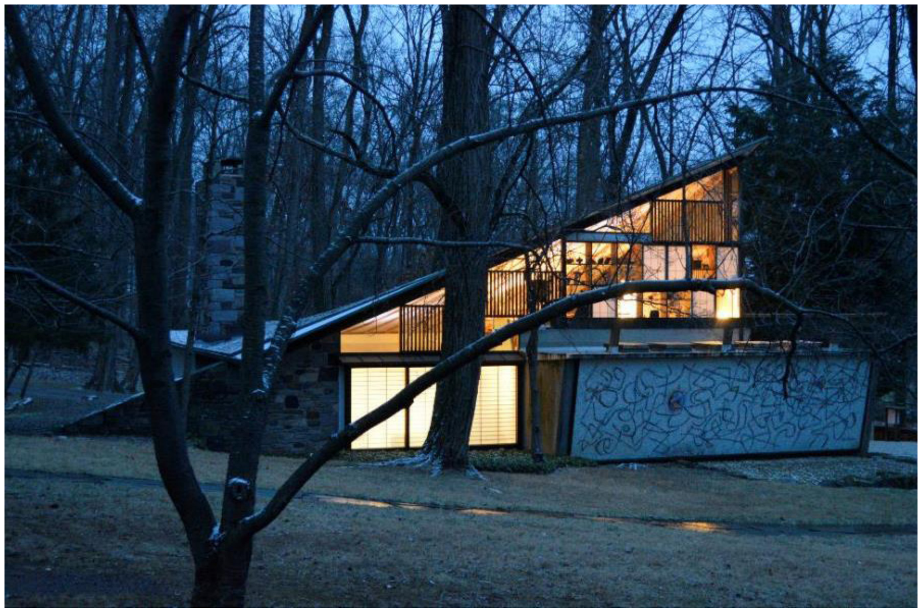
Right: Picture rail and cable hanging system, May 1967
Left: System used in Cave, hook of stainless steel (January 2017)

Detail of framed works hung on shoji screens, May 1967

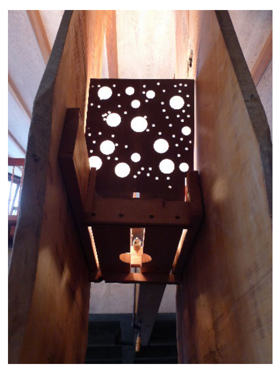
Hook hanging system showing holes drilled into concrete and wood. Screw anchor in masonry wall (January 2017)

Lighting

The lighting installation throughout the building was based on the use of hanging Akari Light Sculptures by Isamu Noguchi and floor and table lamps from Nakashima's existing catalogue of designs. Care was taken in positioning the lighting for both compositional and functional purposes and these relationship should be maintained. Nakashima improvised a "light sculpture" composed of 12 foot tall, book matched English walnut planks to illuminate the ceiling, an effect that conveys a special ambiance to the approach from the west. Path lighting is provided for special events thought the use of paper lanterns.



Dusk with Kent Hall lamp positioned on loft (January 2017)



Nakashima's "light sculpture" seen in 1972 with current side view and mechanics, January 2017

The paper Akari lamp associated with the platform has been replaced at least twice. The current fixture, while conforming in size (22 inch diameter) and character, does not bear the Noguchi stamp of authenticity. The lamp under the stair has also been replaced a number of times. The source and design of the unusual elongated original installation remains unknown. Originally, each was presented tightly to a wooden mount. Now, each shows a significant separation of mount and support; additionally the platform lamp has been lowered 18 inches and now hangs at 62 inches off the floor. The original height to bottom is estimated at 80 inches.

Nakashima outfitted the interior with a selection of his own designs, including a desk lamp in the Cave, a table and floor lamp in the Gallery, and a Kent Hall Lamp on the Loft. All but the Kent Hall lamp were repositioned according to need. At present, the floor lamp is housed at Mira's House—exchanged for a second Kent Hall Lamp. Judicious additions of Nakashima lighting could be explored.

Policy 67

The character and position of the light fixtures is an important design element which should be maintained. A color temperature range of 2700-2800K should reflect the incandescent light that was seen by Nakashima. Warm-white florescent bulbs were used in the Kent Hall lamp.

Policy 68

Any program to improve lighting conditions within the Arts Building must not compromise the original design intentions for the building.

Cloister

The cloister is a modest, utilitarian structure, connected to the Arts Building by a covered walkway and porch. A combined bath and kitchen connect to a living-sleeping room; a design reminiscent in character to Nakashima's Monastery of Christ in the Desert. The interior is simple, but thoughtfully furnished with Nakashima designs. Lighting is by Noguchi along with a desk lamp made in Takamatsu, Japan. Artwork by Nakashima's long-time friend, Dorothy Grotz (whose work can be found throughout the campus), and wall hangings collected in India in 1964, adorn the walls.

Policy 69

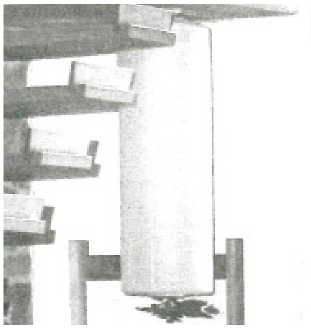
The cloister is an essential component of the Arts Building complex and its use and character should be maintained.

Policy 70

The archive room is not a significant space, and alteration would be acceptable

Policy 71

The combination bathroom and kitchenette is a space of significance and should be respected.



From top to bottom:
Platform lamp, August 1969
Current condition, January 2017. Note sagging in position of light, down over 18 inches.
Detail of lamp under stair, May 1973.
Existing condition, January 2017.

Administrative and Collections Management Policies

Collections are held in trust for the public and are made accessible for the public's benefit. It is crucial to maintain legal, ethical, and professional standards by establishing policies to support and guide the mission, operations, and decision-making of the collection. Institutional policies give the governing authority and staff the means to fulfill its responsibilities as stewards of collections. Following the mission statement, collections management is governed by establishing all of the policies and procedures connected with collection acquisition and management.

Recommendations

1. Expand the mission of the Nakashima Foundation to include the collecting, preserving, and interpreting of artifacts related to the life and work of George Nakashima in general and, specifically, works that contribute to the historical value of the Arts Building and Cloister as an integrated environment. Commitment at the board level is the highest priority and provides the legal framework around which the Foundation's collection can be established.

2. Draft key policies and procedures for the management and development of the Collection. Working with a curatorial or archival consultant, create a working collections development policy dedicated to reinforcing the significance of the Arts Building and Cloister. This is a high priority that needs to be carefully considered. Because of the significance of this policy, it should be a document formally adopted by the Foundation board. Policies related to the appraisal of objects for their historical significance and relevance to the collecting mission, accessioning and de-accessioning policies and procedures, as well as systems to maintain intellectual and physical control of the collection, should be prioritized. Disassociation of objects from the Arts Building is a serious concern that these policies will help address and control. A collections development policy provides the mechanism to consider additions to a collection, who has the authority to accept collections, and if the collection should be accepted or not. Create a template for a "deed of gift" based on best practices.[19]

3. Transfer legal ownership of objects determined to be of exceptional value and significance in maintaining the authenticity of the Arts Building and Cloister to the Foundation as quickly as possible. This is a high priority. It is important to recognize that the above referenced legal framework must be in place; a collections development policy agreed upon; and that decisions about gifting objects to the Collection rest with individuals and may be governed by long-term estate planning. Ensure that there is adequate space in the building to receive new collections.

19. Refer to the Society of American Archivists *A Guide to Deeds of Gift*, at http://www2.archivists.org/publications/brochures/deeds-of-gift

Physical Care of Collections

Preservation and safe access are the primary goals of collections management. Physical care of collections is controlled through a complex interrelationship of allocation and use of space, access, environmental control, furnishings, housing, and risk management. Mission and policies on professional standards guide all facets of collections management.[20]

Recommendations

1. Draft polices related to the handling, storage, housing, and exhibition of collections recognizing that a significant value associated with the Arts Building and Cloister is the continued use of the furniture and collections presented within. Engage an objects conservator to conduct a conservation needs assessment for the furniture, objects, and artworks as a means of guiding the development of policies. Identify individual items where use should be limited or restricted due to condition issues or on the basis of other criteria to be determined.

2. Create a dedicated collections storage and work area in the Cloister, north room. Remove business records, packing materials, and other "non-collection" items currently held in this location. Consult with an architect or engineer about improvements to this space to optimize environmental conditions for collections storage and security. Use this area to store items that contribute to the significance of the Arts Building and for related collections management records.

   This space may also serve as a holding area for objects that the Foundation is considering accessioning but may lie outside the collection development scope of the Arts Building. Nakashima's set of woodworking tools, for example, may be of value for interpretive purposes, but do not fit as elements for regular display in the Arts Building. Such items should be distinguished in their storage and cataloguing from collection materials specific to the Arts Building.

3. Take advantage of the loft, particularly the raised wood-floored zone, to delineate a restricted access, "hands-off" area that includes the adjacent window niches. This division can be reinforced, if necessary, by non-intrusive signage or other barriers. Active use of the furniture can be permitted elsewhere in the Arts Building. In fact, in keeping with Nakashima's preferences, this should even be encouraged. The loft, however, provides a natural division and an added layer of control and security that can be easily exploited to improve the physical safety of selected fragile or rare collection objects. In a very large public event, access to the loft can be closed off altogether. Visitors will appreciate the clarity of knowing that it is ok to touch downstairs, but not upstairs.

20. Refer to these resources for additional information. AAM: Direct Care of Collections Ethics, Guidelines and Recommendations, April 2016 http://aam-us.org/docs/default-source/default-document-library/direct-care-of-collections- ethics-guidelines-and-recommendations-pdf.pdf?sfvrsn=2