

Mitchell Park Horticultural Conservatory

Milwaukee Co., Wisconsin

Name of Property

County and State

United States Department of the Interior

National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in National Register Bulletin, *How to Complete the National Register of Historic Places Registration Form*. If any item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions.

1. Name of Property

Historic name: Mitchell Park Horticultural Conservatory

Other names/site number: Mitchell Park Domes

Name of related multiple property listing: _____

(Enter "N/A" if property is not part of a multiple property listing):

2. Location

Street & number: 524 South Layton Boulevard

City or town: Milwaukee State: WI County: Milwaukee

Not For Publication: Vicinity:

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended,

I hereby certify that this nomination request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60.

In my opinion, the property meets does not meet the National Register Criteria. I recommend that this property be considered significant at the following

level(s) of significance: National Statewide Local

Applicable National Register Criteria A B C D

Signature of certifying official/Title:	Date
Trisha Canaday, Wisconsin State Historic Preservation Officer	
State or Federal agency/bureau or Tribal Government	
In my opinion, the property <input type="checkbox"/> meets <input type="checkbox"/> does not meet the National Register criteria.	
Signature of commenting official:	Date
Title:	State or Federal agency/bureau or Tribal Government

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6. Function or Use

Historic Functions

(Enter categories from instructions.)

AGRICULTURE/SUBSISTENCE:
Horticultural Facility

Current Functions

(Enter categories from instructions.)

AGRICULTURE/SUBSISTENCE:
Horticultural Facility

7. Description

Architectural Classification

(Enter categories from instructions.)

MODERN MOVEMENT: Mid-Century Modern

Materials: (enter categories from instructions.)

Principal exterior materials of the property: CONCRETE; STONE: Beach Stone; METAL: Aluminum; GLASS

Narrative Description

(Describe the historic and current physical appearance and condition of the property. Describe contributing and noncontributing resources if applicable. Begin with a **summary paragraph** that briefly describes the general characteristics of the property, such as its location, type, style, method of construction, setting, size, and significant features. Indicate whether the property has historic integrity.)

Summary Paragraph

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Narrative Description

Methodology:

The Mitchell Park Horticultural Conservatory (Mitchell Park Domes) has an extensive construction record and published history. New History, Inc (formerly Preserve, LLC) utilized primary sources in the Milwaukee County Parks records as well as secondary sources and accounts published in local newspapers and trade press to compile a history of the Domes, a record of modifications over time, and the state-level statement of significance. To document the Domes' national level of significance as the work of master engineer Charles Whitney, New History reviewed and analyzed Whitney's papers and publications, as well as secondary sources that summarize his achievements. The basis for this nomination is a Nomination Questionnaire submitted in 2016 and the subsequent response from Ms. Peggy Veregin dated April 13, 2016, stating that the building may be eligible for listing on the National Register of Historic Places.

In 2019, New History conducted a site visit to confirm existing conditions, research findings, and prepared a draft National Register Nomination. The listing effort for the property was placed on hold prior to final completion and submittal to the Wisconsin State Historic Preservation Office. In Fall 2025, the pursuit of National Register listing was restarted, and New History was engaged to complete the Nomination. Site visits and additional research was conducted in order to confirm and expand on findings from previous efforts.

The State Historical Society's *Cultural Resource Management in Wisconsin* was used as the foundation of all research, providing context and direction.

A few notes on terminology:

While the official name of the complex is the Mitchell Park Horticultural Conservatory, the project was known as the Mitchell Park Domes in local press and planning documents even prior to completion. This served it to distinguish it from the previous conservatory building on the site. More recently, the property has become increasingly referred to as the Milwaukee Domes. For the same reason, "Mitchell Park Domes" or simply "the Domes" is used throughout this document to reference the current building. Historically, the Domes were also referred to as "Houses." This terminology is used selectively when discussing early planning phases of the project and referring to specific historic documents.

The building is oriented with the main entrance facing southwest. This elevation with the main entrance at the center is referred to as the front or entrance elevation in keeping with original drawings. As a collection of circular structures, the Domes do not have clear orthogonal elevations. The narrative descriptions are instead organized by building elements: Entrance Pavilion and Lobby, Domes (A, B, and C), Transition House, Air Lock and other back-of-house spaces, and Greenhouse Addition.

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Summary

The Mitchell Park Horticultural Conservatory (Mitchell Park Domes) is located at the northwest corner of Mitchell Park, a 60-acre park on Milwaukee's near south side. Mitchell Park is one of five original public parks established in 1890 by the Milwaukee Board of Park Commissioners, the city's first parks board. The park was designed by architect Henry C. Koch and Company and featured a pond for recreational boating as well as a conservatory and gardens. Mitchell Park is also located south of a bend in the Menomonee River and the associated valley, making it appear significantly higher in elevation than land to the north. The bend in the river results in a predominant view corridor of Milwaukee's central business district from certain sections of Mitchell Park. The area surrounding Mitchell Park is hilly and predominantly industrial with businesses located south of the park. Residential development is concentrated in the blocks south of Pierce Street along the park's southern edge, characterized primarily by Queen Anne, Bungalow, and Colonial architectural styles. Most visitors to the Domes arrive by car, bus, or bike. Although the Domes are visually tied to the park like setting of nearby Mitchell Park, it is a distinct and separate entity from the park itself currently co-managed by Milwaukee County Parks and the Milwaukee Domes Alliance (MDA).

The Domes were commissioned in 1954 to replace an earlier conservatory on the site (constructed in 1898). In 2013, a large greenhouse facility was added to the back (east) side of the Domes consisting of a series of interconnected greenhouse structures. Despite its size, the addition is well hidden by the Domes from most of the primary view corridors. The greenhouse addition is not open to the public except during special events and is used to cultivate plants for the entire Milwaukee County parks system. The largest greenhouse in the addition is also used as an event and exhibition space. The uses of the Domes have expanded over time. At present, the Domes serve as a conservatory, an ecological museum, a horticultural educational center, an event space, and a living plant museum.

There are a total of two contributing resources and two noncontributing resources within the National Register boundary (Figure 3). The Domes facility itself, erected from 1959-1967, is considered contributing. Two nonhistoric additions including the Education Center Addition (c.2000) and the Greenhouse Addition (c.2013-2014) are connected to the primary building. The Reflecting Pool Walls found in the entrance plaza that surround the Domes are also considered contributing. Although the reflecting pools themselves were removed in the early 2000s, the walls were left as a visual reminder of this feature of the plaza's original design. A noncontributing sign with a lighted display screen is located on the north side of the turn into the Domes complex from South Layton Boulevard. The Flex House Greenhouse was erected in 2013-2014 along with the Greenhouse Additions but is a separate free-standing structure on site. It was constructed outside of the period of significance and is therefore considered noncontributing.

From the entrance sequence, the exterior of the Domes appears almost exactly as it did when the building opened in 1967. Landscape features around the entrance and sides as well as the arcaded entrance feature have been modified but retain the approach and plaza aspects of the original design (landscape modifications are described in more detail in the following sections). The interior of the lobby and support spaces was substantially remodeled in 2008 to provide

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upgraded public restrooms, address new ticketing processes, and accommodate the growing demand for event rental space. Many original features are retained. The interiors of Dome B (Tropical Dome) and Dome C (Arid Dome) are highly intact. The interior landscape features of Dome A (Show Dome) were intended to change with various exhibitions and events; the original structural and architectural features remain intact. The Transition House, a smaller greenhouse with a round glass hip roof, is also highly intact. The concrete dome space frame, highly innovative during a time when architects and engineers were experimenting with the limits of concrete construction, has suffered in the moist environment due to leaking glass and interior humidity levels. For a period during 2016, the Domes were closed due to falling concrete. A network of mesh netting was added to the interior of each Dome to ensure no additional concrete fell within the Domes themselves. This netting is a temporary fixture and does not impact the overall appearance or integrity of the Domes. Planning is currently underway for large-scale repair, restoration, and revitalization of the Domes.

Site and Setting

The Domes complex was designed to be viewed from all angles due to its setting within a park. It is nestled within plantings and trees. In addition, Mitchell Park is located on a small hill at the south rim of the Menomonee River Valley, making the Domes visible above the trees from several blocks and even miles away. The Domes are an unmistakable landmark for anyone traveling east or west on the I-94 expressway. The Domes complex is angled and set back from the South Layton Boulevard, approached via a circle drive with access to parking in either direction. To the north of the entrance drive, a small parking lot sits in front of Dome A (Show House). To the south of the entrance drive, a large parking lot consists of three rows of double-loaded angled parking separated by grass medians. The circle drive features a large planted area in the center. Between the circle drive and the Domes entrance is a large plaza with minimal seating and additional planters. Concrete and pavers comprise the majority of the plaza which was once flanked by two large reflecting pools. Deemed too difficult to maintain, the pools have been paved over and were replaced with small splash fountains (supplied by rainwater) in the early 2000s. The plaza leads up to the main entrance.

The north side of the Domes is wooded, creating a visual separation from the wide swath of railroad tracks which are in close proximity to the site. This wooded area slopes significantly down to the north where the railroad tracks are found, adding to the physical and visual separation between the recreational park site and the industrial valley below. Parkland to the east and south further buffer the Domes from nearby industrial and commercial areas.

Outside of the National Register boundary and south of the Domes and to the east of the large parking area, the ground forms a shallow depression. This location once featured a sunken garden with terraced plantings down to a reflecting pool. The reflecting pool and plantings were removed sometime in the early 1990s; the terracing was smoothed and sodded over. Steps leading down into the depression remain on the north end. A park drive continues from the north parking lot around the north edge of the site. A paved service and loading dock area is located on the north side of the building, accessing the Transition House and the loading/service area of the greenhouse addition. This concrete area is fenced with tall black chain link fencing. A gate of the same fencing materials separates the service docks from the service drive and park. On the

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east side, east of the Greenhouse Addition, a fence constructed of modern-era concrete masonry block posts and steel security pickets separates the greenhouses from the adjacent park land.

While the only vehicular approaches are via South Layton Boulevard to the west or West Pierce Street to the south, the Domes are connected to a series of park and county-wide trails. Within the park, a system of asphalt paths connects the Domes to a concert stage, playground/wading pool, athletic fields, and park pavilion as well as a circle path around a 2-acre pond. On the north side of the park, a path and bridge connect the Domes to the Hank Aaron State Trail, a fourteen-mile paved bike trail that extends along the lakefront to the Milwaukee/Waukesha County line and traverses an area of restored prairie, watershed, woodlands, urban development, and riverfront. A surface parking lot is also found to the northeast of the Domes.

Landscape Features

Circle Drive

The circle drive is one of the original landscape features included in the Domes design. It forms the pivot point from the orthogonal street grid of Milwaukee to the canted Domes plaza. Within the circle, a large circular planting bed is maintained with seasonal plants. The drive connects back to the north and south parking lots.

Stone Wall/Reflecting Pools/Entrance Plaza

The entrance plaza makes the transition from the circle drive to the undulating entrance pavilion arches. A low stone wall surrounds the area that once separated the reflecting pool on either side of the entrance plaza. The original plaza was designed as concrete with a scored sinewave pattern flanking a rectilinear central path. The plaza cut between two reflecting pools which abutted Domes A and B. The walls around the reflecting pools were constructed of dolomitic limestone with a precast concrete cap and remain intact. The pools have been infilled.

The entrance plaza was redesigned in 2010 to promote site drainage and increase natural storm runoff. The redesign was completed internally by the Milwaukee County Department of Transportation and Public Works. Large sections of concrete were replaced with raised planter beds with natural plantings. An inlaid stone and brass interactive sundial feature was incorporated into a poured circular section between the planters and the circle drive. At the same time, brick pavers were installed at the former reflecting pool locations. The pavers form a grid of stacked and soldier bond units bordering sections of herringbone brick. A series of nine column jet water fountains is arranged along the wall on each side. Similar to the planter beds, pavers are pervious and designed to promote better site drainage.

Signage and Sculpture

The primary signage along Layton Boulevard is a modern-era sign dating to 2013-2014. It is green with an LED display. The sign is internally supported within three-pointed shapes appearing as abstract leaves. This sign is a noncontributing object. An additional sign dating to the period of significance is located further south along Layton Boulevard and is located outside of the National Register Boundary for the property. This sign is a silhouette of the dome shape formed in extruded anodized aluminum. Within the aluminum silhouette is a brown signage board with anodized aluminum letters. This sign sits atop a short dolomitic limestone plinth.

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Configuration of Building Elements

The Mitchell Park Domes are a Mid-Century Modern style complex of conoidal Domes rising more than seventy feet above a one- and two-story, flat-roofed building housing lobby, service, storage, ticketing, and educational functions. Undoubtedly unusual in its architectural form, the complex evokes a number of Mid-Century Modern stylistic references ranging from New Formalism, Neo-Expressionism, and even elements of Brutalist design. A series of greenhouses closed to the public are also part of the complex. The Domes are arranged in an isosceles triangle, with Dome A (Show Dome) and B (Tropical Dome) forming the base of the triangle and Dome C (Arid Dome) the apex. The Domes are connected by a large central lobby. The entrance pavilion is located on the base of this triangle between Domes A and B under an undulating precast concrete roof arcade, connecting the exterior plaza to the lobby. The lobby terminates at the back-of-house spaces between Domes A and C and at the Education Center and offices between Domes B and C. The boiler room on the lower level and air lock above form a service space on the north side of Domes A and C. The air lock connects Dome A to the Transition House, a shorter, smaller round greenhouse with a round hip roof. The boiler room infills the rest of the space between the Transition House, Dome A, and Dome C. The Greenhouse Addition (constructed in 2013-2014) is a 65,000 square foot complex with seven greenhouses, a storage and chemicals building, and a connecting corridor that runs along the southeastern edge of the historic complex. The addition has its own entrance set back on the southeast side of the Domes.

Architect Donald Grieb initially envisioned a bold color palate for the Domes' color scheme, specifying yellows and oranges for doors, slate blue for toilet partitions, exposed piping, and stairs, and sky blue for coating the precast structural members.¹ Robert J. Mikula, County Landscape Architect, vetoed several of these selections as "too flamboyant" and selected colors he deemed "more sedate" while achieving "a little life and brightness." Instead, Mikula selected Mellow Orange for several exterior doors and Restful Green for the remaining doors and frames. He also selected Bright Red for the handrails.²

Due to the unique composition of the Domes' complex, the building cannot be divided into traditional primary and secondary elevations as a typical building would. The architectural descriptions are instead organized by each distinct space:

1. Entrance Pavillion and lobby
2. Three Domes (Dome A, B, and C)
3. Transition House
4. Air lock and other back-of-house spaces
5. Greenhouse addition

Entrance Pavilion and Lobby (1959-1967)

From Grieb's perspective, the greatest function of the lobby and the entire entrance sequence was to accentuate the scale of the Domes themselves. In one of his design diagrams, he shows

¹ Donald Grieb Associates. "Mitchell Park Conservatory Interior and Exterior Color Selection," December 15, 1961.

² Letter, Robert J. Mikula to Gilbert O. Grunwald, Subject: Conservatory Color Selection, January 26, 1962.

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his concept of a tall entry foyer (at least twenty feet), that compresses down to a low-ceilinged lobby. The visitor is further compressed by the glazed-brick entrance features, with ceilings that are barely seven-feet tall.³ These entrances lead the visitor directly into the Domes from the main lobby. Having been compressed as much as code would allow, the visitor steps into the eighty-five-foot-tall glass dome. This sequence of compression and release was one of Grieb's most skillful techniques to accentuate the scale of the dome interior and is fully retained in the entrance and lobby spaces despite a 2008 remodel.

The front entrance faces southwest and features an undulating precast concrete arcade with modern-era anodized aluminum curtainwall under each arch. The precast panels have a stone aggregate finish. On the edges of the canopy, the aggregate is fine, like small pebbles. Below the curtainwalls and on the walls surrounding the lobby space, the aggregate is a large smooth beach stone collected from Lake Michigan and culled for color and size. The undulations are formed by nine twenty-four-foot precast concrete arches with splayed verticals. The arches are faced with identically shaped panels using the fine stone aggregate described above. The arches are supported on precast concrete plinths atop inverted, tapered concrete piers, with the narrowest width at the ground. Set far back behind the arches, the flat wall face surrounding the entrance pavilion recedes. It is also faced with fine aggregate precast concrete. Between the arches, the entrance pavilion and the entire lobby volume have a flat roof with a rubber roofing membrane. Glass French entrance doors occupy the center of each of the three center bays.

The front entrance doors lead into a foyer with a modern-era ticketing booth surrounded by glass. A set of interior glass doors on either side of the ticketing booth lead to the lobby connecting the three Domes and the education center. Also housed in the entry pavilion volume is an office, restrooms, and the gift shop. These are all accessed off the lobby. The foyer is characterized by smooth finished plaster walls and a finished plaster vaulted ceiling. The ticket booth has partial height gypsum board walls with glass from the counter height up to the ceiling on all sides. Five modern-era pendants echo mid-century fixtures.

Several original features are extant in the remodeled lobby. Non-historic frosted glass in windows around the base of each dome provide diffuse light from the Domes above and obscure the water drainage system for the Domes. This frosted glass was part of the 2008 lobby remodel. The entrances to Dome C are positioned across from entrances to Domes A and B so that one could move between the Domes without crossing back through the lobby. Glazed brick walls distinguish the entrances of each dome from the rest of the frosted glass walls surrounding the Domes. Each dome entrance features a different color of glazed brick. Dome A (Show) is teal, Dome B (Tropical) is sage green, and Dome C (Arid) is yellow. Doors at the far ends of the lobby between the Domes lead to non-public and service spaces as described below. The original terrazzo floor was retained and repaired with the exception of an almond shaped section below the skylight where new terrazzo was poured to match the remodeled skylight opening. The skylight was retained. Finished plaster is retained at non-remodeled walls.

³ Milwaukee County Park Commission, "Milwaukee County/Mitchell Park Horticultural Conservatory," (Milwaukee: E. F. Schmidt Company, undated), 19.

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The 2008 remodel included the new ticketing booth and new finishes throughout the lobby, restrooms, gift shop, and offices. As part of the renovation, new signage was placed over the entrance to each dome. There are two entrances to each dome from the lobby. In the toilet rooms, most fixtures were retained with the exception of upgrades to meet modern accessibility standards. Sinks and countertops were replaced.

Education Center

The Education Center is a small flat-roofed addition between Domes B and C adjacent to the Greenhouse Addition connector. This was constructed in c.2000. The Education Center has a green roof, gypsum board walls, and an anodized aluminum-framed glass storefront wall dividing it from the rest of the lobby. It previously served as a gift shop.

Domes (1959-1967)

The Domes are the signature feature of the complex, rising above the flat roofed support spaces. Each dome features an identical structure, size, and shape. The only variance is its connection to the Lobby Space and spatial relationship to the rest of the complex. The Domes are not technically domes in the geometrical sense. Donald Grieb, the original architect, referred to them as beehive- or conoid-shaped; engineering literature on the project also refers to the structure's geometry as conoidal. They are taller than they are wide, distinguishing them from the hemisphere-producing structural system used to construct Buckminster Fuller's geodesic dome.

The circular foundations of each dome are composed of two poured concrete walls with a cavity between for maintenance, pipe runs, and drainage. The radius to the outermost foundation wall is 70 feet. This wall construction continues above grade to the base of the glass-clad dome. It is capped by a built-in gutter and water drainage system. Where the concrete wall is exposed to the exterior, it is finished with large-aggregate precast concrete as described on the Entrance Pavilion. The top edge of the concrete wall is serrated. Inset into each vertical triangle is a triangular-shaped louvered panel. Additional louvered panels are located within the glass skin between the precast concrete peaks. Together, the louvers comprise the ventilation and exhaust system for the Domes. The louvers at the base of the Domes comprise the fresh air intake for each Dome, which is then exhausted by a large fan at the apex of each Dome.

The Domes, which are eighty-five feet tall, are self-supported by a unique precast reinforced concrete space frame. The glass and aluminum skin of the Domes is connected to the framework using aluminum struts. In his patent application, architect Donald L. Grieb described the structural system as "precast reinforced concrete geometric sections preferably of generally hexagonal and also diamond shape, joined together in recurring pattern in circular tiers providing the dome shape."⁴ At the Mitchell Park Domes, starting from the valley between the saw-tooth shaped concrete wall, the structural framework is composed of three tiers of hexagonal pieces with six spokes radiated from the center point to each corner, each hexagon diminishing in size from the one below it. Above the hexagons, the second two tiers are diamond-shaped members with a cross strut. The top tier below the ring supporting the apex

⁴ D. L. Grieb. "Dome Building Construction," Patent US3192668A, July 6, 1965, 1.

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consists of a triangular tier. (See Figure 8). Concrete was originally painted with two coats of specialized epoxy paint intended to protect it from fungi growth and moisture exposure.

Above this sequence of diminishing shapes is a ring beam that supports the apex, the top of each dome that was structured independently to bear on the ring beam. The apex was installed separately as single structural piece. The transition between the lower dome structure and the apex is clearly visible. The apex is structured as two concentric circles with ribs radiating from the center to the outer ring. (See Figure 9). The top of each dome, within the apex, has an exhaust and ventilation system nested in a ribbed, opaque cap and suspended down from the structure.

An impressive 115,00 square feet of quarter-inch thick plate glass with reinforced wire netting comprise the aluminum-framed skins. 240,000 feet of neoprene gasketing holds glass in the frames. The glazing frames, consisting of over 120,000 linear feet of aluminum extrusions, are connected to the concrete framework using connectors Grieb termed “hubs.” (see Figure 8). The eight-inch diameter hubs are located at intersections of concrete structure and aluminum frames, holding the aluminum frames several inches off the structure. There are 5,500 hubs total on all three Domes.⁵

In 2008, LED lights were installed to form halo rings illuminating each dome apex on the exterior at night. Additional LED lights allow the Show Dome to offer nightly light shows.

The Domes are serviced and maintained using an electric scaffold with a wire cable, a permanent fixture designed for the Domes. The system was intended to be used for washing and replacing glass or neoprene sills, but has not been utilized by facilities for many years due to maintenance and safety issues.

The interiors of each dome consist of multi-level plantings and pedestrian rest areas. Each dome has a specific focus as described below.

Dome A – Show Dome

Dome A is the Show Dome and features rotating displays and exhibitions. The original annual cycle of shows included special themed displays for Orchid, Easter, Mother’s Day, Summer, Exotic Plant Clinic, Chrysanthemum, and Christmas shows. The permanent features of Dome A include select perimeter plantings and a paved walkway from the lobby doors down into the dome. A central water feature is incorporated into most shows. Temporary installations such as buildings, gazebos, or other pavilions may be installed as part of a show. The Domes collaborate with model railroad groups to incorporate model rail displays into exhibitions in the Show Dome. Teal glazed brick flanks the interior walls at each Lobby entrance. In 2010, brick pavers were installed in the Show Dome.

Dome B – Tropical Dome

⁵ Milwaukee County Park Commission, “Milwaukee County/Mitchell Park Horticultural Conservatory,” (Milwaukee: E. F. Schmidt Company, undated), 24.

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Dome B is the Tropical Dome and features mature tropical plants and trees forming a canopy almost as tall as the dome itself. A 25-foot waterfall that was part of the original installation remains, as does the original configuration of paths, bridges, and rest areas. Interspersed throughout the Tropical Dome, man-made rock and earthworks add dimension and shield sections of the path as it meanders from one set of Lobby doors to the other. The main pathway changes in elevation approximately one story before returning to the Lobby level. The height change allows plants requiring more shade or cooler temperatures to be shielded from the sun exposure closer to the glazed dome wall surface. In addition to plants, the Tropical Dome is home fish. Green glazed brick flanks the interior walls at each Lobby entrance.

Dome C – Desert Dome

Dome C is the Arid Dome (now Desert Dome) and features mature cacti, palms, and succulents from arid regions around the world. Man-made rock formations separate sections of path and simulate desert rock formations. The original paths, resting points, and central “oasis” water feature are all intact. Similar to the other Domes, the path goes from one Lobby door to the other and drops approximately one story in the intervening space. The Arid Dome is also home to birds and formerly home to reptiles in tanks. Yellow glazed brick flanks the interior walls at each Lobby entrance.

Transition House (1959-1967)

The Transition House is a circular greenhouse adjacent to the Show Dome (Dome A). It is intended to help plants acclimate to the air circulation and quality present in the main Domes. It was historically used to store and renovate plant material for reintroduction into the main Domes. The Transition House was not intended to be open to the public; as a result, the building is more utilitarian. It is a two-story volume comprised of part of the air lock and loading dock from the lower floor offices. The basement of the Transition House is a storage and intake area from the rear service loading docks accessed by a large overhead door. The upper floor is used for plant material. The walls from grade up to a few feet above the first floor are composed of concrete faced in veneer brick on the exterior. The walls are faceted into straight segments to make the cylinder without having to construct materials on a curve. The upper portion of the walls are composed of aluminum curtainwall in straight segments around the circumference of the circular supporting wall. A four-lite awning-style ventilator window is located in the center of each segment. At the southeast segment of the Transition House is a small subdivided space dedicated exclusively for the care and management of orchids. The hip roof is a shallow cone, fully glazed, with a steel-framed structure. At the top, a fan hood provides ventilation to the Transition House.

Air Lock and other Back-of-House Spaces (1959-1967)

This section of the Domes is largely utilitarian and is comprised of the subgrade air locks and basement boiler spaces east of the lobby and more public areas. The first floor Air Lock and basement Boiler Room are both large utility spaces. The exteriors are concrete. The Air Lock is used to transport materials from the loading dock into the Domes complex through the large overhead doors. It also serves as a passthrough to transport plants from the Transition House into the Show House. The Boiler Room is used to house mechanical equipment. It also features overhead doors to the exterior loading and exterior service area at the northeast side of the

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complex. Both spaces are characterized by exposed concrete and structure without additional finishes.

The Domes featured the most modern equipment available at the time of their construction. Basement utility spaces housed an electric generator, three gas-fired boilers, an acid treatment system for water with two 18,000-gallon tanks, and compressors for the humidification system. These features, or in some cases updated equivalents, are retained in the basement support spaces and the Boiler Room.

Greenhouse Addition (2013-2014)

The Greenhouse Addition was constructed in 2013-2014 to replace the Greenhouse Center located at North 104th Street and Watertown Plank Road. It is the growing site for plants displayed at the Mitchell Park Domes, Boerner Botanical Gardens, General Mitchell International Airport, and all other Milwaukee County Parks. Plants may be grown from seeds more than a year in advance of final placement.

The Greenhouse Addition extends along the entire east side of the Domes. It consists of a series of greenhouses and support buildings oriented with their long axes running east-west linked by a separate connecting corridor running north south at the west end of the greenhouses. The corridor has concrete floors, exposed ceilings, and a combination of concrete, metal, and gypsum board walls. The roof of the connecting corridors is metal standing seam. Doors and windows are aluminum storefront construction.

At the north end, the Flex House is separated from the rest of the structure by twenty feet. This smaller-scale building is composed of concrete, steel, and glass. The Storage/Prep and Chemical Building is a board-formed concrete structure with a metal monitor-style gabled roof. It also features a loading dock area that shares the exterior paved loading/service area with the original Domes building.

South of the Storage/Prep and Chemical Building, six directly-abutting rectilinear greenhouses are constructed with concrete block lower walls topped with aluminum curtainwall and gabled roof supported by steel trusses. Approximately thirty-two feet separate the greenhouses from the Storage/Prep and Chemical Building. A panel at the ridge of each gable opens along both sides for the full length of the ridge to allow natural ventilation to occur. The furthest north greenhouse acts as the head house and is narrower than the five. The connecting corridor jogs at this bank of greenhouses and is linked to the greenhouses with short passages connecting to their west entrances.

Forty feet south of the greenhouses, connected by the connecting corridor, is a larger greenhouse which is outfitted as exposition and event space. Similar to the other greenhouses, it is structured with a lower wall of concrete block and aluminum and glass curtainwall and roof supported by steel trusses. This greenhouse has a monitor-style gabled roof (fully glazed). It has a concrete floor and large concrete piers. Two gabled volumes within the south greenhouse are clad in tile and corrugated metal. The south inner volume houses a men's and women's restroom.

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The Greenhouse Addition is well-concealed from the public rights-of-way. Most of the greenhouses and connected support spaces are low enough relative to the clear Domes that they are not perceived from the interior of the structure. Additional storage/garage space is located on the basement level between Domes B and C and the addition. The most visible portion of the addition's exterior is the entrance on the south end. Despite the size of the addition, it is subservient to the historic Domes. The greenhouses are closed to the public, set far back from the original building, and more subdued in materials and design.

Alterations and Integrity

While maintenance and care for the Domes has been an ongoing process since their erection, there are several changes that are pertinent to the discussion of integrity and character defining features. A summary of known major alterations to the Domes described above are also listed out below.

Year	Alteration
c. 2000	Construction of the Education Center (formerly gift shop); reflecting pools removed and plaza hardscape redesigned
2008	Lobby renovation and installation of LED lights in Show Dome
2010	Entrance plaza redesign
2012	Lighted Domes sign was erected on the site
2013-2014	Greenhouse addition was erected in addition to the Flex House Greenhouse to the north of the greenhouse addition
2016	Netting was installed around the concrete structure to contain spalling concrete and falling debris.
2017	Electrical service was upgraded, resulting in no substantial changes to the architecture

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Overall, the Domes complex retains integrity in order to demonstrate its significance at both the state and national levels under Criterion C. The site and setting of the property is largely intact, although changes have been made to the surrounding landscape of Mitchell Park itself and the property historically associated with the Domes has undergone minor changes including the removal of the reflecting pools and updates to signage, site lighting, and landscaping. The reflecting pool walls showing the original configuration and circulation of the entrance plaza is still intact along with the roundabout directing vehicular traffic to the Domes specific parking lot to the west. Within the interior of the Domes, primary spaces such as offices and lobbies have undergone minor updates and renovations over the years, but the circulation and general layout illustrate the original design of the Domes. Within the Domes themselves, the original design is immediately evident through the volume and arrangement of the spaces. While the plant material has changed overtime, some original plant material and soil, and circulation patterns do remain. Materials and workmanship are evident through the articulation of the building systems including both the aluminum-framed glazing system in addition to the concrete frame of the Domes themselves. Through this intact integrity, the Domes retains excellent integrity of feeling and association. Through its continued use as a horticultural conservatory and the retention of each individual Dome climate, the current property is immediately recognizable as the completed horticultural conservatory constructed between 1959-1967.

Resource Inventory

AHI Number	Property Address	Historic Name	Date	Class
52569	524 S Layton Boulevard	Mitchell Park Horticultural Conservatory	1959-1967	C
248272	524 S Layton Boulevard	Reflecting Pool Walls	1959-1967	C
248273	524 S Layton Boulevard	Lighted Domes Sign	c.2012	NC
248274	524 S Layton Boulevard	Flex House Greenhouse	2013-2014	NC

END OF DESCRIPTION, DO NOT DELETE

8. Statement of Significance

Applicable National Register Criteria

(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

- A. Property is associated with events that have made a significant contribution to the broad patterns of our history.
- B. Property is associated with the lives of persons significant in our past.
- C. Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.
- D. Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria Considerations

(Mark "x" in all the boxes that apply.)

- A. Owned by a religious institution or used for religious purposes
- B. Removed from its original location
- C. A birthplace or grave
- D. A cemetery
- E. A reconstructed building, object, or structure
- F. A commemorative property
- G. Less than 50 years old or achieving significance within the past 50 years

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Areas of Significance

(Enter categories from instructions.)

Architecture

Engineering

Significant Person

(Complete only if Criterion B is checked.)

N/A

Period of Significance

1964-1967

Cultural Affiliation

N/A

Significant Dates

1965 (Dedication by Lady Bird Johnson)

2008 (Lobby Remodel)

2013 (Greenhouse Addition)

Architect/Builder

Grieb, Donald L.

Whitney, Charles Smith

Statement of Significance Summary Paragraph (Provide a summary paragraph that includes level of significance, applicable criteria, justification for the period of significance, and any applicable criteria considerations.)

Criterion C, Architecture and Engineering: State Level Significance

The Mitchell Park Domes are significant at the state level under Criterion C in the areas of Architecture and Engineering as a unique architectural form. They are believed to be the first conoidal Domes in the world and the only conoidal Domes used to span a conservatory to this day. They are an engineering feat and a local architectural landmark, and represent a significant method of construction that was conceived as part of their design and engineering. Their height, signature beehive shape, and position overlooking the Menomonee Valley have made them one of Milwaukee's most iconic structures.

Architect Donald Grieb won the commission for the Domes and proceeded to design not only a building, but an entirely new architectural form, in collaboration with engineer Charles Whitney. The unique conoidal shape was an innovative solution to one of the project's key challenges: producing a dome that could accommodate taller mature plants within a limited circumference. The design included an integrated structural and environment management system and

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accounted for water management issues of interior condensation and exterior water and snow drainage. Its construction was also an achievement in and of itself, involving significant effort in fabricating and installing the precast concrete members and the aluminum and glass skin. In 1965, Grieb was awarded a patent for the dome construction design, demonstrating its uniqueness and also hindering the structure from being replicated elsewhere.

While unique, the design of the Domes was influenced by mid-twentieth century trends in architecture and engineering. It reflects Mid-Century Modern architectural styles popular at the time it was built, especially New Formalism and Neo-Expressionism. These influences are present especially in the front plaza and Entrance Pavilion, as well as other details throughout. The Domes themselves are the product of new experiments within the architecture and engineering communities that allowed architects like Buckminster Fuller and Grieb to cover large interior spaces with relatively minimal structure and no interior columns. Engineers of the era, notably Charles Whitney, were also making applicable and valuable contributions to architecture at this time by increasing theoretical understanding of and practical applications for concrete. The Domes certainly benefitted from these experiments, using precast concrete to form the Entrance Pavilion arches, the stone-aggregate cladding, and the select portions of the substructure of the Domes.

Criterion C, Engineering: National Level Significance

In addition to its state-level significance in the areas of Architecture and Engineering, the Domes are significant at the national level under Criterion C in the area of Engineering as the work of master engineer Charles Whitney (1892 – 1959). Whitney is a nationally significant engineer known for his contributions to reinforced concrete and structural analysis. Through his theoretical work and engineering practice, Whitney translated complex material behavior into simple yet accurate mathematical abstractions and approximations, most notably the “Whitney Stress Block,” which remains a standard concept in engineering education for reinforced concrete design. His theories of structural analysis describe the behavior of complex indeterminate structures, like arches, domes, and shells, and are expressed in numerous papers published in the periodicals of engineering organizations such as the American Concrete Institute and the American Society of Civil Engineers. Whitney made significant contributions to these organizations, serving on numerous committees and eventually as the president of the American Concrete Institute.

Whitney was also a prolific practicing engineer, running his own practice based in Milwaukee, Wisconsin from the 1920s until his death in 1959, as well as a famous partnership with New York-based engineer Othmar Ammann that began in 1946 and continued until Whitney’s death. Over nearly four decades of practice, Whitney translated theory into practice through the design of a wide range of structures, including highways and bridges, airport hangars and terminals, institutional and higher-education buildings, and facilities for the United States military and federal government, producing designs that were both innovative and economical. Whitney and Ammann collaborated with numerous architects, including midcentury masters such as Eero Saarinen and Minoru Yamasaki, providing the expertise needed to support the architectural design visions.

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Constructed beginning in 1959—the year of Whitney’s death—the Milwaukee Domes was a capstone project of Whitney’s career, clearly embodying his mathematical models of structural behavior. As the only known space-frame structure of Whitney’s career that was constructed, the Domes constitute a unique physical realization of his theories, literally expressing the flow of structural forces through the conoidal dome. Whitney’s expertise in engineering theory and practice supported architect Donald Grieb’s vision, making the Domes’ architectural form and horticultural requirements possible. As an excellent representation of Whitney’s nationally-significant contributions to the field of civil engineering in America, the property is nationally significant under Criterion C as the work of a master.

Period of Significance and Justification

The period of significance is 1964 to 1967. The Domes were completed in stages and opened to the public over a period of three years. The first of the three Domes, the Show Dome, opened in 1964 for the first Christmas show in the new facility. First Lady Lady Bird Johnson dedicated the Domes in 1965 in a grand opening celebration. The Tropical Dome opened in 1966 and the Arid Dome in 1967. Throughout this time, the earthworks, planting, and hardscapes of the site were installed. The period of significance includes all of these significant points of completion and is the most effective window of time that captures all the primary contributing resources associated with the architectural and engineering significance of the Domes.

Narrative Statement of Significance (Provide at least **one** paragraph for each area of significance.)

Historical Context – Milwaukee’s Parks and Mitchell Park

The City of Milwaukee is located along Lake Michigan at the confluence of the Milwaukee, Menomonee, and Kinnickinnic Rivers. The first mention of a community at this location was during the visit of Father Zenobius Membre to Fox and Mascouten tribes at what is now Jones Island near the mouth of the Milwaukee River. The native population of the area grew in subsequent years, including Potawatomi, Sauk, Ottawa, Chippewa, and Menominee groups. Settlers of European descent initially used the area as a seasonal trading post during winter months when conditions further north were too harsh. Increase Lapham reported thirty or forty wigwams on the current site of Mitchell Park, overlooking the Menomonee Valley. The natural hill made the site a good settlement location.⁶

As early settlement of the United States pushed west, land was forcibly taken from native peoples, many of whom were relocated to Iowa and Kansas. The early settlements that became Milwaukee were founded in the 1830s by Solomon Juneau (Juneautown, with business partner Morgan Martin), Byron Kilbourn (Kilbourntown), and George Walker (Walker’s Point). Each claimed a piece of land and began settlements around the rivers, drawn by the large bay and deep mouth of the Milwaukee River, the deepest on the western shore of Lake Michigan. Although the settlement’s growth was driven by commerce, political, religious, and cultural institutions quickly followed. The Town of Milwaukee was officially established in 1839 when Juneautown and Kilbourntown combined. Walker’s Point was incorporated in 1845.⁷ One of the

⁶ John Gurda, *The Making of Milwaukee* (Milwaukee: Milwaukee County Historical Society, 1999), 7.

⁷ Gurda, *The Making of Milwaukee*, 49.

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first white settlers in Milwaukee, Jacques Vieau, built a cabin on the hill in present Mitchell Park and turned it into a trading post in 1795. Vieau's daughter Josette, whose mother was of Menomonee descent, became the wife of Solomon Juneau, Milwaukee's first mayor.⁸

Boosted by an influx of European immigrants, Milwaukee's population more than doubled in the four years following incorporation. By 1860, it had doubled again. After the Civil War, the trend increased, encouraged by industrial development. The economy was growing at an astounding rate. In the twenty years following incorporation, Milwaukee became Wisconsin's center of commerce. The railroad, new regional roads, and the harbor made Milwaukee a trade hub for many products, most notably wheat from the Wisconsin countryside. It was the greatest shipper of wheat on earth by 1865 and one of the top twenty cities in America in the trade of a wide range of other products.⁹

Located at the southeastern corner of the 27th Street Bridge, the Domes serve as a visual gateway to one of the near South side's many neighborhoods, Clarke Square.¹⁰ The neighborhood is now located in what once would have been considered a fairly suburban area of the city. Though originally subdivided as Clarke's Addition in 1837, it would not become an established neighborhood until the second half of the nineteenth century. As the population expanded from Walker's Point to the east, neighborhoods like Clarke Square, National Park, and Silver City began to develop along the Milwaukee's Menomonee Valley. The neighborhood has historically been known for its ethnic diversity and to some degree its economic diversity. Late nineteenth-century settlers included Germans, Norwegians, Swedes, Scottish, Irish, and Yankees from the northeast, all of whom were largely second-generation immigrants. In addition to new open land, the area of Clarke Square was also attractive due to its proximity to the number of burgeoning industries along the Menomonee Valley. In addition to the Chicago, Milwaukee & St. Paul Railroad, the Valley was home to industries like Milwaukee Harvester, Falk Brewing, and various tanneries, machine shops, and packing houses. For this reason, and due to the many small businesses that arose within the neighborhood itself, much of Clarke Square was home to working class families resulting in dense arrangements of small frame or brick houses lining the streets. Areas like National Avenue, however, were home to larger, more elaborate estates in the early years of the neighborhood's development. The neighborhood was also home to some of the County's earliest dedicated greenspaces, Clarke Square Park and Mitchell Park.

By the 1880s, bolstered by trade and the rapid growth of industry and manufacturing, prosperity grew along with population. Opportunities for leisure became more common among working class individuals. The demand for theaters, concert halls, parks and other places of recreation was growing. On June 18, 1889, the first Board of Park Commissioners in the City of Milwaukee met to discuss purchasing land for a system of public parks. By 1890, five park locations had been chosen: Kosciuszko and Humboldt to the south, Lake and Riverside to the north, and Mitchell to the southwest. The park was named for the Mitchell family who sold twenty-five acres to the board in 1891 and donated five additional acres two years later. The sale

⁸ Urban Anthropology Inc., "Milwaukee Neighborhoods: Mitchell Park," accessed June 6, 2019 <<http://www.neighborhoodsinmilwaukee.org/Mitchell%20Park.pdf>>

⁹ Gurda, *The Making of Milwaukee*, 103.

¹⁰ Gurda, *Milwaukee: City of Neighborhoods*, 355.

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and donation were executed by U.S. Senator John L. Mitchell, son of a railroad tycoon Alexander Mitchell. Twenty-eight acres were purchased from prominent Milwaukee resident John Burnham in 1900. The remaining acreage was provided by the Milwaukee Southern Railway Company which managed the tracks north of the site. Henry C. Koch (Milwaukee City Hall (NRHP 1973), Gesu Church, Pfister Hotel), was commissioned to design the park and, in 1898, a horticultural conservatory.^{11 12}

The first major component of Mitchell Park was a pond for the purposes of recreational boating (extant). Beginning in 1892, rowboat rentals proved to be so lucrative that the pond size was doubled and an island created in the center. In 1904, after the conservatory was built, a sunken garden and reflecting pool were built in the style of fifteenth- and sixteenth-century French parterre. A boathouse was built in 1906 near the reflecting pool, and additional gardens were added. In 1910, the Old Settlers' Club replicated the original Vieau cabin on its Mitchell Park site (burned 1949). Between 1911 and 1916, tennis courts, a baseball field and a toboggan slide were added. In the 1950s, near the same period as the Domes project planning and construction, the park received other new facilities and improvements, including a pavilion overlooking the pond, concert stage, wading pool, and playground. Electrical lighting was installed in 1937, allowing the conservatory to remain open to the public in the evenings.¹³ The Wisconsin state legislature established the Milwaukee County Parks Commission in 1907. Mitchell Park management was transferred to this commission at that time, with ownership of the park land transferring during the Great Depression.¹⁴

In the period following World War II, the original conservatory's visitor numbers continued to rise despite the building falling into disrepair. In 1949, the Parks Commission had directed the County's Regional Planning Department to pursue plans for a new conservatory to be used for cost estimating. Staff traveled to conservatories in other cities, but ultimately no plans were produced. By 1954 Alfred L. Boerner, county parks manager, began pursuing options for repair or replacement of the structure. He cited frequent glass breakage in high winds and disintegration of building material due to corrosion and age. Wood rot and rust had made the building vulnerable to moisture and the interior climate impossible to control. Boerner was forward-thinking. He felt the new conservatory should be a state-of-the-art structure, using cutting edge modern materials like glass, aluminum, and concrete. Unlike the existing structure, which relied heavily on shows and displayed smaller-scale flowers and plants grouped by type into small greenhouses (roses, ferns, orchids, etc.), Boerner envisioned a facility that would house large-scale exotic landscapes grouped by regions or climate, with plants unlike anything Milwaukeeans could see in Wisconsin. In addition to the conservatory spaces, Boerner felt the new facility should include educational and service facilities such as a café or concessioner.¹⁵

¹¹ Urban Anthropology Inc., Milwaukee Neighborhoods: Mitchell Park, accessed June 6 2019 <
<http://www.neighborhoodsinmilwaukee.org/Mitchell%20Park.pdf>>

¹² Milwaukee County Park Commission, "Milwaukee County/Mitchell Park Horticultural Conservatory," (Milwaukee: E. F. Schmidt Company, undated), 24.

¹³ "Mitchell Park," (excerpt), Milwaukee Public Library clippings files, Mitchell Park 1950-1954; Elizabeth Wiza for the Milwaukee Preservation Alliance, "Nomination Questionnaire: Mitchell Park," March 28, 2016.

¹⁴ Urban Anthropology Inc., Milwaukee Neighborhoods: Mitchell Park, accessed June 6 2019 <
<http://www.neighborhoodsinmilwaukee.org/Mitchell%20Park.pdf>>

¹⁵ "Danger Seen to Greenhouse," *Milwaukee Journal*, April 17, 1954.

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The original conservatory closed permanently in July of 1955, with officials citing deterioration to the extent that the structure posed a hazard to visitors. Howard E. Gregg, a Milwaukee landscape architect in favor of the closure said, "When it rains, more water falls inside than outside." The west section of the building required special temporary bracing to be erected whenever wind storms were predicted. It was announced that the conservatory would be razed, and the promise was made to build a new structure once funds could be procured. Other greenhouses in the park which were not open to the public were used to store flowers and displays until the new facility was constructed.¹⁶ The County Board of Supervisors was asked to allocate a million dollars towards a new facility. Aldermen began arguing for possible new locations that would benefit their districts, and a public movement began to keep the conservatory in Mitchell Park. Ultimately, an architect was chosen and planning begun, with the supporters of Mitchell Park succeeding in retaining the facility.¹⁷

Mitchell Park Domes History

Planning for the new horticultural conservatory began in earnest in 1957. As many as thirty architectural firms submitted proposals for the proposed million-dollar horticultural conservatory. The Park Commission narrowed the list down to three firms: Eschweiler & Eschweiler, Schutte Phillips & Mochon, Inc., and Donald L. Grieb, Architect. The finalists were unified in their belief that the new structure should be a free-span space of contemporary materials such as aluminum, glass, and concrete. Grieb was the only architect who presented concepts and examples of his work. He was awarded the commission. At the time, Grieb's other commissions included the Saxony Restaurant and the Glendale, Wisconsin municipal building.¹⁸ The commission also hired Stanley C. Foll, a florist and University of Wisconsin researcher who studied means and methods for growing plants under glass. Foll was intended to assist Grieb in ensuring that the design accounted for proper temperature, lighting, and ventilation.¹⁹ Howard Gregg was also influential in the design of the Domes interior landscapes. Gregg was the former General Manager of County Park system. Along with horticultural Director, Howard Brossman, the two were responsible for the ecological approach to the plantings at the Domes.²⁰ This naturalistic approach to a horticultural conservatory, consisting of three scientifically controlled climates, was a radical shift from the typical greenhouse landscape consisting of highly curated examples plant life displayed together as they would not in nature. The Domes represented a shift in the importance of seeing plants in their natural environment and aimed to give the people of Milwaukee and its visitors access to these unique environments.

In June 1958, Grieb's plans were submitted and approved by the County Park Commission. A model showed three large glass hemispheres and a smaller domed transition house to be constructed of a reinforced concrete framework and tempered glass. A fourth dome was also proposed to house temperate climate plants and a horticultural hall but was postponed for a later

¹⁶ "County Votes to Close Mitchell Conservatory," *Milwaukee Journal*, July 9, 1955.

¹⁷ "Lock Conservatory at Mitchell Park," *The Times* (Milwaukee), July 14, 1955.

¹⁸ "3 Architects Interviewed on Conservatory," *Milwaukee Sentinel*, May 25, 1957.

¹⁹ "County Blazes New Trail in Conservatory," *Milwaukee Sentinel*, March 1, 1958.

²⁰ Bill Folton, Horticultural Conservatory in Mitchell Park, record on file at the Mitchell Park Horticultural Conservatory.

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phase of the work and never completed. Grieb's initial design consisted of 140-foot diameter Domes (the same diameter as the current Domes) rising 65 feet tall and composed of uniform hexagonal sections (These were later changed to Grieb's patented conoidal Domes, as described in the following section.) Other elements of the final design were present in the initial concept as well. Grieb included the nine white granite and concrete arches with gold anodized aluminum grills and infilled with high glass walls, the 60-foot plaza and reflecting pool (though the initial shape differed from the final design), and a large connecting foyer (see Figure 11).²¹ A month later, a more elaborate five-dome plan was approved. It was expected to be completed in two phases over two years and cost 2.4 million dollars. The first two Domes were approved to begin construction documents and bidding. The Milwaukee Sentinel called the five-dome plan "an ultra-modern Eskimo village."²² By September of that year, the plan was reduced back to three main Domes plus the transition house, more in keeping with Grieb's first proposal.

The Domes project was immediately beleaguered with budget difficulties. Problems came from within, over disputes between county officials, tax levies, and other public funding stressors. County supervisors cut a 1.8-million-dollar request for the conservatory from the 1959 budget, elevating tensions. \$400,000 in bonds were allocated to be sold in support of the Domes, but due to miscommunications and budget fights the bonds were never sold. Problems also came from outside county government, with the projected cost of the project up eleven percent before breaking ground. The cost increase was due to the plan to construct the building in stages, which would lengthen the construction period and increase the architect's, contractor's and tradespeople's fees. The stages would allow funding to occur more slowly, but increase the overall cost of the project. Finger-pointing started in earnest, with the assistant general manager of parks stating that the architect and park staff had no educated estimate of costs and had grossly underestimated costs for the ambitious design. Ultimately a two-stage plan was accepted, with final completion expected by 1961. The first stage would be the Show House, Transition House, Air Lock, Boiler Room, and Arid House. The Tropical House, Lobby, and entrance plaza would be constructed in the second stage. Landscaping would occur after final completion of the Domes themselves.²³ Even this plan proved to be overly ambitious. The Show House did not open until December 12, 1964 with a featured Christmas show. First Lady Lady Bird Johnson dedicated the Mitchell Park Domes in October 1965 (see Figure 12). The Tropical and Arid Houses were constructed but still receiving planting and landscaping. The Tropical House did not open until January 1966, providing a long-promised respite from the Wisconsin winter. The opening of the third dome, the Arid House, was delayed nearly a year due to delays constructing the man-made rock formations and the difficulty of shipping cold-sensitive plants during winter months. It finally opened in November of 1967. The final project was millions of dollars over the initial budget estimate and six years behind schedule, and the two planned stages had stretched into seven.²⁴

²¹ "Plan Dome House Conservatory," *Milwaukee Journal*, June 20, 1958.

²² "2 Conservatory Glass Domes OKd," *Milwaukee Sentinel*, July 20, 1958.

²³ "Conservatory Cost 'In Stages' Up 11%," *Milwaukee Sentinel*, August 7, 1958.

²⁴ Various Milwaukee Journal and Milwaukee Sentinel clippings, County Government Clipping File, Milwaukee County Historical Society, microfilm box 182.

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Regardless of the financial woes and growing discontent between the designer, construction teams, and county government, the Mitchell Park Domes were an instant success with the public. The conservatory drew more than 14,000 visitors its first weekend with only one dome completed. Over 155,000 visitors attended the first Domes Christmas show, over half the average attendance that the previous conservatory had drawn in an entire calendar year. Traffic jams on South Layton Boulevard were a constant problem, with park officials finally appealing to the County Board to provide six part-time parking lot attendants to help facilitate traffic flow. By May of 1965, after six months with only one dome open to the public, conservatory attendance had doubled the previous facility's annual average attendance and nearly reached the all-time high for a twelve-month period. It surpassed that high by 100,00 people in August of 1965 with attendance figures of 872,692. The visitor count for the first weekend of the 1965 Christmas show was 29,000 people, 5,000 more than the opening weekend of the previous year. The Show House was still the only dome open to the public. When the Tropical House opened in January 1966, it drew 14,492 visitors in its first weekend. The Domes became such a popular place for wedding photos that the Park Commission periodically imposed bans on wedding photography during busy weekends and shows as early as 1968. In 1970, the Domes and the Milwaukee County Zoo began charging admission. Admission to the Domes was initially 25 cents, resulting in initial attendance figures down seventy-five percent when compared to the same weekend the previous year. Despite the drop in numbers and the cost of maintaining ticketing staff, the county's projected admissions amounted to more than \$200,000 in revenue.²⁵

Statement of Significance - Architecture and Engineering

Large-Span/Glass Dome Structures

In 1951, architect, inventor, philosopher, and engineer R. Buckminster Fuller filed a patent application for his geodesic dome, a concept that had become the primary focus of his career since his first experiments with it in 1947. While precedents existed for Fuller's design, he popularized the geodesic dome structure and envisioned a wide range of applications, including a large dome spanning over the entirety of Manhattan and, more practically, for growing plants under glass. Fuller envisioned a dome that was lightweight, easily assembled of cost-effective materials, and able to enclose more free-span or uninterrupted space than any other known structural system. Fuller's dome relied on the balance of compression and tension among individual structural members, resulting in a structure that was resistant to settling and capable of withstanding shear forces in addition to being self-supporting. Fuller's first commercial dome commission was at the Ford Motor Company headquarters (Dearborn, Michigan). The U.S. Military hired him to design lightweight Domes to cover radar stations around the Arctic Circle, pleased that the Domes could be reasonably constructed in remote areas and also weather-resistant. The Buckminster Fuller Institute estimates that there are more than 300,000 geodesic Domes around the world ranging from utilitarian children's play structures to large roofs over stadiums and arenas.²⁶ Built in 1960, the Climatron® at the Missouri Botanical Gardens was the

²⁵ County Government Clipping File, Milwaukee County Historical Society, microfilm box 182.

²⁶ The Estate of Buckminster Fuller, "About Fuller," Buckminster Fuller Institute, accessed June 7, 2019 <<https://www.bfi.org/about-fuller/biography>>

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first conservatory to use the geodesic dome to cover a large planted area. The conservatory is 175 feet in diameter and rises 70 feet at the central apex.²⁷

Architect Donald L. Grieb was inspired by the geodesic dome, which used an alternating grid of hexagons and pentagons to free-span an enormous space. Grieb initially reached out to Fuller's team about collaborating on the Domes; he was turned down. Grieb wanted to create the same transparent but protected environment as Fuller's geodesic dome for the Mitchell Park Domes. Grieb's site plan was designed to maximize sunlight for each dome's designated climate, with the hottest Tropical House on the south side and the most temperate Show House on the north side. However the Domes site, hemmed in by the beloved Sunken Gardens to the south and the railroad to the north, would prevent the construction of a geodesic dome of sufficient height. The maximum diameter Grieb thought feasible was 140 feet, resulting in a maximum hemispherical dome height of 70 feet (or one-half the diameter). It was the opinion of Grieb and his team that this was not a sufficient height for mature plants. Grieb was also planning for four full-sized Domes (the Temperate House was never built), further constricting the available space. Grieb also worried that the relatively flat apex of geodesic Domes would not properly drain snow, causing structural and light problems. Practical concerns mixed with Grieb's strong independent streak led him to develop the conoidal, or cone-shaped, dome.²⁸

Grieb's conoidal Domes borrowed Fuller's geometric system but utilized varying shapes (hexagons, then diamonds, then triangles) to elongate the Domes as they extended upwards. The result was a height at the apex of 87 feet, seventeen feet higher than a geodesic dome of comparable circumference. Grieb set a goal of eighty-percent transparency, with twenty percent remaining for structural members. He constructed an eighteen-inch diameter plastic bubble in the approximate shape he desired and set about identifying the tessellated pattern using paper and scotch tape. He struggled to generate a sensical pattern of repeated sizes for each panel. In addition to his paper-and-tape experiments, he studied glass weights and uniform sizes. According to his own account, Grieb awoke in the middle of the night having dreamt of a flower-like pattern of geometric forms: three hexagons, two diamonds, and one triangle composing an orange-peel shaped section, joined at a central ring as the center of the flower. Twenty-five of these "peels" would form a conoidal form. Grieb had managed to implement Fuller's idea of repetitive shapes, intended to reduce supply and fabrication costs, and combine it with an altered geometry to establish a conoidal form.²⁹ Grieb was awarded a patent for his dome system design in 1965 ("Dome Building Construction," U.S. Patent # 3,192,668).

From the initial concept, Grieb collaborated with his team of specialists to develop every aspect of the conoidal construction, from precast concrete framework to glass and aluminum skin, to moisture control, cleaning and maintenance. Grieb retained the firm of Ammann and Whitney as consulting engineers, collaborating with engineer Charles Whitney on the development of the structural frame. The Hufschmidt Engineering Company was responsible for detailing, forming,

²⁷ "Climatron," Missouri Botanical Garden, accessed June 7, 2019 < <https://www.missouribotanicalgarden.org/gardens-gardening/our-garden/gardens-conservatories/conservatories/climatron.aspx> >

²⁸ Milwaukee County Park Commission, "Milwaukee County/Mitchell Park Horticultural Conservatory," (Milwaukee: E. F. Schmidt Company, undated), 24.

²⁹ Milwaukee County Park Commission, "Milwaukee County/Mitchell Park Horticultural Conservatory," (Milwaukee: E. F. Schmidt Company, undated), 7-9.

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precasting, and erecting the frame, and Super Sky Products, Inc was selected to design, fabricate, and erect the aluminum and glass system.

For the web-like structural framework, reinforced concrete was selected as the material. The possibilities of concrete were being expanded every year in new mid-century structures, and Grieb took advantage of the newly expressive possibilities for the material. As Robert Hopwood, chief manager and chief engineer for Ammann and Whitney's Milwaukee office, explained in a 1961 interview, "Almost at the outset, we decided to use concrete on this structure as the most practical material to resist the effects of moisture and insecticides from within the Domes."³⁰ Thanks to recent advancements, concrete formwork in any shape was becoming more economical. Additionally, elements could be precast and assembled onsite with minimal additional cutting or adjustments.

In an article in Milwaukee Engineering from May 1961, Hopwood described the complex engineering task that Ammann and Whitney faced in realizing Grieb's vision for the structure:

The architect, having furnished us with the surface of revolution, made one other request which was to give them a surface that would permit 75 percent unobstructed light to enter. Ordinary smooth Domes are not difficult to design. We began the design as a smooth surfaced one, then switched to a patterned surface, much the same as one would do in the design of a truss to replace a beam design. The principal stresses in a dome are compression along the meridians and either compression or tension along the horizontal circles. The first step was to find what patterns of members were suitable to carry the resolved stresses and maintain stability in the structure. These patterns were discussed with the architect for his final choice in beginning his aesthetic treatment of the structure. The dome stresses were finally grouped at juncture points and resolved into the individual members.³¹

In practice, the fabrication of the precast pieces (the largest nearly eighteen feet across) was complex. The curvature of the Domes was different in the horizontal direction than the vertical direction, which prevented large pieces from being fabricated without consideration for the direction the piece would be installed (as was possible with geodesic Domes). Grieb collaborated with W. John Hufschmidt of the Hufschmidt Engineering Company to devise a system of molds from master plaster of paris patterns. This would ensure uniformity of components and significantly reduce fabrication time. As the structure was being built, a temporary "falsework" of eight-inch pipe and I-beams was erected under each dome to support the concrete structure. The final position of each prefabricated unit was tested before it was set by using a heavy plumb bob to measure the distance out from the center point of the dome and the height above the floor. The unit's position was adjusted as needed using bolts on the steel stools attached to the falsework. Once the concrete was in place up to the apex ring, the falsework was removed. Over 100 tons of steel was used to construct the falsework, none of which remains in the final

³⁰ W. John Hufschmidt, "Precast Complex Conoidal Horticultural Domes," *Journal of the American Concrete Institute* 58, No. 5 (November 1961), 544 – 545.

³¹ W. John Hufschmidt, "Precast Complex Conoidal Horticultural Domes," *Journal of the American Concrete Institute* 58, No. 5 (November 1961), 544 – 545.

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completed work.³² ³³See Figure 13 [Dome falsework and concrete assembly].

Super Sky Products, Inc. based in Thiensville, Wisconsin, was the sole bidder for the glass skin. They designed, fabricated, and erected the aluminum and glass system in collaboration with Grieb. The design and engineering of the system took nearly three years. A shed was constructed on site for the assembly and preglazing of large sections of curtainwall panels which were then lifted into place with cranes and installed from the interior by workers on scaffolding. Crews pre-measured and punched marks in the precast frame for insertion of the panels. Stainless steel supports on the glazed units were then arc-welded to steel plates embedded in the concrete.³⁴

A ball-and-socket system, which Grieb referred to as “hubs,” allows the glass and aluminum skin to float off of the concrete substructure and serves as a condensation collection point. Given the contrast between the warmth and humidity of the indoor environment and the much colder, drier outside air of Milwaukee’s winter climate, Grieb showed foresight in attempting to deal with the inevitable condensation. Collecting condensation is critical to preventing standing moisture on the concrete as well as preventing interior rain from falling on the heads of unsuspecting visitors. The balls in the hubs transmitted condensation to tubes which carried excess moisture to the base of the Domes and eventually into the storm water management system.

The top of each dome is capped with an independently structured dome that Grieb called the “apex.” Each apex is a single prefabricated section crane-lifted into place. The apex weighs three tons, is thirty-seven feet in diameter, and is self-supported, bearing on the concrete ring at the top of the conoidal shape. The apex has a stainless steel rib structure extending out from the center vent. It is clad in a similar aluminum and glass skylight. The center of the apex is clad in two-inch-thick opaque aluminum panels which help support the exterior catwalk.³⁵

Those charged with maintaining the Domes are not surprised to find that the system is experimental and the first-of-its kind. Maintaining and repairing the Domes is often a dual problem of access and assets. The custom components are expensive to repair. Elements of the system are failing due to deferred maintenance, made more difficult by the failure of built-in maintenance systems and equipment. Despite the elaborate system of transferring condensation through the structure, excess moisture has caused concrete to crack and spall. The difficulty of reaching structural members to recoat the concrete with protective coatings has prevented this critical maintenance task from occurring, exacerbating conditions. Grieb is not the first architect to design a masterpiece that is problematic to maintain. Over time, Milwaukee County Parks have sought ways to improve failing components of the system while keeping with Grieb’s design intent. The current interior mesh netting required to prevent falling concrete from injuring patrons is evidence that further innovation is necessary.

³² Milwaukee County Park Commission, “Milwaukee County/Mitchell Park Horticultural Conservatory,” (Milwaukee: E. F. Schmidt Company, undated), 9-12.

³³ “World’s First Space Frames Rise in Milwaukee,” reprint from *Milwaukee Engineering*, May 1961, 4.

³⁴ Milwaukee County Park Commission, “Milwaukee County/Mitchell Park Horticultural Conservatory,” (Milwaukee: E. F. Schmidt Company, undated), 13-15.

³⁵ Milwaukee County Park Commission, “Milwaukee County/Mitchell Park Horticultural Conservatory,” (Milwaukee: E. F. Schmidt Company, undated), 16-17.

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In the face of tremendous pressure and backed by a progressive and forward-thinking local government body, Grieb attempted to, as one publication put it, “adapt principles of design never tried before.”³⁶ The American Concrete Institute’s journal called it a “radical departure from the standard gable-type roof design for greenhouses or horticultural exposition buildings.”³⁷ The May 1961 edition of *Milwaukee Engineering* called the Domes “unique in the world,” and “the world’s first space frame in the shape of a complex conoid.” At the Mitchell Park Domes, the collaboration between Grieb, Whitney and other consultants resulted in the invention and construction of a new architectural form. Ultimately, it was the first of its kind, building on existing webbed dome structures while solving issues unique to the site. While the geodesic dome was certainly adaptable for conservatory design, at the time Grieb began developing his conoidal dome, the geodesic dome had not yet been used for a glass-roofed conservatory structure (the first was constructed in 1960). In terms of large span conservatory design, the two forms are contemporaries rather than one deriving from the other. Grieb was challenged with solving issues of glazing, construction, fabrication, and moisture regulation of a glass dome that was still in the process of being fleshed out by Fuller, despite Fuller having developed the structural system almost a decade prior.

The Domes is an iconic building, highly evocative of its time while continuing to awe visitors in the present. On March 22, 2017, the Mitchell Park Domes were named a National Treasure by the National Trust for Historic Preservation. The difficulties with repairing and preserving the deteriorated structure also earned the building a place on the National Trust’s 2016 list of “America’s 11 Most Endangered Historic Places.” The National Treasure designation is the most recent of many local and national recognitions the innovative domed construction has received. The Cultural Landscape Foundation, in the same press release as the National Treasure announcement, compared the Domes to the St. Louis Arch as a similarly noteworthy mid-century structure.³⁸

The influence of the architecture of the Domes can also be seen in newer construction, including the Amazon’s Spheres in Seattle, WA. As a history of the Spheres explains, “Beginning with an idea similar to a collaborative indoor garden, The Spheres were first envisioned as a single curved glass building filled with plants and tall trees. During early planning, the design team studied the form and function of several sphere-like conservatories around the world, including the UK’s Kew Gardens, the Mitchell Park Conservatory in Milwaukee, WI, and La Biosfera in Genoa, Italy.”³⁹

Mid-Century Modern Style

The style of the Domes is heavily influenced by the structural system of the Domes themselves and therefore difficult to classify. The engineering feat of the Domes is on full display and

³⁶ “The New Horticultural Conservatory in Mitchell Park,” *Journal of the American Institute of Park Executives, Inc.*, September 1965, 486-503.

³⁷ W. John Hufschmit, “Precast Complex Conoidal Horticultural Domes,” *American Concrete Institute Journal Proceedings*, November 1961, 543-554.

³⁸ National Trust for Historic Preservation, “Nation’s Leading Historic Preservation Organization Names the ‘Milwaukee Domes’ a National Treasure,” Press Release, March 22, 2017.

³⁹ <https://www.seattlespheres.com/the-spheres-weekend-public-visits>

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supersedes any style classification. In the *Wisconsin Cultural Resource Management Plan*, this variety of style of architecture is classified under Contemporary. This larger term includes Brutalism, New Formalism, Neo-Expressionism, Late Modernism, and Post-Modernism. “Buildings that are universally distinctive, or even with eccentric designs, as well as those designed by notable architects...” are worthy of documentation.⁴⁰ The Domes falls into this category worthy of further documentation and recognition for its state and national significance. The extant entrance pavilion, signage, circle drive and plaza features, colors, and interior finishes evoke elements of mid-twentieth century styles such as New Formalism (Philip Johnson’s Amon Carter Museum, Fort Worth, Texas, 1961) and Neo Expressionism (Eero Saarinen’s Dulles International Airport, Chantilly, Virginia, 1960). Grieb also cited Organic Architecture as a precedent but tended to abstract organic inspiration into graphical shapes and lines to an extent that the organic inspiration was unreadable.

Buildings in the New Formalism Style tend to emulate the forms of past styles and precedents while streamlining and simplifying more ornate details. New Formalist buildings tend to be smooth (even glossy) with thick columnar supports with arches appearing in a variety of shapes made possible by concrete and steel. Often the arch is the primary motif, with dramatic full-height arches on the front façade or an arcade surrounding the building. Where ornament is utilized, it takes the form of metal screens, cast stone, grills, and concrete with or without apertures. Philip Johnson began experimenting with the style using classical precedents as early as the 1950s, when he blended elements of New Formalism into Miesian-inspired works. Johnson often adopted the plans of Neo-Classical designs for his New Formalism projects. His theater complex at Lincoln Center, with its central plaza, was based on the Louvre in Paris. Edward D. Stone and Minoru Yamasaki also furthered New Formalism in their work, choosing a more eclectic mix of inspirations than Johnson and pushing the boundaries further. Stone’s New Delhi embassy made perforated concrete screens a signature mid-century building feature while Yamasaki’s metal screens and Gothic-inspired designs inspired many similar screened elements on smaller-scale projects in downtowns and commercial centers. New Formalism appealed to mid-century ideals that celebrated a growing affluence among the larger U.S. population (even if materials only looked expensive) and sought to restyle classic, culturally-significant forms in the futuristic optimism of a post-war world.⁴¹

Domes architect Donald Grieb designed many New Formalist buildings in Milwaukee. The Milwaukee Road downtown train depot was a fine example of his New Formalist work (remodeled and façade replaced 2007). New Formalism is present at the Domes, especially in the Entrance Pavilion, where the classical arcade has been extracted and extruded into the precast concrete arches. The design of the entrance plaza and reflecting pools also evokes a classical entrance sequence. The Domes themselves represent a modern take on the glazed conservatory, like the one it replaced. Ribbed instead of tessellated, these nineteenth century structures also attempted to maximize light by using the full width between structural members for glass.

⁴⁰ Barbara Wyatt, *Wisconsin Cultural Resource Management Plan*, 2-37.

⁴¹ Marcus Whiffen, *American Architecture Since 1780, A Guide to the Styles* (Massachusetts Institute of Technology, 1992), 261-266.

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Neo-Expressionism eschews typical rectilinear geometry, from sweeping curved rooflines to canted columns and details. Arches and vaults are frequently utilized, as long as the arch does not take the form of a semicircle or barrel vault. The semicircle was grouped with other “static” forms lacking the dynamism and movement Neo-Expressionists sought. Other hallmarks of Neo-Expressionism include convex, concave, and faceted surfaces and leaning structural columns and piers. Neo-Expressionism eschews the adoption or adaptation of forms, preferring instead to derive form from the program with room for wide interpretation by the architect. Neo-Expressionism was not simply about sweeping geometry, but to express the program (that is, the building’s use) in its overall form. In practice, this philosophy manifests in a wide variety of forms. Eero Saarinen, who trained as a sculptor and an architect and was a leader of the Neo-Expressionist movement, designed his TWA Terminal at Kennedy Airport to express the idea of flight experienced through liberty from gravity and continuous movement. Like Saarinen, many architects in the movement were sculptors or inspired by sculptors, while others were engineers or inspired by engineers. Neo-Expressionist structures often required a significant understanding of engineering or collaboration with engineers to manipulate building materials, especially concrete, into new and more expressive forms. Engineers contributed concrete shell vaults and the catenary curved suspended steel-cable roof. An existing technology that Neo-Expressionists pushed to greater limits was the spraying of concrete (gunite) over a metal armature.⁴²

The Domes are Grieb’s work with the most Neo-Expressionist elements. The merger of engineering and function/program that drove the architectural expression of the three main Domes shares many sensibilities with Neo-Expressionism. The elongated conoidal arch, which is nearly a catenary curve in profile, and the innovative use of reinforced concrete throughout also evoke Neo-Expressionist ideals.

Organic Architecture promotes harmony between the natural world and the impact of the built environment upon that world. Frank Lloyd Wright used the term ‘organic architecture’ in an article for *Architectural Record* in August 1914. While Grieb cited many organic inspirations for the Domes (i.e. the flower-like arrangement of the dome geometry described in the previous section), the forms themselves are far removed from their organic inspiration and distinct, rather than integrated into the landscape. The incorporation of large smooth river rock in the exterior concrete panels and the natural environments in the Domes themselves are the strongest links to Organic Architecture.

Architect Donald L. Grieb

Donald Leon Grieb was born September 24, 1918 in Milwaukee to Leon Grieb, a builder, and Lulu Grieb. He wanted to be an architect from a young age. He earned his architecture degree from the University of Illinois and returned to Milwaukee to practice. He worked as a designer for Eschweiler & Eschweiler from 1945-46, with Fritz Von Grossman from 1949-1952 (briefly as a partner), and then with Brust & Brust during 1952 before founding his own firm. He intentionally avoided partnership opportunities, desiring to be the sole name on the letterhead. He won the American Academy of Rome award in architecture in 1941 and received the Joseph Horn fellowship to the University of Pennsylvania in 1942 on the basis of work done as a

⁴² Whiffen, *American Architecture Since 1780*, 273-278.

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student at the University of Illinois where he graduated with honors. He served during World War II as a first lieutenant in the U.S.A. Air Force from 1942-1945.^{43 44 45}

Grieb is an important mid-century architect in Milwaukee with a diminishing extant portfolio. Prior to the Domes he designed the Glendale Municipal Building (a north Milwaukee suburb, building partially demolished) and participated in design for the Milwaukee Arena, Marquette University's Memorial Union, and the 95th Street School.⁴⁶ His work on the Domes earned him an AIA honor award and led to many other public commissions, many of which have been razed or dramatically altered. He designed a large annex to the Milwaukee County Courthouse featuring the "Whaling Wall" mural overhanging 1-43 (razed), a plaza and clock tower at MacArthur Square (clock tower razed), and a number of local school and commercial buildings including the Whitefish Bay State Bank (Milwaukee) and the Green Tree Elementary School (Glendale). He often used futuristic curves and arches in his Mid-Century Modern designs. Grieb's design for the downtown train depot was supposed to usher in a Union Station environment. It replaced a historic Milwaukee Road depot, an unfortunate turn that did not ingratiate him with preservationists. When Grieb's train station was completely transformed by a façade renovation in 2007, it occurred with little protest.⁴⁷

Grieb bore similarities to R. Buckminster Fuller beyond experimenting with dome design. He sought answers to problems he perceived in the built environment, experimenting with plastic and Styrofoam-like homes and advocating for affordable design. His son recalls him waking up at 4 a.m. to experiment with toothpicks and balsa wood. He somewhat strangely advocated for an area of downtown Milwaukee to be completely reimaged in the pattern of a Copenhagen's Tivoli Gardens, a nineteenth century amusement park. Minneapolis architect Vincent James, a contemporary of Grieb, called him "a self-styled visionary, as idealistic as he was idiosyncratic... the Jetsons would have loved some of his buildings."

Later in life, Grieb relocated to Houston. He died February 25, 2018. His family requested that donations be sent to Friends of the Domes, a private non-profit that supports educational, scientific, and cultural programs held at the Mitchell Park Domes, a final nod to his greatest architectural achievement.⁴⁸

Statement of Significance – Work of Master Engineer Charles Whitney

Engineer Charles Smith Whitney

Charles Smith Whitney was born in 1892 in Bradford, Pennsylvania. In 1914, he received a master's degree in civil engineering from the Sibley College of Engineering at Cornell University. Subsequently, he worked as a concrete designer for the firm of Stone & Webber in

⁴³ "Donald Grieb to Design Park Conservatory," *Milwaukee Sentinel*, June 15, 1957.

⁴⁴ Rick Barrett, "Architect who designed Milwaukee landmark the Domes has died at age 99," *Milwaukee Journal Sentinel*, March 17, 2018.

⁴⁵ "Grieb, Donald," AIA Directory, various years 1956-1972.

⁴⁶ "Donald Grieb to Design Park Conservatory," *Milwaukee Sentinel*, June 15, 1957.

⁴⁷ "Grieb, Donald," AIA Directory, various years 1956-1972.

⁴⁸ Rick Barrett, "Architect Who Designed Milwaukee landmark the Domes has died at age 99," *Milwaukee Journal Sentinel*, March 17, 2018.

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Boston and for architect Gustav Lindenthal in New York. In Lindenthal's office, Whitney met and worked alongside Othmar Ammann on the Hell Gate Bridge. Following this, Whitney spent a period of time working for architect John Parkinson in Los Angeles. In 1919, he joined Milwaukee-based architectural firm of A. E. Eschweiler (a fellow graduate of Cornell), and then began a partnership with another Milwaukee firm, George A. Hool and Nathan C. Johnson, in 1920.⁴⁹

In 1922, Whitney established what would become a highly successful individual practice in Milwaukee. Some of his early work included the design of bridges in Racine, Watertown, and Milwaukee and serving as the village engineer for the Village of Fox Point. Whitney invested significant time into research and writing during his early career and began to build his reputation as a scholar, innovator, and practitioner in the field of reinforced concrete design and complex structural analysis. During the mid-1910s, he wrote several articles that appeared in *Engineering Record* and the *Cornell Civil Engineer*: "Theory of Displacements Applied to Analysis of Suspension Bridges," "Graphical Analysis of Arches with Fixed Ends Greatly Simplified," "A Simple Method of Determining Two-Hinged Arch Reactions," "Design of Steel and Reinforced Concrete Domes," and "The Erection of Hell Gate Bridge."⁵⁰

As indicated by the article titles, Whitney had an early interest in the analysis of arches and Domes, which would continue through the rest of his life. "His "Design of Steel and Reinforced Concrete Domes," which was based on his master's thesis at Cornell, explored methods of construction and the related theories and means of analysis used to design both steel and reinforced concrete domes. Whitney's interest in dome design may have arisen from the lack of available engineering literature on the topic at this point in his career; as he notes in the article, "the construction of domes is a very interesting problem and one on which there is very little literature available."⁵¹ These early articles also show his interest in providing simplified means of calculating complex material behavior. In "Graphical Analysis of Arches with Fixed Ends Greatly Simplified," Whitney laid out a method of graphical analysis that he claimed was the "simplest and most direct method possible for determining the reactions of an arch rib with fixed ends under moving loads, and the effect of displacements of the abutments." In his words, "graphical methods are sufficiently accurate for practical design, because no great refinement in the solution of such problems is warranted; the solutions all depend upon the fundamental assumption of rigid supports, which is well known to be inexact."⁵² In 1921, he co-authored the

⁴⁹ Michael A. Tomlan, National Register of Historic Places Nomination: Onondaga County War Memorial, National Register of Historic Places Nomination no. 88002754 (National Park Service, 1988), sec. 8, 5, <https://npgallery.nps.gov/AssetDetail/NRIS/88002754>; Gertrude S. Whitney, *The Life of Charles Smith Whitney* (n.p., 1965), 21–22; Joseph A. Wilkes and Robert T. Packard, "Ammann & Whitney," in *Encyclopedia of Architecture: Design, Engineering, and Construction*, vol. 1 (New York: John Wiley & Sons, 1988), 197.

⁵⁰ Charles S. Whitney, "Theory of Displacements Applied to Analysis of Suspension Bridges," *Engineering Record* 74, no. 8 (August 19, 1916): 234–235; Charles S. Whitney, "Graphical Analysis of Arches with Fixed Ends Greatly Simplified," *Engineering Record* 72, no. 11 (September 11, 1915): 324–326; Charles S. Whitney, "A Simple Method for Determining Two-Hinged Arch Reactions," *Engineering and Contracting* 44, no. 7 (August 18, 1915): 123–124; Charles S. Whitney, "Design of Steel and Reinforced Concrete Domes," *The Cornell Civil Engineer* 24 (1916): 108–129; Charles S. Whitney, "The Erection of the Hell Gate Arch," *The Cornell Civil Engineer* 24, no. 3 (December 1915): 85–89; Whitney, *The Life of Charles Smith Whitney*, 24–25.

⁵¹ Whitney, "Design of Steel and Reinforced Concrete Domes," 125.

⁵² Whitney, "Graphical Analysis of Arches with Fixed Ends Greatly Simplified," 324.

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Concrete Designers Manual with George Hool, another testament to his interest in reinforced concrete and its structural analysis.⁵³

Even at this early stage in his career, the quality of his Whitney's research was recognized by the broader engineering profession. He received the Fuertes medal from Cornell University for two papers published in 1925 and 1927: the "Design of Symmetrical Concrete Arches" and "Analysis of Continuous Arch Systems," respectively. His book *Bridges, A Study in Their Art, Science and Evolution*, published in 1929, brought continued recognition.⁵⁴ Beginning in 1932 and continuing through 1957, Whitney also served as the chairman of the American Concrete Institute's Committee 312, which was focused on creating standards for reinforced concrete arch design.⁵⁵

Whitney is best known for his impact on ultimate strength design and plastic theory for reinforced concrete design.⁵⁶ In order to understand his contributions, it is necessary to understand the previous theory for reinforced concrete design that was dominant in the early twentieth century - the working strength (or working stress) method. This method was based on elastic theory, which assumes that "at design loads structures behave in a linearly elastic manner."⁵⁷ In other words, this theory is based on the assumption that concrete and other materials function somewhat like a spring under typical loads—bending and deforming in direct proportion to the load, and returning to their original shape once the load is removed.⁵⁸ The working strength method is based on designing a structure only for the loads that it is anticipated to carry: its own weight (dead load) and environmental stresses like people, snow, wind, etc. (live loads).

In contrast, Whitney promoted plastic theory and ultimate strength design. Plastic theory does not assume that a structure must remain perfectly elastic under increasing load. Instead, it recognizes that real structures—especially reinforced concrete—can crack, yield, and redistribute internal forces. Materials can yield or crush without immediate failure. Rather, forces redistribute as elements reach their strength limits. Rather than focusing on stresses under everyday loads, plastic theory examines the condition at which a structure reaches its ultimate capacity. Ultimate strength design applied these ideas of plastic theory to the designs of structures, ensuring that the structure's maximum (ultimate) load-carrying capacity at failure was greater than the factored design loads, rather than limiting stresses under everyday conditions. In this approach, safety is evaluated by comparing the structure's ultimate strength to the applied loads, rather than by limiting stresses to remain below elastic thresholds.

⁵³ George A. Hool and Charles S. Whitney, *Reinforced Concrete Design* (New York: McGraw-Hill Book Company, 1921); Wilkes and Packard, *Encyclopedia of Architecture*, 197.

⁵⁴ Whitney, *The Life of Charles Smith Whitney*, 24 – 25.

⁵⁵ David Frederick Kelley, "Safety and Stability in Concrete Barrel Shell Roof Structures" (master's thesis, Princeton University, October 1991), 4; Whitney, *The Life of Charles Smith Whitney*, appendix.

⁵⁶ Stutzki and Schultz, "The Mitchell Park Horticultural Conservatory in Milwaukee, Wisconsin," 3.

⁵⁷ Sutat Leelataviwat, Subhash C. Goel, and Shih-Ho Chao, "Plastic Versus Elastic Design of Steel Structures," in *Encyclopedia of Life Support Systems (EOLSS)*, (UNESCO/Eolss Publishers), accessed February 6, 2026, <https://www.eolss.net/sample-chapters/c05/E6-139-04.pdf>.

⁵⁸ B. Lautrup, *Physics of Continuous Matter, Exotic and Everyday Phenomena in the Macroscopic World*, chap. "Linear Elasticity," PDF file, accessed February 6, 2026, <https://cns.gatech.edu/~predrag/courses/PHYS-4421-04/lautrup/7.6/elastic.pdf>.

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One of Charles Whitney's key contributions to this evolution of reinforced concrete theory and design was to provide a simple tool for calculating distribution of stresses according to plastic theory. This tool, now known as the "Whitney Stress Block," was explained in his 1937 paper, "Design of Reinforced Concrete Members Under Flexure or Combined Flexure and Direct Compression." According to Whitney,

It is the purpose of this paper to suggest a complete revision of the method of designing reinforced concrete members subjected to bending and to present a rational method for the proportioning of arch ribs, rectangular columns under eccentric load, and rectangular beams. This method may be extended to cover the design of T beams, round columns and any other form of concrete members. *Simple formulas are given which predict the ultimate strength with remarkable accuracy* based on the cylinder strength of the concrete and the yield point of the steel independent of the ratio of their moduli of elasticity. *It is believed that these equations will greatly simplify the work of the designer and result in the more efficient and economical use of reinforced concrete.* The suggestions are intended to place structural concrete design on a solid practical foundation which is now justified by the advance in construction practices, the availability of better materials, and the information gained by a great amount of research work.

The method here proposed for the design of members under bending and direct stress, particularly for arches, is direct and simple... It is therefore proposed... that the ultimate strength of the member be computed by a new type of formula based on the ultimate strength of the concrete, and on the yield point strength of the steel. [emphasis added].⁵⁹

In short, the Whitney Stress Block is a simplified way engineers represent how concrete resists compression when a beam bends. Instead of calculating the actual but complex, uneven stress pattern, the method replaces it with an equivalent rectangular zone of uniform compression that produces the same overall force. This simplified method makes reinforced-concrete design more practical.

Over the next two decades, Whitney continued to advance and develop his ideas about plastic theory and ultimate strength design through additional publications. For example, in his 1942 article "Plastic Theory of Reinforced Concrete Design," Whitney asserted that he had "improved and extended the equations so that he hopes they may be recognized as forming a satisfactory basis for practical design and further research."⁶⁰ The Whitney Stress Block became a cornerstone of modern concrete design after it was adopted into the American Concrete Institute's code in 1956, and is now the generally accepted method worldwide.⁶¹ In 1956, Whitney and Edward Cohen (an associate at Ammann and Whitney) published a "Guide for Ultimate Strength Reinforced Concrete," which was intended to explain the method "in its simplest form" as a supplement to the recently updated ACI code. Whitney and Cohen explain

⁵⁹ Charles S. Whitney, "Design of Reinforced Concrete Members Under Flexure or Combined Flexure and Direct Compression," *Journal of the American Concrete Institute* 8, no. 4 (March–April 1937): 483 – 484.

⁶⁰ Charles S. Whitney, "Plastic Theory of Reinforced Concrete Design," *Transactions of the American Society of Civil Engineers* 107, no. 1 (1942): 252.

⁶¹ Stutzki and Schultz, "The Mitchell Park Horticultural Conservatory in Milwaukee, Wisconsin," 3; David Darwin, Charles W. Dolan, and Arthur H. Nilson, *Design of Concrete Structures*, 15th ed. (New York: McGraw-Hill Education, 2016), 91.

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the efficiency and cost savings produced by this method, noting that “the designer is enabled to make a more rational structural design, and to avoid wasting construction material.”⁶²

During his career, Whitney also developed a specialty in thin shell concrete; another of his notable theoretical innovations was a new design method for concrete barrel shell roofs. Whitney’s ideas on this topic were covered in three articles published between 1944 and 1955, including “Aircraft Hangars and Terminal Buildings of Reinforced Concrete” (*Aeronautical Engineering Review*, 1944) and “Cost of Long Span Concrete Roof Shells,” (*Journal of the American Concrete Institute*, 1950). Specifically, Whitney argued that it was more economical and efficient for a concrete shell to be placed at the mid-height of the ribs, rather than at the top. According to a thesis published by David Kelly, Whitney’s method allowed for “the elimination of edge stresses in the shell due to rib flexure and the reduction of the stiffness of the combined rib and shell with a corresponding reduction in volume change moments,” leading to a reduction of required rib size and construction cost.⁶³ In 1952, Whitney oversaw the completion of the manual *Design of the Cylindrical Concrete Shell* for the American Society of Civil Engineers (ASCE), reinforcing his expertise in this structure type.⁶⁴

As noted by his biographer Gertrude Whitney, “Charles Whitney approached the builder’s task with the inquiring mind of the scholar...No problem presented to him was solved without first of all clarifying its theoretical implications.”⁶⁵ The enduring significance and foundational nature of his contributions to the theory and practice of reinforced concrete design and structural behavior are illustrated by the fact that the Whitney Stress Block is still taught in classrooms today.

Ammann and Whitney

As Whitney was developing and refining his theories, he was also developing his engineering practice. Around 1940, Whitney’s Milwaukee practice began to experience increased growth, a fact that his biographer attributes to the recognition that he had gained for his theoretical work.⁶⁶ As the United States prepared to enter World War II, Whitney worked with the firm of Mead, Ward & Hunt on the design of the \$30 million Camp McCoy in Wisconsin, which was later used train troops after the invasion of Pearl Harbor.⁶⁷ In the words of Gertrude Whitney, Whitney by this time had established his “renown in the field of concrete design,” and his firm “had very little competition in the design of buildings that were going up in the growing city of Milwaukee,” leading him to pursue new challenges through a partnership with Othmar Ammann.⁶⁸

⁶² Charles S. Whitney and Edward Cohen, “Guide for Ultimate Strength Design of Reinforced Concrete,” *Journal of the American Concrete Institute* 28, no. 5 (November 1956), 456.

⁶³ Kelley, “Safety and Stability in Concrete Barrel Shell Roof Structures,” 1 – 2, 4 – 5; Charles S. Whitney, “Cost of Long-Span Concrete Shell Roofs,” *Journal of the American Concrete Institute* 21, no. 10 (June 1950), 766.

⁶⁴ Rob Whitehead, “Portentous and Predictable: Eero Saarinen, Ammann & Whitney, and the Failures of Kresge Auditorium (1950–1955),” in *Proceedings of the IASS Symposium 2018: Creativity in Structural Design*, July 16–20, 2018, MIT, Boston, USA, 4, <https://dr.lib.iastate.edu/server/api/core/bitstreams/822fab1b-47d5-45cb-b21f-7ebd473dcdad/content>.

⁶⁵ Whitney, *The Life of Charles Smith Whitney*, 29.

⁶⁶ Whitney, *The Life of Charles Smith Whitney*, 26.

⁶⁷ Wilkes and Packard, *Encyclopedia of Architecture*, 197; Whitney, *The Life of Charles Smith Whitney*, 26.

⁶⁸ Whitney, *The Life of Charles Smith Whitney*, 29

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Ammann was born in Switzerland in 1879 and received his engineering degree from the Swiss Federal Polytechnical Institute in 1902. By 1912, he was living in New York, where he served as chief assistant to the well-known bridge engineer Gustav Lindenthal from 1912 until 1923. In 1923, he established his own firm, and went on to establish himself as a bridge designer. He designed many bridges in the New York area, including the Goethals and Outerbridge Bridges (1928), the Bayonne Bridge (1931), the Triborough Bridge (1936), the Lincoln Tunnel (1937) and the Bronx-Whitestone Bridge (1939). He served as chief engineer for the Port of New York Authority from 1930 until 1937 and as director of engineering from 1937 until 1939. The George Washington Bridge (1931) over the Hudson River, which connected Ft. Lee New Jersey with Washington Heights, New York, is particularly notable among his earlier designs; his consulting for chief engineer Joseph B. Strauss on the design of the Golden Gate Bridge in San Francisco, California (1937) is also notable. Ammann also contributed to the profession through the publication of a book in collaboration with F. C. Kunz - the *Design of Steel Bridges*. Published in 1915, the book was a standard for many years.⁶⁹

By the time Whitney approached Ammann about a partnership, Ammann had ended his employment with the New York Port Authority and was working solely as a private consulting engineer.⁷⁰ Following the beginning of their collaboration in 1946 (a collaboration formalized as an official partnership in December 1948), Ammann and Whitney leveraged their respective specialties – Whitney in reinforced concrete and Ammann in bridge design – and already-established reputations to launch the firm to national prominence.⁷¹ The *Encyclopedia of Architecture* (published in 1988) asserted that

the firm of Ammann & Whitney...has been in the vanguard of the architectural engineering field since 1946, when two of the most celebrated engineers of their day came together to form what is now considered one of the best structural engineering firms in the United States. Bridge designer Othmar H. Ammann and reinforced-concrete specialist Charles S. Whitney combined their respective talents to make seemingly “impossible-to-build” architectural designs a reality. Magnificent soaring designs such as Eero Saarinen’s TWA Terminal at John F. Kennedy Airport and the Verrazano-Narrows Bridge (both New York, N.Y.) owe their realization to Ammann and Whitney...the Ammann and Whitney firm in itself is responsible for many of the architectural wonders of the past two decades.⁷²

According to the *Encyclopedia of Architecture and Design*, the firm “immediately enjoyed success in the development and application of the latest state-of-the-art technology to attain practical and economic design solutions.”⁷³ The firm’s launching off point was the design of airport hangars during the post-World War II era. One of Ammann and Whitney’s (A&W) first projects was a concrete hangar at Midway Airport in Chicago, designed for American Airlines and constructed in 1946. This thin shell concrete hangar was designed as a two-hinged arch,

⁶⁹ Tomlan, *Onondaga County War Memorial*, sec. 8, 5.

⁷⁰ Wilkes and Packard, *Encyclopedia of Architecture*, 196-197.

⁷¹ Whitney, *The Life of Charles Smith Whitney*, 41.

⁷² Wilkes and Packard, *Encyclopedia of Architecture*, 196.

⁷³ Wilkes and Packard, *Encyclopedia of Architecture*, 197.

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where the ends of the arch sat on hinges at the abutments. This was an innovative change from earlier thin shell concrete domes, in which arches were rigidly fixed to the abutment with thickened ends for support.⁷⁴ The hangars were also noted for their economical use of concrete, which departed from the typical steel construction. The ribs of the concrete vault were designed with smaller cross sections, therefore using less concrete and resulting in savings when compared to a similar hangar of steel construction. The project was covered extensively in engineering periodicals; a 1948 article in the *Architectural Forum* noted that the hangars were an exception to the relative lack of famous concrete arch structures in the United States up until that time.⁷⁵ According to Gertrude Whitney, “The concept of the design... was Charles’ alone.” The design “was a pioneer effort in the new and growing air industry and the success of the solution of the design, using new theories for thin concrete shells that Charles had developed, made it a pattern for many structures that followed, demonstrating the practicality and economy of long, clear spans that satisfied the requirements for recreational building as well as airfield structures.”⁷⁶

One of the next major projects for the firm was the Onondaga War Memorial Auditorium in Syracuse, New York (NRHP No. 88002754, 1988), constructed in 1951. Whitney’s work in reinforced concrete and his connection to the Portland Cement Association were helpful in obtaining the engineering commission, completed for the architectural firm of Edgerton & Edgerton.⁷⁷ According to the National Register nomination for the auditorium, the structure is “exceptionally significant in American engineering history for the innovative thin shell concrete vaulting system used in its roof... The broad flat arches that composed the roof are supported on two rows of cantilevered brackets, permitting an unobstructed span of 160 feet. This technique was popularized in textbooks and was widely emulated in other large auditoriums and arenas in the early 1950s.”⁷⁸ The use of brackets to support each vault rib helped increase headspace at the balconies and also lowered the thrust line of the ribs, increasing the structural efficiency and safety of the building.⁷⁹ According to Gertrude Whitney, the successful design of this auditorium led to other contracts, including the Alabama State Coliseum at Montgomery, Alabama. Like the Onondaga War Memorial, the structure also featured a thin shell concrete dome with ribs supported by “buttress-like braces of reinforced concrete... obviating the need for both interior columnar support and load-bearing walls.”⁸⁰

In 1949, just a year after formalizing their partnership, Ammann and Whitney received an award from the American Concrete Reinforcing Steel Institute for their “outstanding contribution to the advancement of concrete design” displayed in the Alabama State Coliseum and other projects. According to the *Architectural Record*, the award was given for “the firm’s 30 years of research

⁷⁴ Tomlan, *Onondaga County War Memorial*, sec. 8, 2.

⁷⁵ Thomas Leslie, “Crossroads of the Air,” May 26, 2021, Docomomo Paper, accessed February 6, 2026,

https://www.researchgate.net/profile/Thomas-Leslie-4/publication/351879492_Crossroads_of_the_Air_Docomomo_Paper_May_26_2021/links/60ae5745299bf13438eb5071/Crossroads-of-the-Air-Docomomo-Paper-May-26-2021.pdf; “Reinforced Concrete Shells Span 257 Ft. Wide Airplane Hangars,” *Architectural Forum*, September 1948, 139, <https://www.usmodernist.org/AF/AF-1948-09.pdf>.

⁷⁶ Whitney, *The Life of Charles Smith Whitney*, 36-37.

⁷⁷ Whitney, *The Life of Charles Smith Whitney*, 40.

⁷⁸ Tomlan, *Onondaga County War Memorial*, sec. 8, 2.

⁷⁹ Tomlan, *Onondaga County War Memorial*, sec. 8, 6 – 7.

⁸⁰ Whitney, *The Life of Charles Smith Whitney*, 40; Susan Enzweiler, “Garrett Coliseum,” *Society of Architectural Historians, SAH Archipedia*, accessed January 26, 2026, <https://sah-archipedia.org/buildings/AL-01-101-0033>.

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on concrete arch bridges, on thin-shell arch buildings and on plastic theories of concrete design by Mr. C. S. Whitney and the application of this research to recent designs by the firm.”⁸¹

From here, the firm’s reputation and number of innovative designs continued to increase. In the words of Kathy Howe of the New York State Office of Parks, Recreation and Historic Preservation, “The combined experience of Ammann and Whitney propelled their firm to prominence in the United States and around the world.”⁸² According to the *Encyclopedia of Architecture and Design*, the firm made an important contribution to airport design in the late 1950s through its “series of unique cantilevered airplane hangars which provide large unobstructed floor areas. Ammann and Whitney pioneered an innovative fire-proof, cable-suspended folded plate roof structure of reinforced concrete. This particular hangar design may now be seen in many of the world’s major airports.”⁸³ Some examples of airport hangars with cable-supported roof structures completed by Ammann and Whitney included the TWA Maintenance Hangar, constructed in 1956 at Philadelphia International Airport (HAER No. PA-561) and the Dulles Airport Terminal, completed in 1963.⁸⁴

The Dulles Airport Terminal was one of several unprecedented concrete shell projects in which A&W collaborated with the notable architect Eero Saarinen. Two others included Kresge Auditorium at the Massachusetts Institute of Technology (MIT; completed in 1955) and the TWA Terminal at JFK Airport (completed 1962, NRHP No. 05000994, 2005).⁸⁵

According to scholar Rob Whitehead, the years of collaboration between Saarinen and A&W led to designs in which the architecture and engineering was increasingly integrated.⁸⁶ The TWA Terminal at JFK airport is nationally significant and listed in the National Register of Historic Places as the architectural masterpiece of Eero Saarinen, as well as for its contribution to the development of airline terminal design. The design was unveiled in 1957 and construction began in 1959, but the project was not completed until 1962, after both Whitney and Saarinen had passed away. As project engineers, Ammann and Whitney helped Saarinen realize his vision for the project. The terminal roof consists of four segmental Domes separated by skylights. Each dome rests on two ground supports and on the center of the terminal roof. This design varied from the original single-shell options explored by Saarinen, influenced in part by the engineers’ concern about using a single continuous roof form. Nevertheless, the form was still primarily driven by the architectural design, rather than vice versa. The final design – four separate, arched, barrel-vault quadrants, separated by continuous skylights, with expressive, continuous,

⁸¹ “Concrete Prize,” *Architectural Record*, November 1949, 24, <https://www.usmodernist.org/AR/AR-1949-11.pdf>; Enzweiler, “Garrett Coliseum.”

⁸² Kathy Howe, *National Register of Historic Places Nomination: Trans World Airlines Flight Center*, Nomination no. 05000994 (National Park Service, 2005), sec. 8, 13.

⁸³ Wilkes and Packard, *Encyclopedia of Architecture*, 198.

⁸⁴ *Historic American Engineering Record*, “TWA Maintenance Hangar, HAER No. PA-561,” Historic American Engineering Record, National Park Service/Library of Congress, 1999, accessed February 6, 2026, <https://tile.loc.gov/storage-services/master/pnp/habshaer/pa/pa3700/pa3780/data/pa3780data.pd>; Richard L. Martin, “A Reinforced Concrete Structure with Cable Supported Roof” (master’s thesis, Massachusetts Institute of Technology, 1962), 12, accessed February 6, 2026, <https://dspace.mit.edu/bitstream/handle/1721.1/68302/33256156-MIT.pdf?sequence=2>.

⁸⁵ Rob Whitehead, “Saarinen’s Shells: The Evolution of Engineering Influence,” in *Proceedings of the IASS-SLTE 2014 Symposium “Shells, Membranes and Spatial Structures: Footprints,”* September 15–19, 2014, Brasília, Brazil, 1.

⁸⁶ Whitehead, “Saarinen’s Shells,” 1.

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curving, and cantilevered beams along the edges – demanded innovative structural engineering, involving a central plate that is the only structural connection between the four shells.⁸⁷

In 1958, Ammann and Whitney was hired by the U.S. Civil Aeronautics Administration as the prime contractor for the Dulles Terminal in Washington D.C., and the firm in turn retained Saarinen for the architectural design. The building’s iconic design features a rectangular footprint covered with a catenary curved roof suspended between two curved concrete outer edge slabs. Steel cables stretched across the span support lightweight precast concrete roof panels. As Whitehouse explains, the final design featured “many of the economic and construction advantages long promoted [by Ammann and Whitney].” More specifically,

the construction process was relatively economical thanks to the collective integration of specific strategies for spatial shell construction. Remarkably, the main roof was constructed without *any* scaffolding because the precast panels served as the formwork and the finished roof surface. Because the structural elements were regular and repeating, multiple trades could be working simultaneously as construction progressed from one end to another—in fact, the large steel towers that were used to cast the edge slabs were simply rolled to their new location and the formwork was re-used again.⁸⁸

Other collaborations between A&W and Saarinen included the structural design for the Jefferson Memorial at St. Louis (with the exception of the arch, which was engineered by another firm), dormitories at the University of Pennsylvania, and the John Deere Administration Center in Moline, Illinois.⁸⁹

Minoru Yamasaki was another notable collaborator with Ammann and Whitney. In an article in the *Journal of the American Concrete Institute*, Charles Whitney noted that he “had the privilege of collaborating as structural engineer with Mr. Yamasaki for a number of his buildings. Each one shows originality and a keen understanding and appreciation of the characteristics and potentiality of reinforced concrete. In each case, the structural forms have been suggested by the architect and involve the most modern techniques.”⁹⁰ Projects engineered for Yamasaki included the American Concrete Institute Headquarters Building and the McGregor Conference Hall at Wayne University, both located in Detroit, Michigan and completed in 1958. The ACI headquarters building features a folded plate roof that cantilevers 20 feet from central corridor bearing walls. The roof was composed of precast folded plate units welded together after the roof was erected, and covered with a plastic coating in lieu of insulation and roofing.⁹¹

According to Gertrude Whitney, “the work of Ammann and Whitney was very diversified and at some of its peak periods the New York and associated offices had as many as 900 engineers

⁸⁷ Whitney, *The Life of Charles Smith Whitney*, 45-46; Whitehead, “Saarinen’s Shells,” 3-5; Howe, *Trans World Airlines Flight Center*, sec. 8, 13 – 16.

⁸⁸ Whitehouse, “Saarinen’s Shells,” 6-7.

⁸⁹ Whitney, *The Life of Charles Smith Whitney*, 44.

⁹⁰ Charles S. Whitney, “Cantilevered Folded Plate Roofs ACI Headquarters,” *Journal of the American Concrete Institute* 30, no. 4 (October 1958): 429.

⁹¹ Whitney, “Cantilevered Folded Plate Roofs,” 429.

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working overtime on design and detailing.”⁹² The firm’s list of projects is extensive. Some other notable projects by the firm included the Milwaukee Expressway, which necessitated the establishment of a Milwaukee office for the firm, and other highways like sections of the Garden State Highway, the New Jersey Turnpike, Section II of the Connecticut Turnpike, the New York Thruway, the Horace Harding Expressway, and the Ohio Turnpike. The firm was engaged with the designs of other airport hangars and terminals, like the Mohawk Airlines hangar in Utica, the Swissair terminal at Kennedy Airport, the LaGuardia Terminal, the National Airlines terminal at Kennedy Airport, a hangar for TWA at Kansas City, and the National Airlines terminal at Tampa, Florida.⁹³ Additional assembly structures included the Dallas Memorial Auditorium, a 204-ft.-span concrete dome with 45-foot reinforced concrete arms cantilevered from 70-foot high columns, which was dedicated in 1958 and for which A&W was retained by the Dallas-based architecture and engineering firm of Geroge L. Dahl.⁹⁴ The Assembly Hall of the University of Illinois (in Urbana, Illinois), completed in 1963, was a collaboration with architects Harrison and Abramovitz, while the Mellon Arena (Pittsburgh, Pennsylvania), completed in 1961, was designed with architects Mitchell and Riley. The bowl-shaped Assembly Hall featured a folded-plate concrete dome roof spanning 400 feet, only 3.5 inches thick at its thinnest point, and another upturned dome as the base, a design that removed the need for any columns at the interior. The Mellon Arena featured a retractable steel domed roof.⁹⁵ The firm continued the bridge work for which Ammann had become known, including the Throgs Neck Bridge (1961), and the Verrazano-Narrows Bridge (1964), both in New York City. The latter had a span of 4,260 feet, 60 feet longer than the Golden Gate Bridge.⁹⁶

The firm was engaged in work for the federal government, including the Navy, the Corps of Army Engineers, and the Federal Civilian Defense Administration. The firm’s consulting work for the National Security Resources included studies on protective construction. For the Army Corps, A&W completed a manual of Missile Center Control Standards (begun in 1950 and revised in 1959) and a study of a blast resistant test structures.⁹⁷ The firm also completed international projects, like the 1959 Bridge of the Americas in Panama City, Panama; by that year, the firm had contracts in Greece, Turkey, Ethiopia and Iran managed by Charles Whitney.⁹⁸ Locally in Wisconsin, Whitney consulted on many large projects, including the Milwaukee Memorial Center and the University of Wisconsin Camp Randall Memorial Practice Building in Madison.⁹⁹ His biographer also lists numerous industrial buildings, theaters, schools, residential buildings, commercial buildings, and institutional buildings constructed in Milwaukee and

⁹² Whitney, *The Life of Charles Smith Whitney*, 43.

⁹³ Whitney, *The Life of Charles Smith Whitney*, 42 – 43.

⁹⁴ “Buildings in the News,” *Architectural Record*, February 1958, 10.

⁹⁵ Wilkes and Packard, *Encyclopedia of Architecture*, 198; Lu Donnelly et al., “Mellon Arena,” *Society of Architectural Historians, SAH Archipedia*, accessed January 26, 2026, <https://sah-archipedia.org/buildings/PA-01-AL122>; Howe, *Trans World Airlines Flight Center*, sec. 8, 13.

⁹⁶ Frank Griggs, Jr., Dist. M. ASCE, D. Eng., P.E., P.L.S., “Othar H. Ammann,” *STRUCTURE* magazine, April 2013, 44.

⁹⁷ Whitney, *The Life of Charles Smith Whitney*, 50-51.

⁹⁸ “Bridge of the Americas,” *Structurae: International Database and Gallery of Structures*, accessed February 6, 2026, <https://structurae.net/en/structures/bridge-of-the-americas>; “Whitney, Engineer, 66, Dies: Ammann & Whitney Partner Specialized in City Planning – Led Concrete Institute,” *New York Times*, October 27, 1959.

⁹⁹ “Whitney, Engineer, 66, Dies: Ammann & Whitney Partner Specialized in City Planning – Led Concrete Institute,” *New York Times*, October 27, 1959; *Camp Randall Memorial Park: Cultural Landscape Inventory*, revised 2011 (Madison: University of Wisconsin–Madison Campus Planning & Landscape Architecture/Quinn Evans Architects), 11, accessed February 6, 2026, <https://cpla.fpm.wisc.edu/wp-content/uploads/sites/20/2017/05/Camp-Randall-Memorial-Park- rev-2011.pdf>.

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Wisconsin for which Whitney was either the consulting or designing engineer, ranging from the Milwaukee Children's Hospital to the West Milwaukee Village Hall and the Milwaukee Country Club.¹⁰⁰

During this time, Whitney was engaged not only in scholarship and practice but also in the staff development of the Ammann and Whitney firm. According to Gertrude Whitney, Charles invested significant effort in hiring staff of "diversified and recognized abilities" who he intended to train to carry on the work of the firm. Initial employees included Boyd Anderson, Milton Brumer, Leo Just, Nomer Gray, Herbert Rothman, Benjamin Forsyth, Mike Fiegen, and James Whitney (Charles' son), some of whom later occupied key positions in the firm. According to Boyd Anderson, "...Mr. Whitney was as proud of his organization and of his skill in developing it as he was of his foresight of the engineering needs and the masterly solution of the many technical problems with which the firm was faced."¹⁰¹ Charles encouraged his staff to produce scholarly publications, recognizing the "importance to the expansion and continuity of the firm of establishing the reputation of individual staff members."¹⁰²

The demands on Whitney's time during the 1950s were tremendous. He maintained his Milwaukee office, but delegated its management to Robert Hopwood, who by 1961 was noted as the manager and chief engineer for the Milwaukee office. As the partnership with Ammann got underway, Whitney spent considerable time traveling, taking weekly trips to New York and serving as a consultant for committees of the various engineering societies to which he belonged. By the time of his death in 1959, he was alternating weeks between New York City and overseas locations at the firm's international projects.¹⁰³

The awards received during the second half of Whitney's career were numerous. In 1940, he was made an honorary member of the Milwaukee Chapter of the American Institute of Architects. He and Ammann received the Concrete Reinforcing Steel Institute's first annual award in 1949 and received the Alfred Lindau Award from the American Concrete Institute in 1951. ACI awarded him the Mason Medal again in 1952 and 1955, and he served as president of ACI in 1955. As noted in his biography by Gertrude Whitney, "his work on committees for the Institute was very time consuming and resulted in the production of many valuable standards and procedures for concrete design." For ACI, he served as a member of the Building Code Committee (ACI 318), the Standards Committee, as a chairman of the "Plain and Reinforced Arches" Committee (ACI 312) from 1932 until 1957), and as chairman of the "Shear and Diagonal Tension – Joint ACI and ASCE" Committee from 1950 through 1959.¹⁰⁴ In addition to ACI, Whitney was a member of the American Institute of Consulting Engineers, the American Society of Civil Engineers, the American Society of Municipal Engineers, and the American Society for Testing Materials.¹⁰⁵

¹⁰⁰ Whitney, *The Life of Charles Smith Whitney*, 32b.

¹⁰¹ Whitney, *The Life of Charles Smith Whitney*, 35 – 36.

¹⁰² Whitney, *The Life of Charles Smith Whitney*, 37 – 38.

¹⁰³ Whitney, *The Life of Charles Smith Whitney*, 31, 38; "University of Wisconsin to Honor 7 Engineers at May 1 Celebration," *La Crosse Tribune*, April 16, 1959, newspapers.com; "World's First Space Frames Rise in Milwaukee," reprint from *Milwaukee Engineering*, May 1961, 4.

¹⁰⁴ Whitney, *The Life of Charles Smith Whitney*, 26 – 27; *ACI: A Century of Progress* (American Concrete Institute, 2004), 75, accessed February 6, 2026, https://www.concrete.org/Portals/0/Files/PDF/ACI_History_Book.pdf; Whitney, *The Life of Charles Smith Whitney*, appendix.

¹⁰⁵ Whitney, *The Life of Charles Smith Whitney*, 32a.

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On October 25, 1959, Whitney passed away in Paris, after becoming ill while on an international business trip.¹⁰⁶ By the time of his death, Whitney was “recognized as one of the leading engineers in the world.”¹⁰⁷ In 1960, the *American Concrete Institute* established the Charles S. Whitney medal, awarded annually for “noteworthy engineering development work in concrete design and construction,” memorializing his contributions to the profession.¹⁰⁸

Othar Ammann passed away just a few years later in 1965.¹⁰⁹ The firm continued in practice, but was acquired by Louis Berger in 1994 and then integrated with the Louis Berger Group in 2016 to form Louis Berger U.S. In 2018, Louis Berger was acquired by WSP.¹¹⁰

The Milwaukee Domes

Constructed beginning in 1959—the year of Whitney’s death—the Milwaukee Domes was a capstone project of Whitney’s career, clearly demonstrating his ability to understand and mathematically represent the structural behavior of new and complex architectural forms. As the only known space-frame structure Whitney designed that was constructed, the Domes constitute a unique physical realization of his theories, expressing the flow of structural forces through a conoidal-shaped dome while realizing the architectural vision. The new architectural form, and the functional requirements of a horticultural conservatory, demonstrate Whitney’s mastery of reinforced concrete design and structural analysis. Whitney’s expertise in engineering theory and practice supported architect Donald Grieb’s vision, making the Domes’ unique design possible. As an excellent representation of Whitney’s nationally-significant contributions to the field of civil engineering in America, the property is nationally significant under Criterion C as the work of a master.

Grieb’s selection of Ammann and Whitney as consulting engineers for the Milwaukee Domes was a logical choice. By 1957 (when Grieb was selected as the project architect), Charles Whitney had established a prominent reputation in reinforced concrete expertise. The Domes were developed around the same time as the firm’s work on several other well-known projects, including Kresge Auditorium (completed 1955), TWA Flight Center (completed 1962), and Dulles International Airport (completed 1963). As engineer Christian L. Stutzki and professor Joshua A. Schultz state, “at the time of the design for The Domes, Whitney was 67 years old and had a wealth of concrete and construction knowledge that he used to support the development of the innovative space frame structure for The Domes. Notably, Whitney had “developed a robust understanding of thin shelled concrete structures and principal stresses which were used in development of the layout of structural members for The Domes.”¹¹¹ Whitney’s wealth of expertise in design of reinforced concrete would have been invaluable in designing the numerous

¹⁰⁶ “Charles Whitney, Prominent Consulting Engineer, Dead,” *Capital Times* (Madison, WI), October 27, 1959.

¹⁰⁷ Whitney, *The Life of Charles Smith Whitney*, 31.

¹⁰⁸ *ACI: A Century of Progress*, 68.

¹⁰⁹ Griggs, “Othar H. Ammann,” 44.

¹¹⁰ “Berger Group’s Strategy Still Relies on Going Far From Home,” *Engineering News-Record*, July 28, 2003, <https://www.enr.com/articles/28983-berger-group-s-strategy-still-relies-on-going-far-from-home>; “Louis Berger Merges Two Operating Companies to Form New U.S. Operation,” *Zweig List*, July 4, 2016, <https://zweiglist.com/louis-berger-merges-two-operating-companies-to-form-new-u-s-operation/>; “WSP Sells Louis Berger Services,” *WSP.com*, August 7, 2023, <https://www.wsp.com/en-us/news/2023/wsp-sells-louis-berger-services>.

¹¹¹ Stutzki and Schultz, “The Mitchell Park Horticultural Conservatory in Milwaukee, Wisconsin,” 3.

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components of the structure, from the thin shell entrance arches to the precast geometric dome sections.

According to a 1961 article in *Milwaukee Engineering*, Ammann and Whitney were chosen to “provide structural engineering studies and working drawings” to support Grieb’s unique design.¹¹² The approach to the engineering of the Domes is best laid out in an interview with Robert Hopwood, chief manager and chief engineer for A&W’s Milwaukee office. The interview, which took place after Whitney’s death, was published in the *Journal of the American Concrete Institute* in 1961. Hopwood explained how the firm approached the theory and calculations for the unique structure:

Almost at the outset, we decided to use concrete on this structure as the most practical material to resist the effects of moisture and insecticides from within the Domes. The architect, having furnished us with the surface of revolution, made one other request which was to give them a surface that would permit 75 percent unobstructed light to enter. Ordinary smooth Domes are not difficult to design. We began the design as a smooth surfaced one, then switched to a patterned surface, much the same as one would do in the design of a truss to replace a beam design. The principal stresses in a dome are compression along the meridians and either compression or tension along the horizontal circles. The first step was to find what patterns of members were suitable to carry the resolved stresses and maintain stability in the structure. These patterns were discussed with the architect for his final choice in beginning his aesthetic treatment of the structure. The dome stresses were finally grouped at juncture points and resolved into the individual members.

Due to the large cost of the form work, it was decided to detail the Domes for precast handling by selecting field joints to create the smallest number of members and at the same time provide the greatest re-use of forms. The design strength of the concrete was limited to 5,000 psi and the plastic or ultimate theory was used in the final designs.¹¹³

With drawings completed only months before his death, the Domes were one of the last projects designed by Whitney. Unfortunately, Whitney’s own thoughts about his role in the Domes have not been preserved in the historical record. The January 21, 1959 drawings bear the title block of Charles S. Whitney, Consulting Engineer and his stamp indicating that he served as engineer of record, but correspondence, calculations, or memos related to the project have not been preserved. References to the Domes also do not appear in Whitney’s body of scholarly literature, likely because Whitney passed away in October 1959, one month prior to the start of the Domes’ construction.¹¹⁴

Though Whitney’s untimely death limited his ability to self-reflect on the position of the Domes within his career, analysis of the project within the context of Whitney’s achievements indicates

¹¹² “World’s First Space Frames Rise in Milwaukee,” reprint from *Milwaukee Engineering*, May 1961, 4.

¹¹³ W. John Hufschmidt, “Precast Complex Conoidal Horticultural Domes,” *Journal of the American Concrete Institute* 58, No. 5 (November 1961), 544 – 545.

¹¹⁴ Portland Cement Association, “A Unique Ecological Conservatory,” undated, courtesy of Milwaukee County.

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that it is a notable representation of his accomplishments. Whitney resolved the complex movement of structural forces within the dome into simple struts in a way that integrated seamlessly with the architectural vision: his methods of mathematical analysis are seen in the structure itself and arranged to meet the architect's design. The structure is also the only space frame designed by Whitney that was built. While Whitney was well-known for merging his theories of material behavior with engineering practice - like his thin shell concrete domes at the TWA Terminal, Dulles Airport Terminal, and Kresge Auditorium – the conoidal Domes are a one-of-a-kind expression of the movement of structural forces in a new architectural form: the precast members of the Domes physically illustrate the forces that flow through the structure, reflecting theories of behavior in the architectural design. As Stutzki and Schultz state, the “design of the Domes illustrates an important structural methodology that simplifies complicated structural analysis into an efficient and constructable design.”¹¹⁵

The project also represents the key role that Whitney played in helping architects realized their design visions. As the structural engineer, Charles Whitney supported Grieb's vision for the Domes, making the unique conoidal form possible. The collaboration with Grieb to meet his aesthetic vision while providing the required structural stability and light is consistent with the role of a consulting engineer, and with A&W's collaborative approach in working with other architects like Saarinen and Yamasaki.

As National Register Bulletin “How to Apply the National Register Criteria for Evaluation” explains, “A property with national significance helps us understand the history of the nation by illustrating the nationwide impact of events or persons associated with the property, its architectural type or style, or information potential. It must be of exceptional value in representing or illustrating an important theme in the history of the nation.”¹¹⁶ As a unique representation of Whitney's national significance in the theory of reinforced concrete engineering, the Milwaukee Domes are significant at the national level under Criterion C.

Comparative Analysis

In order to capture the significance of the Domes at both the state and national levels both conservatories, significant engineering works were examined in the context of the Domes' design and construction. Due to the unique nature of the Domes, typical comparison properties were not widely discoverable. However, the available examples both in the context of horticultural conservatory construction, dome-shaped buildings, and engineering contributions help to illustrate just how significant the Domes have come to be.

Due to the patent on the original design and conoidal shape, the Domes were never replicated and therefore have no truly identical comparison properties.¹¹⁷ The Greater Des Moines

¹¹⁵ Stutzki and Schultz, “The Mitchell Park Horticultural Conservatory in Milwaukee, Wisconsin,” 1.

¹¹⁶ National Park Service, *How to Apply the National Register Criteria for Evaluation*, National Register Bulletin (Washington, DC: U.S. Department of the Interior, National Park Service, 1995), 10, accessed February 6, 2026, https://www.nps.gov/subjects/nationalregister/upload/NRB-15_web508.pdf.

¹¹⁷ Christian L. Stutzki and Joshua A. Schultz, “The Mitchell Park Horticultural Conservatory in Milwaukee, Wisconsin,” in *Proceedings of the IASS 2022 Symposium, affiliated with the APCS 2022 Conference*, September 19–22, 2022 (Madrid: International Association for Shell and Spatial Structures and Asian-Pacific Conference on Shell and Spatial Structures, 2022),

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Botanical Garden was constructed in 1979 and features a wider, flatter dome (80 feet tall by 150 feet wide). The Bloedel Conservatory in Vancouver, British Columbia, Canada also utilizes varying frame shapes for its triodetic dome. The result, however, is a dome that is wider and flatter, in contrast to the taller conoidal dome. The acrylic panels that once clad the Bloedel dome have been replaced. The Plexiglas at Missouri's 1960 Climatron,[®] discussed in sections above, has been replaced with modern-era glass. Buckminster Fuller's own significant glass-clad dome of the era, the U.S. Pavilion for Expo 67, the World Fair in Montreal, is composed of a double layer of structural supports connected by a latticework of struts and post-dates the Mitchell Park Domes. The Black River Waste Water Treatment Plant in Baltimore, Maryland (also referred to as the Golden Eggs), has a more similar egg shape but is not glazed nor used as a conservatory.

Generally, properties listed in the National Register under Criterion C as the work of a master are more likely to have been nominated for their association with a master architect than for their association with a master engineer. The 2005 listing of Oregon's Coos Bay Bridge No. 0183 in the National Register of Historic Places is an exception to this trend and provides an example of a property that is significant at the national level as the work of a master engineer. The bridge was listed under Criterion A and C. Under Criterion C, the bridge was listed as nationally significant as the work of master engineer and Oregon State Bridge Engineer Cond B. McCollough. Like Whitney, McCollough was nationally known for his contributions to the engineering field. McCollough focused on bridge design and construction and the integration of visually appealing designs with innovative bridge technologies. The Coos Bay Bridge is significant for its association with its engineer and representative of his theoretical contributions to the field, much like the Domes is representative of Whitney's theoretical contributions.

Whitney was a prolific engineer, providing the structural engineering for hundreds of buildings and structures throughout his career. Many of these projects merge his theories of material behavior with engineering practice, like his American Airlines Hangar (1946), the Onondaga War Memorial (1951), the Kresge Auditorium (1955), the TWA Flight Center (1962), and the Dulles International Airport (1963). However, the Milwaukee Domes occupy a uniquely significant position in his body of work. Engineered just months before his death, the Domes are a capstone project of his career, and they are the only-known space-frame structure engineered by Whitney to be constructed. Furthermore, the conoidal Domes are a one-of-a-kind expression of the movement of structural forces in a new architectural form; by physically illustrating the forces that flow through the structure, the precast members of the Dome literally and uniquely reflect theories of behavior in the architectural design.

When comparing the Mitchell Park Horticultural Conservatory to other conservatories and twentieth-century domed structures, and to other engineering designs by Charles Whitney, the significance of the Domes along with its intact integrity clearly position it as a National Register-eligible and nationally significant property. The story of the Domes, both in its architectural and engineering history, uniquely illustrates a confluence of architecture, engineering, and design in a way that exemplifies both the architectural state of mind of Wisconsin at the time in addition to the theoretical contributions of Charles Whitney, truly

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capturing a singular moment in architectural and engineering history in Wisconsin and the United States.

Concluding Significance Statement

The Mitchell Park Domes represent a significant method of construction that resulted in an architectural and engineering icon. Grieb's fully integrated dome construction system incorporates drainage, structure, glazing, stiffening, and access for repairs and maintenance. It is the first and only dome system of its kind used in a conservatory. It represents an architect's vision that is intricately tied to use, that considers unique requirements for plants and visitors, and that seeks to achieve a complex mix of programmatic elements and site considerations through an architectural form that evokes the architecture of the time while imagining the possibilities of the future. For this reason, the property is considered eligible at the state level of significance under Criterion C in the areas of architecture and engineering.

In addition to its state-level significance in the areas of architecture and engineering, the Domes are significant as the work of master engineer Charles Whitney. Whitney is a nationally significant engineer known for his contributions to reinforced concrete and structural analysis. Through his theoretical work and engineering practice, Whitney translated complex material behavior into simple yet accurate mathematical abstractions and approximations, most notably the "Whitney Stress Block," which remains a standard concept in engineering education for reinforced concrete design. Whitney's nationally recognized contributions to the field of reinforced concrete and structural analysis and his association with the Domes make it nationally significant under Criterion C in the area of engineering as the work of a master.

Land Acknowledgement (will be reviewed by the Office of the State Archaeologist)

This nomination recognizes the depth of human presence here, the ancestral homeland of American Indians for millennia. From as early as the seventeenth century, Euro-American exploration and settlement, military campaigns, and government programs, all had the effect of repeated displacement of Indians of many tribal affiliations. This continuous tribal movement resulted in Wisconsin being home to many tribes who originated from other parts of the country, generating a pattern of immigration, relocation, and formation of a new homeland. Some of these tribes remain in Wisconsin but others may not. We acknowledge that the property that is the subject of this nomination is located on land long occupied by American Indians.

Archaeological Potential (will be drafted and reviewed by the Office of the State Archaeologist)

Preservation Activities (for properties in CLGs)

This nomination to the National Register of Historic Places was prepared in conjunction with a rehabilitation effort utilizing state and federal historic tax credits.

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As a partner with the Wisconsin State Historic Preservation Office (SHPO) and the National Park Service (NPS) participating in the Certified Local Government (CLG) program, [city/village/town] is required to maintain a system to survey and inventory historic properties. That entails regular surveys with updates every 20-25 years to identify properties that appear potentially eligible for the NRHP.

END OF STATEMENT OF SIGNIFICANCE DO NOT DELETE

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Mitchell Park Horticultural Conservatory
Name of Property

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9. Major Bibliographical References

Previous documentation on file (NPS):

- preliminary determination of individual listing (36 CFR 67) has been requested
- previously listed in the National Register
- previously determined eligible by the National Register
- designated a National Historic Landmark
- recorded by Historic American Buildings Survey # _____
- recorded by Historic American Engineering Record # _____
- recorded by Historic American Landscape Survey # _____

Primary location of additional data:

- State Historic Preservation Office
- Other State agency
- Federal agency
- Local government
- University
- Other
- Name of repository: _____

Wisconsin Architecture and History Inventory # 5269, 248272, 248273, 248274
and/or Archaeological Site Inventory #: _____

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END OF BIBLIOGRAPHY DO NOT DELETE

DRAFT

Mitchell Park Horticultural Conservatory
Name of Property

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10. Geographical Data

Acreeage of Property: 7.68

Provide either the UTM system or latitude/longitude coordinates

Latitude/Longitude Coordinates

Datum if other than WGS84: _____
(enter coordinates to 6 decimal places)

1. Latitude:	_____	Longitude:	_____
2. Latitude:	_____	Longitude:	_____
3. Latitude:	_____	Longitude:	_____
4. Latitude:	_____	Longitude:	_____

Or

UTM References

Datum (indicated on USGS map):

NAD 1927 or NAD 1983

1. Zone:	<u>16T</u>	Easting:	<u>423033</u>	Northing:	<u>4765268</u>
2. Zone:	<u>16T</u>	Easting:	<u>423033</u>	Northing:	<u>4763942</u>
3. Zone:	<u>16T</u>	Easting:	<u>422790</u>	Northing:	<u>4763954</u>
4. Zone:	<u>16T</u>	Easting:	<u>422790</u>	Northing:	<u>4763954</u>

Verbal Boundary Description (Describe the boundaries of the property.)

The boundary begins at the main driveway extending east of South Layton Boulevard and continues north and east along the park access road that curves around the west parking lot. It then continues along the fence enclosing the greenhouse addition, rear loading areas, and non-public exterior spaces. This tall metal security fence begins at the north side of the northernmost dome and continues east and then south along the east side of the greenhouse addition. It continues west along the greenhouse addition's south façade, offset about twenty feet from the wall, and terminates at the addition's southwest corner. Trees largely obscure this fence from the park. The proposed boundary continues west from the corner of the greenhouse addition, following the north edge of the sidewalk and then the south edge of the entrance drive.

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Boundary Justification (Explain why the boundaries were selected.)

The property boundary includes the area immediately surrounding the Domes and the original approach road, parking lot, and circle drive consisting of both contributing and noncontributing objects, buildings, and structures. Due to its setting within a park, the Domes to inherently share a history with the park itself. However, they operate as a distinct and separate entity from the rest of the park managed by a separate organization. a combination of historical boundaries/site features and existing fences/curbs is utilized to define the present boundary. The existing boundary encompasses the land and resources historically associated with the Domes while excluding altered and/or extraneous land that does not contribute to the significance of the property evaluated in this nomination.

END OF GEOGRAPHIC DATA DO NOT DELETE

Mitchell Park Horticultural Conservatory
Name of Property

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11. Form Prepared By

name/title: Lauren Anderson, Kate Bissen, Meghan Elliott, Donna Weiss, Shannon Winterhalter
organization: New History
street & number: 819 North Cass Street
city or town: Milwaukee State: WI zip code: 53202
Email: winterhalter@newhistory.com
Telephone: 414-206-2141

Additional Documentation

Figure Log

- Provide a list of all maps, plans, and additional documentation provided

Figure 1: Location and Context Map. Source: Google Maps.

Figure 2: National Register Boundary. Source: Google Maps.

Figure 3: National Register Boundary and Contributing/Noncontributing Resources. Source: TKWA and New History.

Figure 4: Site and Exterior Photo Key

Figure 5: Basement Level Plan and Photo Key. Source: TKWA and New History.

Figure 6: Basement Level Plan

Figure 7: First Floor Plan and Photo Key

Figure 8: Diagram of dome structural shapes from U.S. Patent drawing (US3192668A)

Figure 9: Photograph of the apex installation at the top of a dome. Source: Milwaukee County Parks Historic Photograph Collection.

Figure 10: Photograph showing a pre-assembled glass panel being lifted into place. The hubs connect the glass to the concrete at designated points (dark squares). Source: Printed in Mitchell Park Horticultural Center guidebook ca. 1968.

Figure 11: Architect's model showing a concept with additional Domes. Source: *Milwaukee Sentinel*, July 20, 1958.

Figure 12: First Lady Lady Bird Johnson speaking at the dedication of the Domes, October 1965. Source: Milwaukee County Parks Historic Photograph Collection.

Figure 13: Photograph of the falsework used to construct the Arid House. Source: Milwaukee County Parks Historic Photograph Collection.

Figure 14: Example of a Domes Hub during construction. Source: Milwaukee County Parks Historic Photograph Collection.

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Embed figures

- **Maps:** A **USGS map** or digital equivalent (7.5 or 15 minute series) indicating the property's location.
- **Sketch map** for historic districts and properties having large acreage or numerous resources. Key all photographs to this map.
- **Additional items:** such as floor plans of representative spaces, photo keys, historic images, etc.(Check with the SHPO, TPO, or FPO for any additional items.)

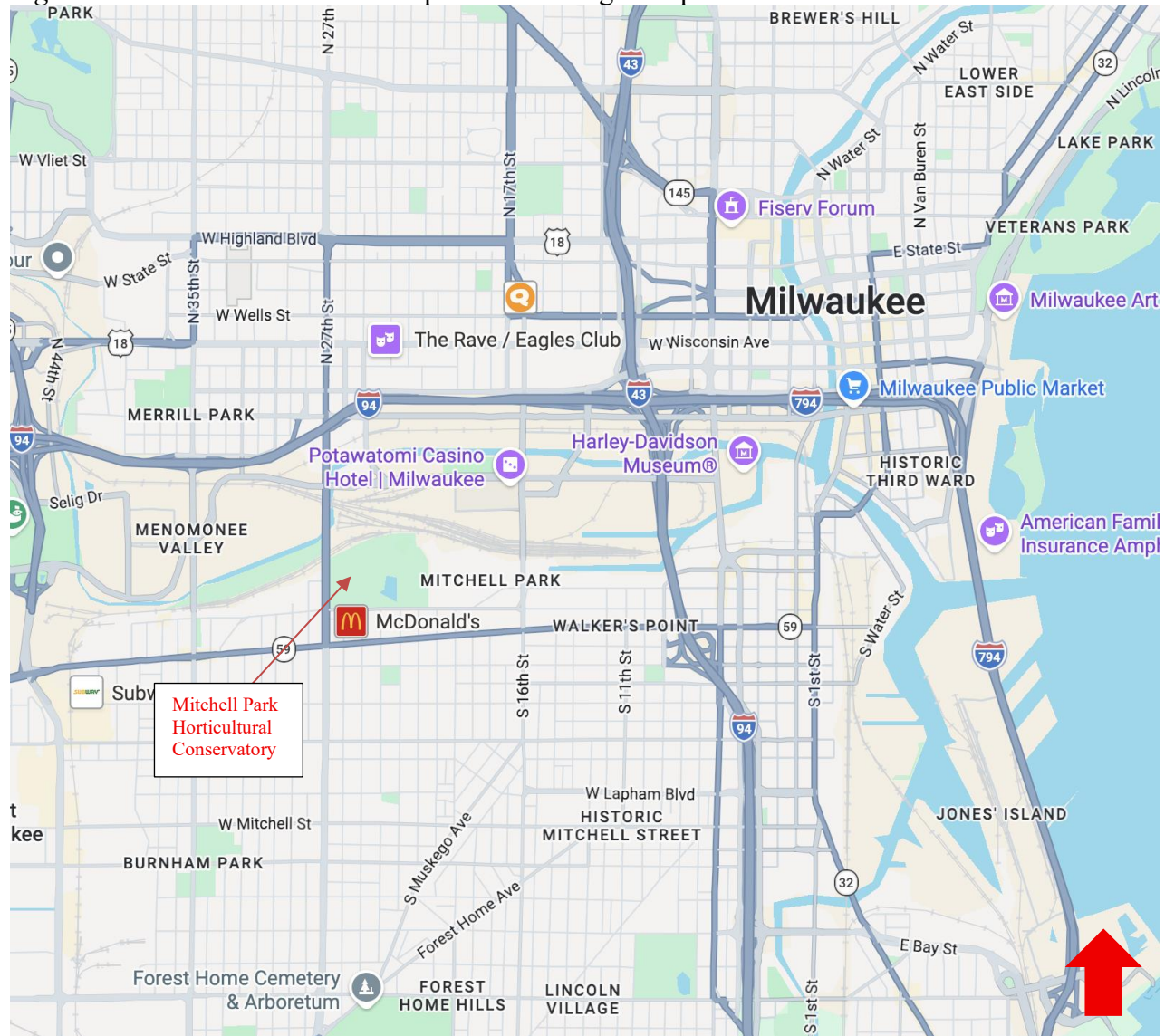
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Mitchell Park Horticultural Conservatory

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Figure 1: Location and Context Map. Source: Google Maps.



Mitchell Park Horticultural Conservatory

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Figure 2: National Register Boundary. Source: Google Maps.

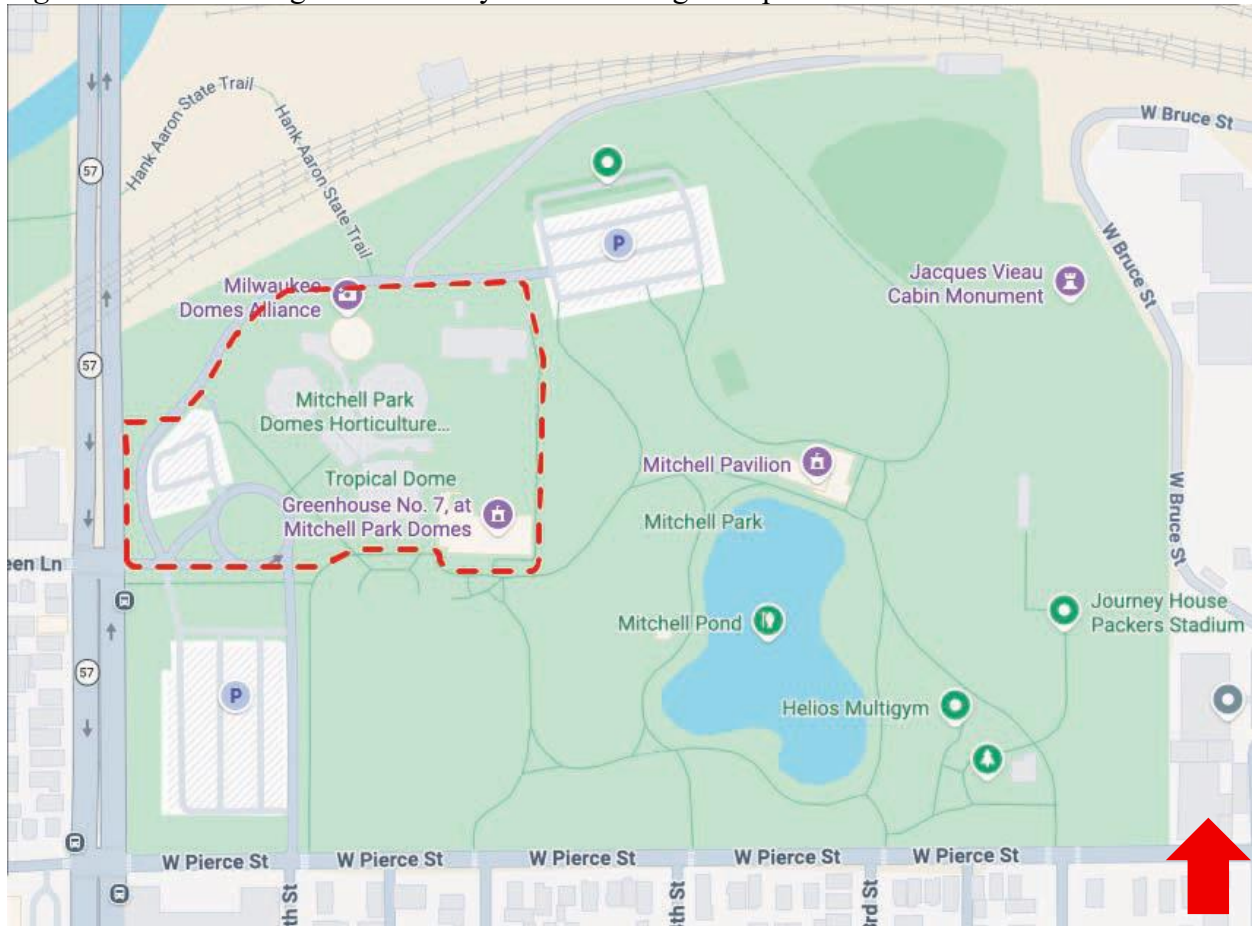
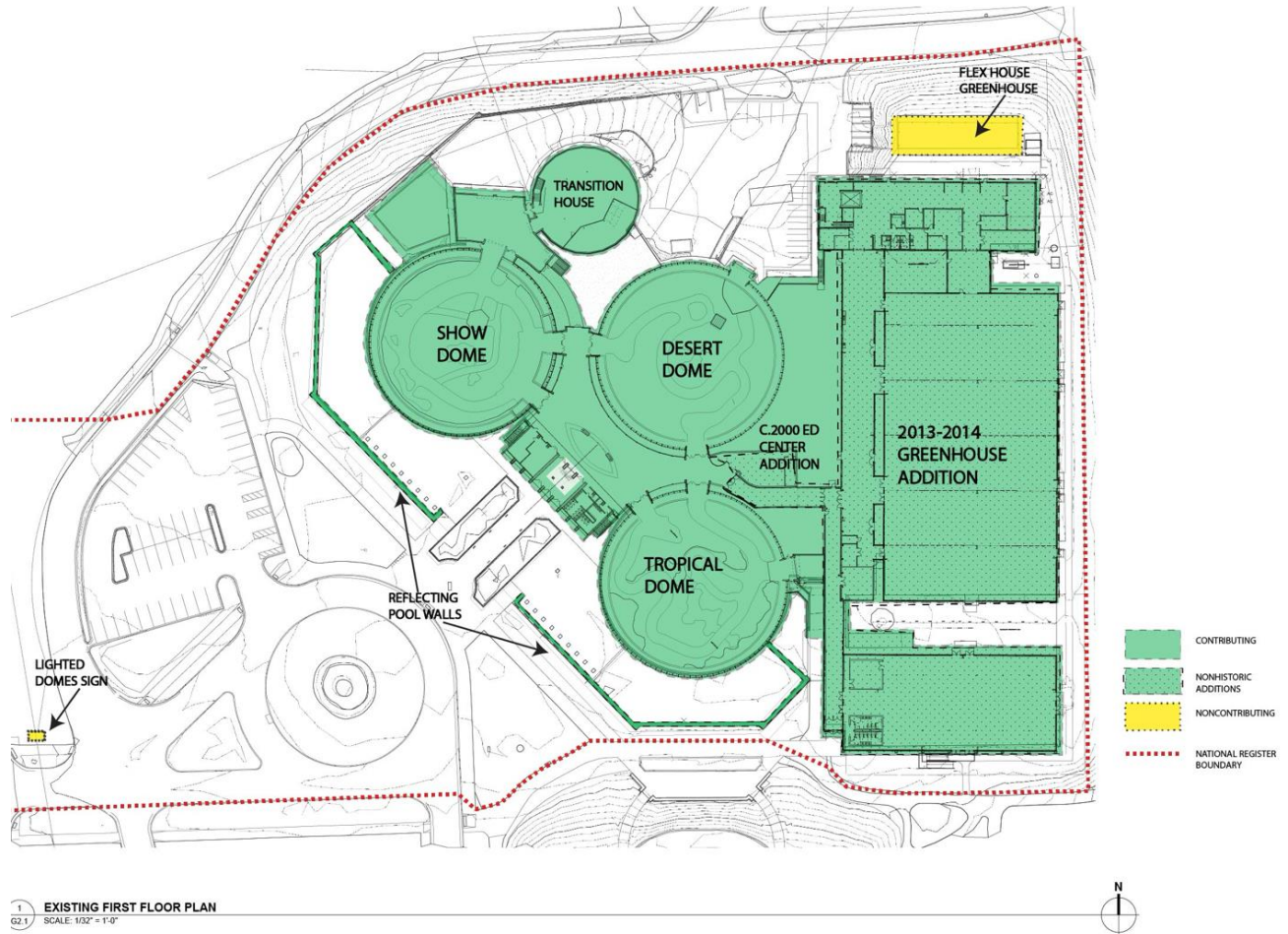


Figure 3: National Register Boundary and Contributing/Noncontributing Resources.
Source: TKWA and New History.



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Figure 4: Site and Exterior Photo Key



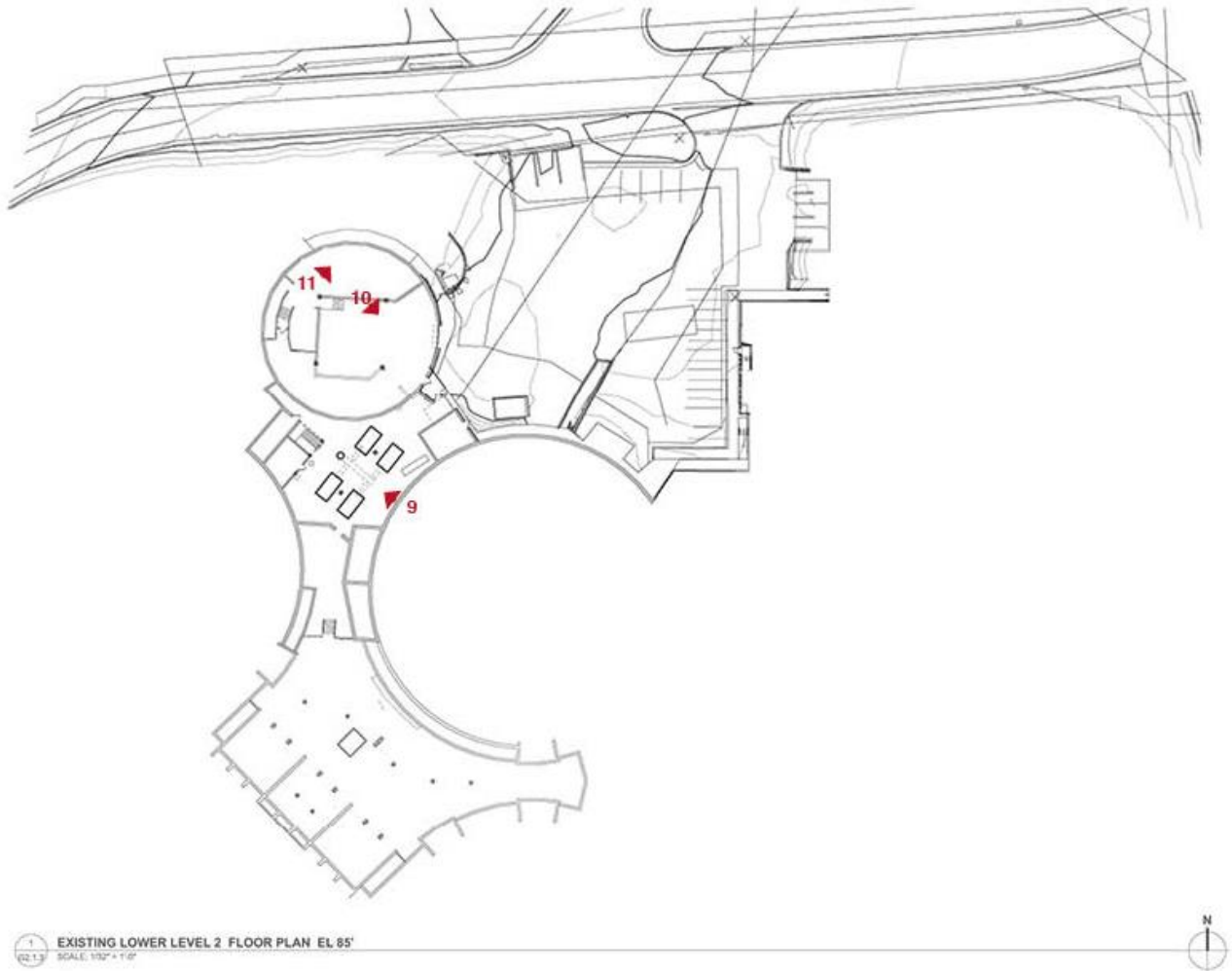
Mitchell Park Horticultural Conservatory

Milwaukee Co., Wisconsin

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Figure 5: Basement Level Plan and Photo Key. Source: TKWA and New History.



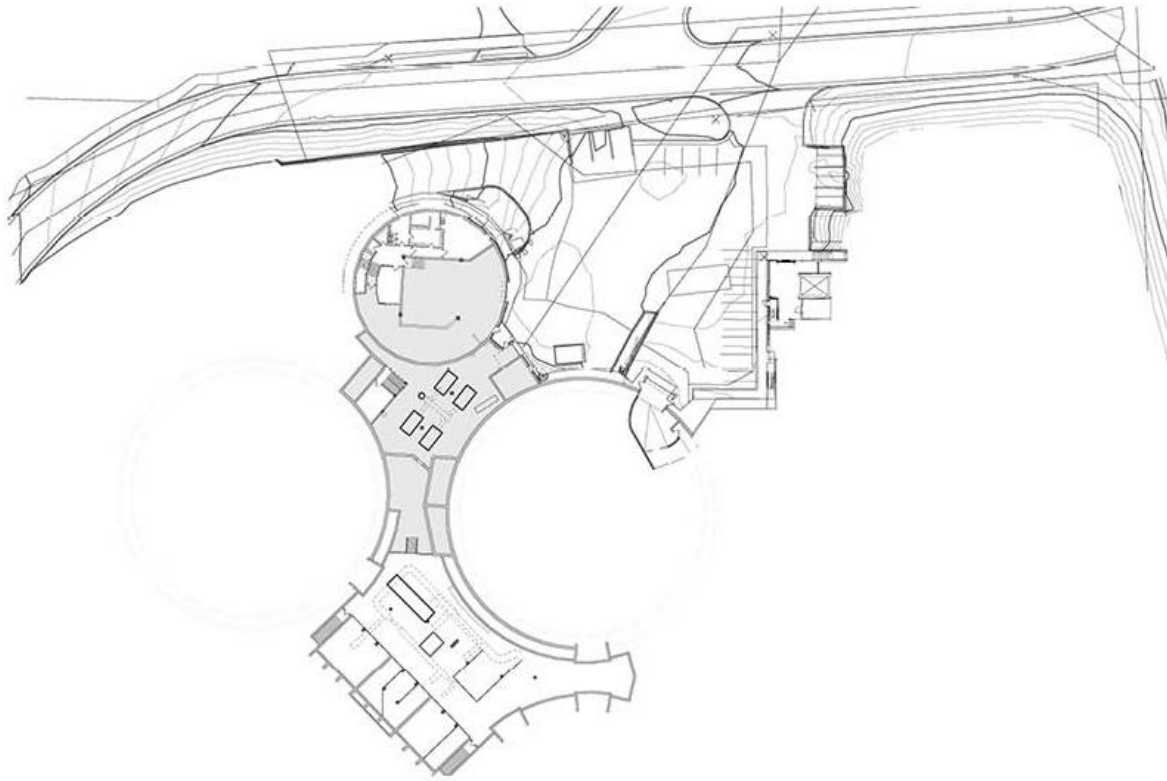
Mitchell Park Horticultural Conservatory

Milwaukee Co., Wisconsin

Name of Property

County and State

Figure 6: Basement Level Plan



1
02.12 EXISTING LOWER LEVEL 1 FLOOR PLAN EL 91'
SCALE: 1/32" = 1'-0"



DK

Figure 7: First Floor Plan and Photo Key

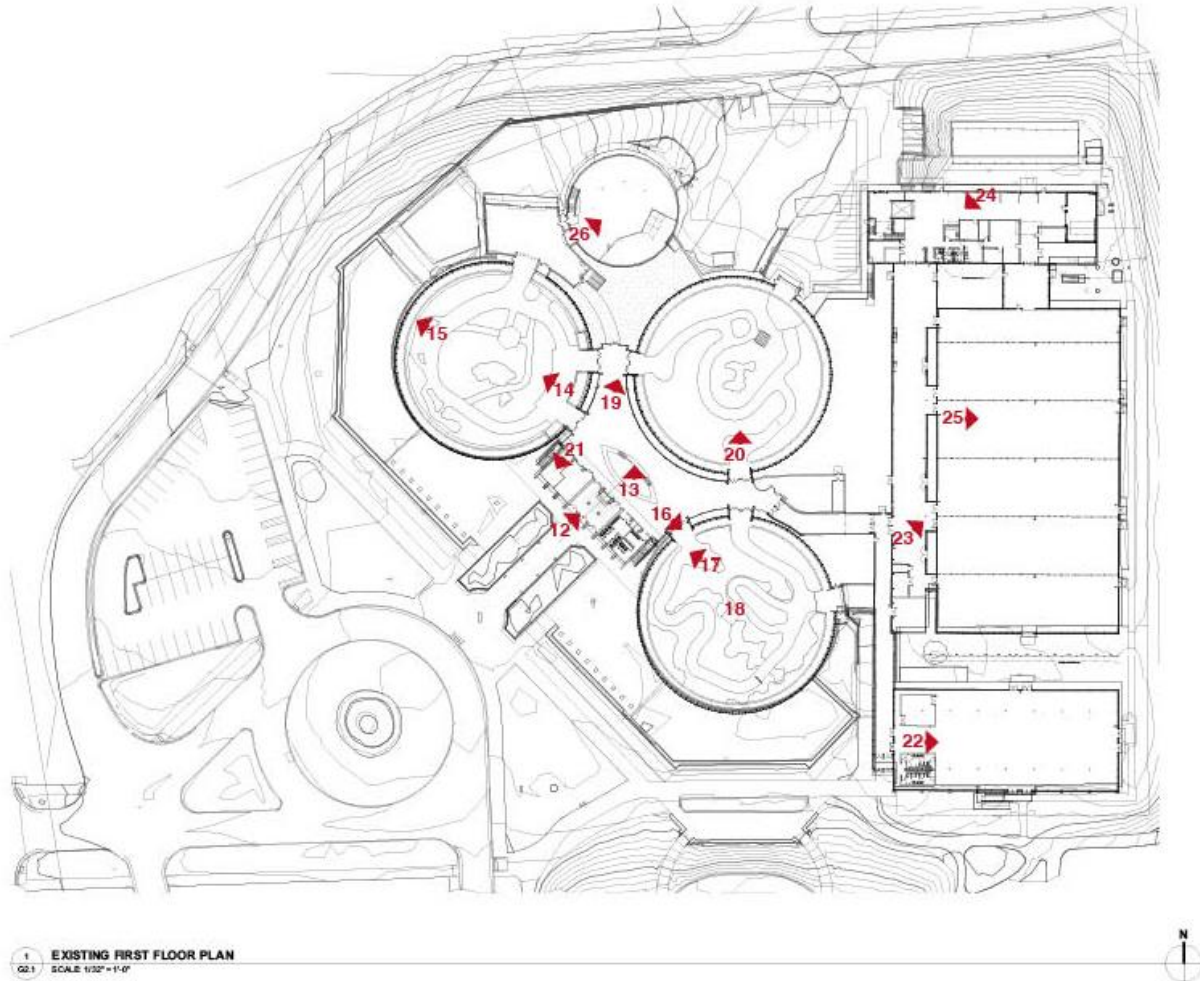


Figure 8. Diagram of dome structural shapes from U.S. Patent drawing (US3192668A)

July 6, 1965

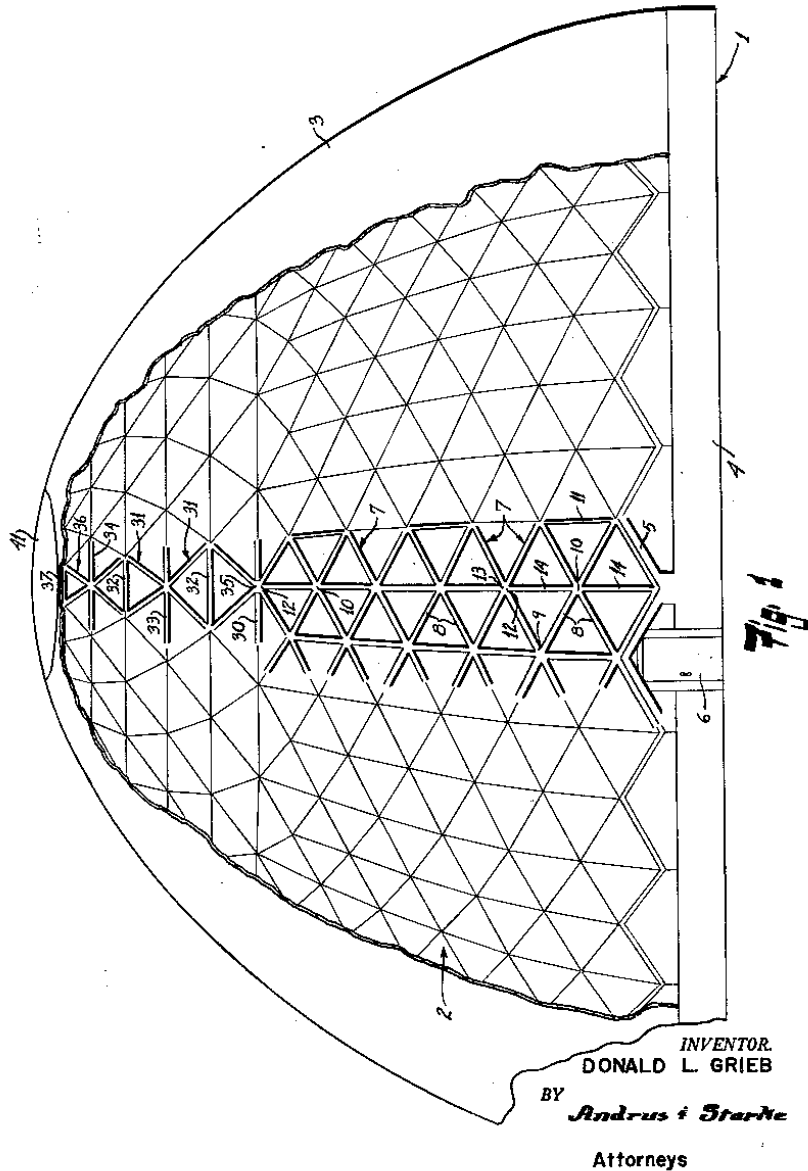
D. L. GRIEB

3,192,668

DOME BUILDING CONSTRUCTION

Filed March 13, 1961

3 Sheets-Sheet 1



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Figure 9. Photograph of the apex installation at the top of a dome. Source: Milwaukee County Parks Historic Photograph Collection.



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Figure 10. Photograph showing a pre-assembled glass panel being lifted into place. The hubs connect the glass to the concrete at designated points (dark squares). Source: Printed in Mitchell Park Horticultural Center guidebook ca. 1968.



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Figure 11. Architect's model showing a concept with additional Domes. Source: Milwaukee Sentinel, July 20, 1958.



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Figure 12. First Lady Lady Bird Johnson speaking at the dedication of the Domes, October 1965.

Source: Milwaukee County Parks Historic Photograph Collection.



Mitchell Park Horticultural Conservatory

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Name of Property

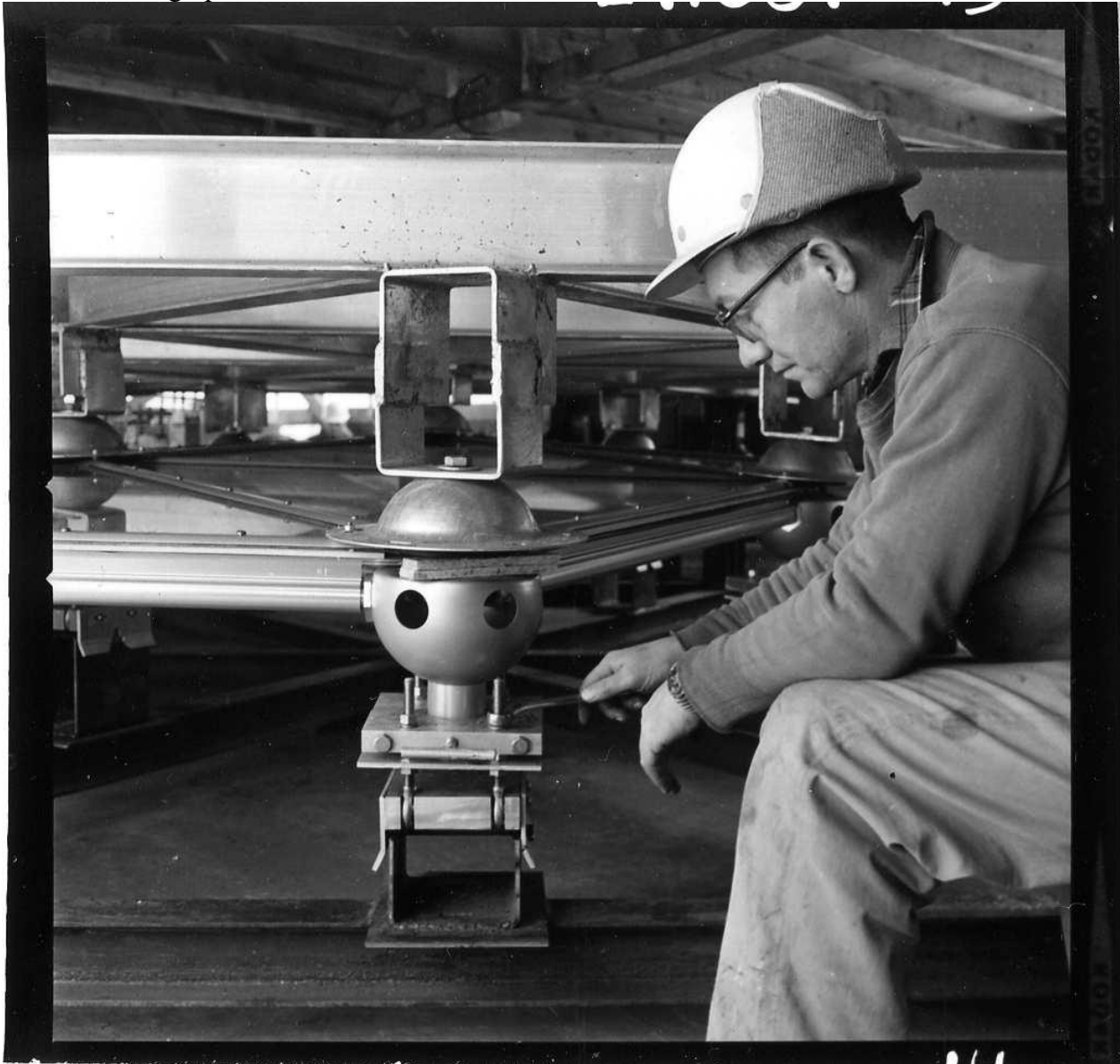
County and State

Figure 13. Photograph of the falsework used to construct the Arid House. Source: Milwaukee County Parks Historic Photograph Collection.



DRAFT

Figure 14. Example of a Domes Hub during construction. Source: Milwaukee County Parks Historic Photograph Collection.



END OF FIGURES SECTION DO NOT DELETE

Mitchell Park Horticultural Conservatory
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Photographs

Submit clear and descriptive photographs. The size of each image must be 1600x1200 pixels (minimum), 3000x2000 preferred, at 300 ppi (pixels per inch) or larger. Key all photographs to the sketch map. For simplicity, the name of the photographer, photo date, etc. may be listed once in the photograph log. The photograph order must correspond with the photograph log.

Photo Log

Name of Property: Mitchell Park Horticultural Conservatory
City or Vicinity: Milwaukee
County: Milwaukee State: WI
Photographer: Tom McGrath
Date photographed: October 2025

Description of Photograph(s) and number, include description of view indicating direction of camera:

1 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_001)
Aerial view of site.

2 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_002)
View of site from South Layton Boulevard, including noncontributing sign, facing northeast.

3 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_003)
View of primary (southwest) elevation and driveway, facing northeast.

4 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_004)
View of lobby building from sidewalk, facing northeast.

5 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_005)
View of base of Tropical Dome, facing southeast.

6 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_006)
View of top of Show Dome, facing northwest.

7 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_007)
View of rear (north) elevations and back of house additions and noncontributing structure, facing southwest.

8 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_008)
View of Show and Tropical Domes and stone retaining wall (contributing), facing southeast.

9 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_009)

Mitchell Park Horticultural Conservatory

Milwaukee Co., Wisconsin

Name of Property

County and State

Basement mechanical room, facing northeast.

10 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_010)

View of basement storage, facing southeast.

11 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_011)

View of basement storage, facing northeast.

12 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_012)

View of vestibule, facing northeast.

13 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_013)

View of lobby, facing north.

14 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_014)

View of Show Dome, facing west.

15 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_015)

View of Show Dome structure detail, facing west.

16 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_016)

View of Tropical Dome entrance, facing southeast.

17 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_017)

View of Tropical Dome exit, facing northwest.

18 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_018)

View of Tropical Dome, looking up toward top of Dome.

19 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_019)

View of entrance to Desert Dome, facing northeast.

20 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_020)

View of Desert Dome, facing north.

21 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_021)

View of historic office space, facing southwest.

22 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_022)

View of event space in nonhistoric addition, facing east.

23 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_023)

View of hallway and greenhouse space in nonhistoric addition, facing northeast.

24 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_024)

Back of house, loading dock, facing southwest.

Mitchell Park Horticultural Conservatory
Name of Property

Milwaukee Co., Wisconsin
County and State

25 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_025)
View of greenhouse space in nonhistoric addition, facing east.

26 of 26 (WI_Milwaukee_MitchellParkHorticulturalConservatory_026)
View of transition house greenhouse, facing northeast.

DRAFT

Paperwork Reduction Act Statement: This information is being collected for nominations to the National Register of Historic Places to nominate properties for listing or determine eligibility for listing, to list properties, and to amend existing listings. Response to this request is required to obtain a benefit in accordance with the National Historic Preservation Act, as amended (16 U.S.C.460 et seq.). We may not conduct or sponsor and you are not required to respond to a collection of information unless it displays a currently valid OMB control number.

Estimated Burden Statement: Public reporting burden for each response using this form is estimated to be between the Tier 1 and Tier 4 levels with the estimate of the time for each tier as follows:

- Tier 1 – 60-100 hours
- Tier 2 – 120 hours
- Tier 3 – 230 hours
- Tier 4 – 280 hours

The above estimates include time for reviewing instructions, gathering and maintaining data, and preparing and transmitting nominations. Send comments regarding these estimates or any other aspect of the requirement(s) to the Service Information Collection Clearance Officer, National Park Service, 1201 Oakridge Drive Fort Collins, CO 80525.

Mitchell Park Horticultural Conservatory
Name of Property

Milwaukee Co., Wisconsin
County and State

Property Owner

Complete this item at the request of SHPO or FPO.)

name/title	Guy Smith, Parks Director	date	February 2026
organization	Milwaukee County Parks	phone	414-257-7275
street & number	9480 Watertown Plank Road	zip code	53226
city or town	Wauwatosa	state	WI

If there are other interested parties that should be noticed, please provide in the tables below

name/title	_____	date	_____
organization	_____	phone	_____
street & number	_____	zip code	_____
city or town	_____	state	WI

name/title	_____	date	_____
organization	_____	phone	_____
street & number	_____	zip code	_____
city or town	_____	state	WI

name/title	_____	date	_____
organization	_____	phone	_____
street & number	_____	zip code	_____
city or town	_____	state	WI