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Tectonics, Tolerances, and Time: Examining Eero Saarinen's and Mies van der Rohe's Buildings at Drake University, Des Moines, Iowa

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Abstract
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Campuses nationwide, including Drake University in Des Moines, Iowa, face massive challenges in the preservation and remediation of these buildings. After WWII, Drake added sixteen new buildings in twenty years, nearly all by celebrated architects, including extensive work by Eero Saarinen and a building by Ludwig Mies van der Rohe. This paper examines the forces that shaped the creation and eventual modifications of three projects on Drake's campus by Saarinen and Mies, including the role of Drake's visionary, highly influential leader during this era, President Henry Gadd Harmon. Specifically, the research examines how the weaknesses in the major building envelope systems were created by a combination of the architect's tectonic expressions, minimal allowable construction tolerances, and inherent limitations of material performance.

When the essential components of a building's structure and skin are simultaneously the sources of failure and the means of expression, fixing these problems without changing the building's design is extremely difficult. The preservation and restoration of these projects present profound challenges, not only because of the notoriety of the architects but because of certain initial decisions made in the design and detailing of the projects.

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> It was at Drake that a whole new age of collegiate architecture in America began.
>
> — Phillip Johnson[1]

In 1947, a Presidential Commission on Higher Education addressed the "unprecedented" and "terrifying" expansion in collegiate enrollments nationwide, calling on educators and campus planners to focus their attention on accommodating future enrollments (Turner 1984, 249). A fivefold expansion of student enrollment would take place nationally, leading to the creation of more than one thousand new campuses and the construction of nearly one hundred thousand new buildings nationwide (Dober 1996). Traditional values of campus planning and design were replaced by the expediencies of construction speed, affordability, and functional efficiencies.

During this era, a small campus in Des Moines, Iowa, emerged as a visionary model of late modern campus planning and architecture, adding sixteen new buildings in twenty years, including nine classroom, dormitory, and religious buildings by Eliel and Eero Saarinen from 1946-1958 and a classroom building by Ludwig Mies van der Rohe in 1965. In an effort to keep this growth "coherent and pleasant" and to maintain a level economic and educational responsibility to its students, the leadership at Drake commissioned buildings that were functionally efficient, cost-effective, technologically innovative, and simply expressed architecturally.[2] Saarinen and Mies consciously sought to develop their "tectonic" by expressing the building's construction system, materials, and structure in creative, original ways (Sekler 1965). They were internationally known for their mastery of an integrated design language that eliminated decoration, favored a clarity in building expression informed by the structural system, reduced redundancies of building elements, allowed minimal dimensional variances, and demanded the highest level of craft in construction (Ford 1996). Because these architects were highly influential, their work at Drake was widely publicized and served as a paradigm for other campuses undergoing similar expansions nationwide (Merkel 2005).

Unfortunately, as with many buildings constructed during this time, these Drake projects have suffered from abysmal energy performance and continual thermal, moisture, and maintenance problems. Some degree of remediation is certainly to be expected, especially in light of the poor efficiencies in the glazing systems and insulation available at the time, but two of these projects have presented unique challenges for preservation and restoration: the Women's Dormitory complex by Eero Saarinen and Associates (1953) and Meredith Hall by Ludwig Mies Van Der Rohe (1965).

Specifically, these projects incorporated relatively innovative and untested technologies into their tightly controlled architectural language, using experimental materials in their exterior enclosure systems. When the structure and skin are so highly integrated, elemental, and expressive, as is the case in most buildings by Saarinen and Mies, any attempts to fix these failures by replacing outdated enclosure systems with contemporary components adversely affects the building's expression.

This paper examines the forces that shaped the creation and eventual modifications of these buildings. Specifically, how the weakness in the major building envelope systems were created by a combination of the architects' tectonic expressions, minimal allowable construction tolerances, inherent limitations of material performance, and the role of Drake's visionary leader during this era, President Henry Gadd Harmon, in influencing these critical decisions.

A NEW TYPE OF CAMPUS

> This wasn't about being modern—it was about scales of economy and cost effectiveness.
>
> — John McCaw, former Dean, Divinity School, Drake University[3]

Harmon's twenty-five-year tenure as Drake's seventh president was intrinsically tied to the architecture he commissioned. Over time, he developed a deep understanding of the building process through a daily involvement with the commissioning, fundraising, project management, and communication with the architects at every stage of design and construction.

In his first years with Drake University, Harmon began planning for the inevitable explosion of enrollment by leading a fundraising campaign for four new campus buildings and a broad campus master plan.[4] The promotional pamphlets for this campaign featured buildings designed with historically inspired gable roofs and porticos, placed within a Beaux-Arts campus plan featuring axial thoroughfares and broad lawns.[5] Even though Modern campuses by Walter Gropius (Bauhaus 1932) and Ludwig Mies van der Rohe (Illinois Institute of Technology 1938-1940) were well known at the time, Drake University, like many other campuses, had chosen a "sentimental" approach for its future campus identity (Dober 1996, 26). Fortunately, in 1944, two nearly simultaneous events occurred that would broaden Harmon's vision of architecture and abruptly alter Drake's future identity.

In a letter to Richard Dober written near the end of his life, Harmon described how he had received a letter from the head of the public school art department in Minneapolis, a woman "whom I had never met and knew nothing about," named Mrs. Mather:

> In substance, she said she had seen the picture of our model and was surprised to find that a young man had chosen architecture of the past for the students of the future. Briefly, she sketched the functional aspects of architecture, explaining why colonial architecture was as it is and why modern, functional architecture had value. I knew little of modern architecture. She invited me to Minneapolis to see what she was talking about. Almost at the same time, a trustee came home from a visit at Cranbrook where he had come to know Mr. and Mrs. Eliel Saarinen. Another trustee…urged me to go to Cranbrook and see what was there and how it impressed me.[6]

After visiting Mrs. Mather in Minneapolis and Eliel Saarinen at Cranbrook, Harmon recommended to the Board of Trustees that they change their vision for the future of Drake University and embrace a new approach.[7] In 1945, he recommended that the board hire Saarinen and Swanson to redesign a master plan and the four proposed classroom buildings for the campus.[8]

Like other buildings produced nationally at the time, the work on Drake's campus during Harmon's tenure is generally defined as stylistically Modern. The buildings rejected traditional methods of expression in their form and materials and placed an emphasis on functionalism and flexibility of planning (Dober 1963; Turner 1984). In national publications at the time, the argument for building Modern architecture on campuses was typically expanded beyond the aesthetic, architectural qualities to include its social and economical benefits (Turner 1984, 251). Harmon and Drake's Board of Trustees recognized that promoting the economic benefits of this approach would project an image of the University as a responsible steward of its resources and communicated these important criteria to Eliel Saarinen.[9] In their initial fundraising material for the Saarinen project, they often repeated the words functional, utilitarian, modern, economical, attractive, and simple to describe (Lyons 2008, 35).

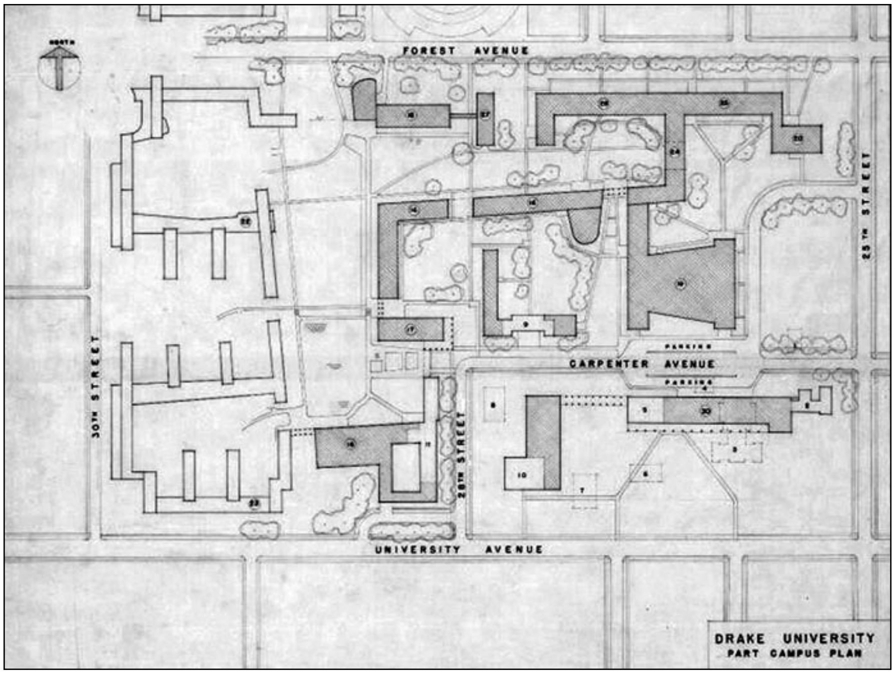

Fig. 1. Master plan alternate, 1947, Saarinen, Swanson, and Saarinen. The initial dormitory design scheme shown on the entire western side of the campus (Eero Saarinen Collection, Manuscripts & Archives, Yale University Library). Used with permission of Drake University.

As the first designs for the campus master plan and initial buildings were revealed, these qualities were recognized and praised (Fig. 1). In an *Architectural Record* article from 1947, Drake was praised for making more funds available for education by observing that "architectural elements have been abjured that are costly, non-productive, purely 'decorative' in favor of a beautifully proportioned design" (*Architectural Record* 1947, 74). A few years later, *Progressive Architecture* lauded Drake for "not spending a cent on the costly, the nonproductive, or the showy" and for producing "unpretentious architecture" that achieved the "maximum utilization of space at lowest possible cost" (*Progressive Architecture* 1950, 66).

These initial projects developed Harmon's vision of Modern architecture as a way to maximize efficiency, control costs, and expedite construction. To this end, Harmon often asked architects to be innovative and flexible in their approach to the project's design, even if it meant using untested materials or construction techniques. It is critical to note that Harmon's ideological influence was not entirely positive, and in fact, contributed to many of the eventual failures of the buildings, most significantly at the Women's Dormitories and Meredith Hall.

SIGNIFICANT FIRST STEPS

> We will always remember the very fine statement you made about the importance of design in education, not just for its own sake, but in order to integrate it to serve the higher values in life.
>
> — Eero Saarinen in a letter to Henry Harmon, April 1949

Guided by Harmon's ideology, the Saarinens set out to design the first new building on campus, the Harvey Ingham Hall of Science and Fitch Hall of Pharmacy.[10] These projects established many significant firsts for Drake University, for Eero Saarinen's career, for curtain-wall technology, and for the urban fabric of Des Moines. At this point, with his father, Eliel's, health failing, Eero Saarinen was named project architect (from now on, this paper refers to him as Saarinen). These two buildings were very early in Saarinen's career and as such clearly illustrate critical aspects of his tectonic expression and personality (Saarinen 1962).

Saarinen's desire to express the separation of structure and skin became a central consideration in the pharmacy building, and indeed, a major component of his future work (Kuhner 1975). As was expected,

Fig. 2. Harvey Ingham Hall of Science, 1950, Saarinen, Swanson, and Saarinen. Nighttime view showing skywalk and curtain-wall system with metal panels (Harvey Ingham Hall of Science Photos Folder. Special Collections, Cowles Library, Drake University).

this system was designed with cost effectiveness and construction efficiency in mind. It employed an integrated fenestration and structural module that encouraged planning flexibility, allowing interior partitions to be moved to another column without adversely affecting the building systems needed for a laboratory. A prefabricated, modular, steel window system that could be installed and replaced easily was designed (Norman 1951).[11] Within this window system was the nation's first prefabricated insulated metal panel system, developed by Saarinen with the assistance of the Chrysler Corporation during his initial work on the General Motors Technical Center.[12]

Due to restrictions of available property, the two buildings would be separated by a street but needed to be linked for functional effectiveness. Saarinen joined the buildings through an enclosed skywalk on the second floor, creating the first of what is now a ubiquitous element in downtown Des Moines. Saarinen was sensitive to the "industrial nature" of the skywalk's initial design (similar to Gropius's Bauhaus), and so he worked to reduce the span and window size accordingly (Fig. 2).[13]

The building established a simple architectural language for the campus—box-like brick forms with large expanses of steel-framed window systems. The building's structure, curtain wall, and mechanical systems were expressed as separate, discrete, yet integrated components. The project was completed on time and within budget and brought national acclaim to Drake University. In 1950, *Progressive Architecture* noted the "remarkably successful and beautiful examples of integrated design. We also consider it perhaps even more remarkable that an established institution of higher learning would commission and accept such unpretentious architecture and not only construct these two initial units, but also base its entire future program around the same design thesis" (*Progressive Architecture* 1950, 66).

During this project, a personal friendship developed between Saarinen and Harmon that lasted the remainder of Saarinen's life. Saarinen used Harmon as a reference for his NCARB architectural certification and consulted him about a "learning institute" he planned to include in his Jefferson Memorial Competition entry. They continued to visit each other socially and exchange personal correspondence for the next fifteen years.[14] Their friendship was also balanced with an intense mutual respect, and Harmon was convinced of Saarinen's ability to solve difficult problems through design innovation and technology.[15]

MODERN CAMPUS LIVING

> If a student lives in this atmosphere for four years…he should emerge with a new appreciation of beauty which should entitle him to a degree in liberal arts even though he never attends a class or opens a book.
>
> — George Shane, *Des Moines Register*, March 7, 1954[16]

The next critical component in the campus's growth was a need for more dormitories. In 1947, Saarinen, Swanson, and Saarinen Architects developed a dormitory scheme that was too expensive and expansive; now, in 1949, it became apparent that the new scheme needed to be smaller and more efficiently built. In a March 8th letter, Harmon told Saarinen that, "it is very clear to me that we must make compromises with the desirable to hold the building costs to a minimum." Harmon and Saarinen exchanged letters throughout the year regarding affordable construction techniques in an attempt to find a solution. A few months later, Saarinen found it.

In a letter to Harmon dated October 27, 1949, Saarinen described a conversation he had with Fred Severud, his structural engineer for the Jefferson Memorial Competition, about a new type of construction ideally suited for dormitories—the "so-called tilt up concrete sandwich slab" construction. He and his partner Joe Lacy had visited dormitory buildings designed by McKim, Mead, and White at the University of Connecticut that had used this system. In the same letter, Saarinen explained to Harmon the building wouldn't require any columns or interior wall finishes (besides paint) and that brick could be placed outside the concrete panel to maintain the desired finish (Fig. 3). He summarized that "through this method we hope to gain…the least expensive method of construction for the dormitories." It was exactly the innovative thinking Harmon was looking for, and the dormitory project design proceeded. However, the use of this panel system coupled with Saarinen's method of detailing it caused problems only a few years later, problems that exist to this day.

The first project phase, known as the Women's Dormitory, consists of three separate, five-story, brick-and-glass, box-shaped residence halls placed in a U-shaped courtyard surrounding a natural ravine (Fig. 4). Each dormitory has a separately framed two-story social hall that extends from the primary form of the box into the courtyard. After the Saarinens determined that "Midwestern college girls are not adverse to an outdoor walk to meals," open-air, raised, pedestrian footbridges were designed to connect the social halls of each dorm with a central dining hall across the ravine[17] (Fig. 5). Similarly designed open-air balconies and fire escapes connected all the dormitories together at each floor level above grade, allowing for only one interior stairway in each dormitory, and thus a more efficient and affordable building.[18]

Saarinen conceived of the building's tectonics with the same spareness he applied to its construction system. He reduced it to its basic compositional elements—brick panels, steel-framed fenestration panels, floor slabs, and balconies. The brick veneer over the tilt-up panel could have hidden the "house of cards" construction method of the panels and expressed itself as a bearing wall, but instead it mirrors the size of the panel behind, framed and supported by a continuous steel channel at the sill and head that clearly demarks the structural floor slab line (Fig. 6). At each room, a gap was left between the panels for a floor-to-ceiling window system, which was used to maximize daylight and ventilation. This pattern repeats itself floor-by-floor and building-by-building,

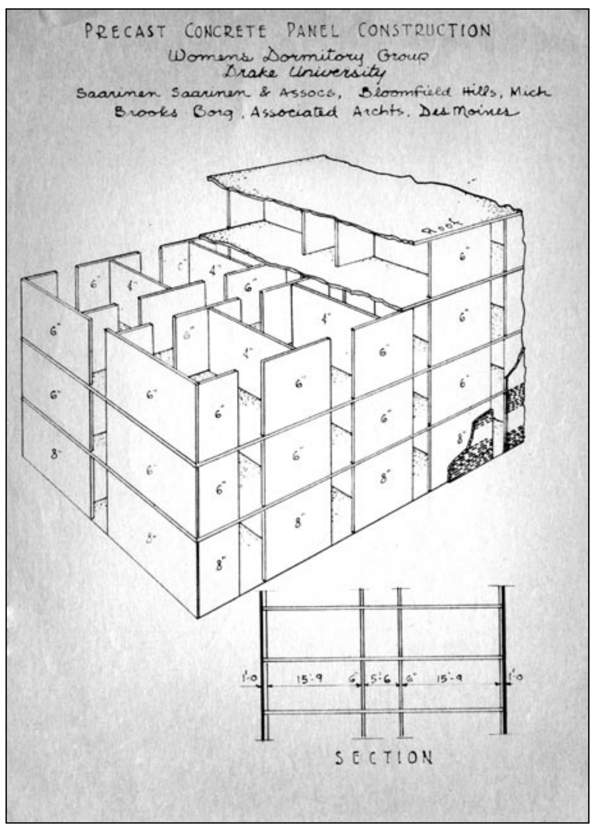

Fig. 3. Women's Dormitory sketch, undated, Eero Saarinen and Associates and Brooks Borg, showing proposed precast concrete panel construction (Residence Halls Photo Files, Special Collections, Cowles Library, Drake University).

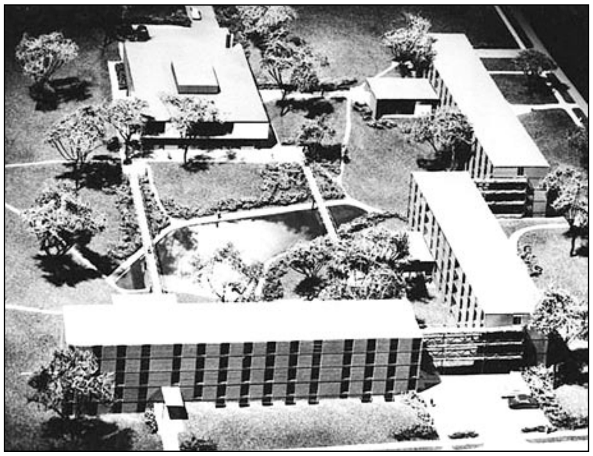

Fig. 4. Dormitory model, 1951, Eero Saarinen & Associates. Drake University Women's Dormitory project looking south from Forest Avenue (Residence Hall File- Presidential Files, Special Collections, Cowles Library, Drake University).

Fig. 5. Crawford and Carpenter Residence Halls and the reflecting pool, 1955, Eero Saarinen & Associates (Residence Halls Photo Files, Special Collections, Cowles Library, Drake University).

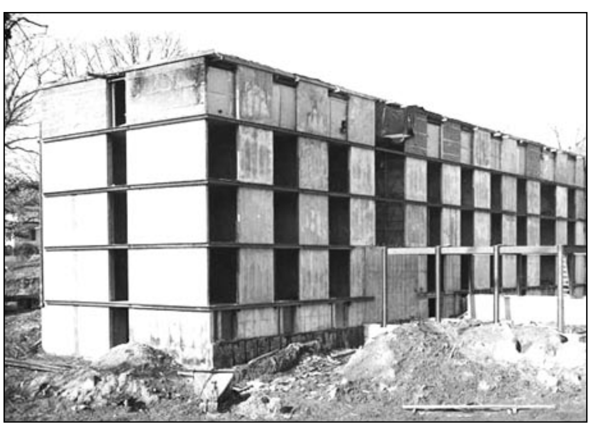

Fig. 6. Crawford Dormitories, 1953, Eero Saarinen & Associates. Dorm under construction showing precast assembly system (Presidential Files, Special Collections, Cowles Library, Drake University).

extending into the rolling grade of the site, with only the social halls and open steel bridges offering relief and variety. Because everything was expressed clearly and elementally, the details had very small tolerances in the alignment of the components.

In many ways, the project was a huge success—it was highly functional and innovative in its planning and execution. In 1955, it was published in *Progressive Architecture* and honored with a national AIA design award. However, soon after occupation, several problems with the building envelope became apparent. In early 1962, after a particularly cold winter in Iowa (made memorable also by the untimely death of Eero Saarinen), Drake asked Saarinen's partner Joe Lacy to assess the causes of the problems: brick had been cracking around the windows, windows were pulling away from the steel channel head/sill, and the dorm rooms were very cold.

Lacy reported that many problems were caused by the interaction between the different materials and were exacerbated by the small tolerances between them. For instance, the steel channel running continuously around the building would move due to thermal changes, subjecting the mortar joints, and eventually the brick, to stress and crack. This occurred mostly at the outside corners of the building and at the window openings, particularly where the steel channels below were adjoined (Fig. 7). Lacy recommended loosening some of the bolts that held the steel channel too tightly in place, re-tuckpointing, and adding a vertical control joint in the brick at one outside corner. This work was done as problems arose, but problems continued throughout the years. Preserving the expression of the building system was an important consideration in Lacy's recommendations and was never questioned by President Harmon.

A report on the dormitories by Charles Leopold Engineers mentioned several problems, including major issues with the steel windows (Leopold 1962). The report noted that the windows weren't thermally broken, were poorly sealed around the operable sashes (with only steel-on-steel connections), and were glazed only with single-pane glass, making the rooms very uncomfortable. The steel saddle at the sill and vertical steel angle jamb supports were also subjected to differential movement, because they were attached to the steel channel at the sill and the brick on the sides. This movement led to increased stress and eventual failure of the caulk joints.

The choice to maximize glass in the rooms inadvertently maximized the problem. As with the Pharmacy and Science buildings, the window module was envisioned to be an easily replaced component, which was one of the reasons that all the rooms had the same size frame. Unlike the previous projects, the steel frames were welded into recessed and concealed angle frames, negating, and complicating the design premise of simple replacement.

Des Moines can be very cold, and insulation is mandatory. These buildings didn't have insulation in the walls to accommodate the tilt-up panel construction. There was an air gap between the face brick and the tilt-up panels that was left uninsulated for fear that moisture migrating through the brick would ruin any insulation in the gap. Because the concrete panels were self-finishing on the interior, there was no place for insulation inside the dorm rooms. Installing anything in the gap would be difficult, as the two-inch air gap was too narrow and ran uninterrupted from the ground to the roof.[19] Leopold's report recommended a "urethane based material…installed in a plastic state" (a precursor to contemporary expanding foam insulation) to address concerns for installation and performance. Nopco Chemical Company was recommended, but because the company had never done this work before it was deemed too experimental, and the plan was scrapped. These walls are still not insulated, even after a recent extensive remodel, for the same reasons discussed nearly fifty years ago.

Further problems with the buildings became apparent later. Placing the buildings in a ravine led to periodic flooding, which took years to resolve. The wood-planked, open-air pedestrian bridges were slippery in winter, even for the hardy Midwestern girls mentioned by the Saarinens. Trapped moisture in the wood planks led to massive rusting of the metal structure and ultimately to replacement (Fig. 8).

Because of the elemental way the buildings were put together and expressed, one cannot easily fix these problems without changing the essential nature of the design. As an example, the dormitories have recently gone through an extensive remodel (Figs. 9, 10). They have new, operable, thermally broken aluminum windows with the same glazing proportions and ventilation capacity as the originals but with a very different visible profile (the aluminum is thicker and doesn't have the visual relief offered by a steel angle system).[20] The site bridges have also been completely rebuilt from the foundations up, with new planking material, higher rail heights, and smaller openings to meet current code requirements (Sloan 2008).[21] The components and colors of the bridges are the same as the original, but the new proportions of the rail supports are different, and the additional horizontal tension wires create a markedly different aesthetic. In a building complex that consists of so few parts, these are all major changes; they were obviously needed but have forever changed the buildings' essential character.

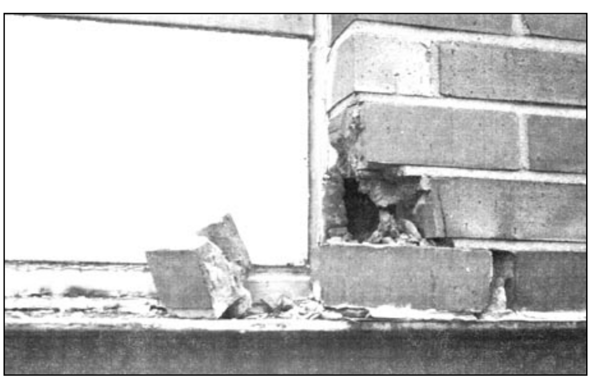

Fig. 7. Broken brick at window sill and horizontal steel channel intersection, 2006 (Photograph by Baldwin White Architects).

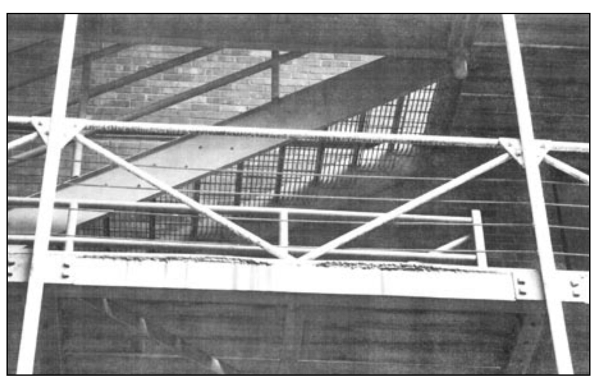

Fig. 8. Exit stair/pedestrian bridge with rusted perimeter, 2006 (Photograph by Baldwin White Architects).

Fig. 9. Dorm exterior under restoration, with new windows installed on top floor (Photograph by Baldwin White Architects).

Fig. 10. Closeup of new window system, 2008 (Photograph by Robert Whitehead).

THE ELDERLY MAN ON CAMPUS

> Every architect I've talked with or heard from has been in Des Moines to see and study our buildings.
>
> — President Harmon to the Meredith Hall Architect Selection Committee, 1961

The School of Journalism was one of the initial campus buildings planned, and after several failed attempts to secure funding over the previous decade, it was finally approved in 1958. Saarinen was consulted several times about this project and was sent a signed contract for architectural services. At this point in his career, even with sixty employees working nearly around the clock, he was too busy even for Drake (Oishi 1984). He told Harmon that he wasn't available to start work on the building for an additional six months, declining Harmon's request to add more staff by stating in a letter that, "I refuse to have my name associated with a project that I am only passively involved in." This schedule wasn't acceptable to Harmon, and he made the difficult decision to end their exclusive working relationship. After completing eight buildings in ten years, Saarinen's role as campus architect came to an end.[22]

This change meant a new architect needed to be selected for Meredith Hall. In 1961, after another delay in project funding, Drake's Committee to Select an Architect contacted other notable Modern architects: Philip Johnson, Paul Rudolph, Ludwig Mies Van Der Rohe, and Louis Kahn.[23] The committee ultimately selected the "elderly man," Mies.[24] His office had extensive experience with campus buildings, including Mies's own designs for twenty new buildings at Illinois Institute of Technology from 1938-1955 (Blaser 2002).[25] The selection committee visited another project by Mies, the American Federal Bank, under construction in downtown Des Moines at the same time, to see his work in person.[26]

Throughout his career as a teacher and an architect, Mies's tectonic expression became extremely well known, highly influential, and often imitated. His work attained a level of significance and influence that dominated large sectors of education and practice for decades (Blaser 1972). Mies created buildings that were highly organized and simple, employed an integrated approach to the design of fenestration and structure, and strove for purity in proportion and craft (Frampton 1995). His buildings clearly expressed the separation between the structure and the curtain wall, featured minimal tolerances and masterful joinery, and favored the functionally specific albeit redundant building components (Ford 1996). Eduard Sekler remarked that, "what so often is referred to erroneously as a concern with excellent construction in the oeuvre of Mies van der Rohe, turns out to be, on closer inspection, tectonic expressiveness refined to an extreme degree" (Sekler 1965, 94).

During the 1950s, there were national debates in publications and educational forums regarding the similarities and differences between the designs of Saarinen and Mies. Harmon soon found that the two differed greatly in their flexibility in allowing project circumstances to affect their architectural language. Saarinen had demonstrated how the building's arrangement, construction, and expression could be determined at some level by the particular circumstances of the program and site; he was amenable to input from Harmon and had a legendary ability to change a project's design quickly if needed (Merkel 2005). Mies, however, preferred to challenge the project circumstances to meet his more narrow range of options in the building's size, materiality, and proportional expression (Blaser 2002). Mies preferred to elaborate on smaller variations within a general theme of expression, writing in 1963 that "the creative vigor of a general principle depends precisely on its generality."[27] Saarinen thought in terms of variety in expression and noted their differences by stating that "I feel strongly that modern architecture is in danger of falling into a mold too quickly—too rigid a mold. What once was a great hope for a great new period of architecture has somehow become an automatic application of the same formula over and over again everywhere…I align myself humbly with Le Corbusier and against Mies van der Rohe" (DeLong 2008, 8). While the comparisons between the two men continued to be debated nationally for years, this major difference in working styles became apparent immediately with the site planning for Meredith Hall.

Similar to the Women's Dormitories, Meredith Hall was to be located in a natural ravine. Harmon believed it was a good opportunity to expose the basement on the low side of the hill, letting natural light into the building. Clearly, this would have required a dramatic shift in Miesian language. It was rejected by Mies's office, which instead proposed that a large, flat plinth should be created around the building, permanently altering the campus landscape and burying the basement without light[28] (Fig. 11). Harmon disagreed with this approach to site planning and stated so in a letter to the project manager, Gene Summers, in June 1962.[29] Typically, when Harmon disagreed with Saarinen's approach to a project's design, revisions were made to address these concerns, but no revisions were offered by Summers. Due to an illness, Harmon's daily

Fig. 11. Northern elevation of Meredith Hall from bottom of ravine, 2008, Mies van der Rohe (Photograph by Robert Whitehead).

involvement with building projects was necessarily ceded to the building committee, and the committee decided that a flat plinth was acceptable, perhaps understanding that certain restrictions came with the design of a beautifully detailed, thoroughly considered Mies building. Unfortunately, certain decisions by Mies's office betrayed an uncharacteristic lack of rigor and apathy for the design that may have affected the eventual failures of the window system.

The building was designed as a simple two-story rectangular box with a large interior courtyard and a flanking auditorium, similar to the Chemical Engineering and Metallurgy Building (1945-1946) on IIT campus (Blaser 2002). Central to his tectonic was the expression of structure to establish the correct rhythm and proportion of the building skin, which meant that the structural module and floor-to-floor heights were usually part of the initial decisions (Frampton 1995). Startlingly, Summers abdicated some of the responsibility for determining these dimensions by asking Harmon in a letter dated July 19, 1962, to "please let us know if the 22 foot bay is alright and what you think the floor-to-ceiling dimension should be." While these decisions were eventually confirmed by a cost estimate, questions about the number and size of windows went unresolved for another six months.[30] Mies wanted to have wider, taller windows, but this was ruled out because of a relatively innovative request by Drake's building committee to use "Thermopane" insulated glass to stop the "excessive light and heat from sunshine" that was typically felt inside Mies's buildings.[31]

Discussing this issue in a letter to Drake's vice president, Carl Kastens, Summers stated that "we have never used Thermopane before." He acknowledged the thermal advantages but cautioned they might be offset by the disadvantages of cost and a "greater incidence of failure." Additional funding for the glass was approved by Drake, and the smaller window size was approved by Mies's office in order to ensure that a grey-colored glass could be used (larger panes of Thermopane could be only clear glass, which was unacceptable to Mies).[32] Strangely, after lengthy exploration and correspondence about the issue, the windows did not end up the same size. The windows at the ends of each bay are narrower than the middle windows, a result of the interior columns being expressed on the exterior (Fig. 12).

Drake's innovative requests continued. In April 1963, Kastens asked that the building have a thermally broken window frame in support of a proposed humidity-control system within the building. The university wanted to avoid condensation and frost forming on the inside of the frame. Summers replied that the office had studied the issue, but by creating a thermal break, "the design of the curtain wall would be adversely affected" and the cost would be "extremely high." No specific details to support this were listed in the minutes from the meetings from April 22, 1963. He went on to argue that the humidity-control system wasn't necessary for a classroom building and was normally used for laboratories. The issue was dropped, and the building was completed less than eighteen months later. Soon thereafter, the glass began to fail.

Similar to many other buildings that used insulated glass around 1965, the Bondermatic seal between the panes of glass failed, and condensation formed on the inside face of the glass, producing a nearly opaque fogged-over window. The benefit of historical perspective has allowed us to identify the two major factors that contributed to this failure: improperly designed glazing channels at the sill that allowed the bottom edge of the glass to sit in water and oversized units subjected to windy conditions that led to failure in the lead spacer between the glass (Syroka 2008).[33] Both of these conditions seem to exist at Meredith Hall.

At Crown Hall on IIT's campus, the American Federal Bank in Des Moines, and other Mies buildings, a large amount of rust can build up on the sill, exert pressure on the glass, and break it (Sexton 2008). This rust build-up is due to the choice of materials (a flat sill of painted steel component), its location (ground floor window sills are often covered in standing snow/ice for weeks at a time), and condensation from the non-thermally broken window. All of these factors occurred at Meredith Hall. As the rust appeared, the lower seals began to fail.

The large glass panels at Drake also seemed to accelerate the failure of the seals. The window units average nearly 5 feet wide by 10 feet tall, and since the building sits high on a plinth with no natural wind breaks, Meredith Hall has certainly been subjected to extremely windy conditions for years, further weakening the seal. Currently, only a few of the four hundred original windows remain.

Unfortunately for maintenance and replacement, this building is designed and detailed down to its essential characteristics. When one component like the window system fails, the design leaves few, if any, tolerances to fix it in place, and the resulting solutions risk a transfiguration of the original detail expression (Kamin 2005). Mies intended his fenestration frames to be built with common, off-the-shelf components, extolling the benefits of repetition as a way of simplifying replacement (Ford 1996). Indeed, the window frames were detailed to allow each window to be replaced separately without disrupting the entire system, with a series of screws securing the glass and frames in place (Fig. 13). The Drake Facilities Services group has tried to reglaze the building as needed by "unscrewing" the original interior window frame and replacing the glass, but thermal transfer issues have rusted and broken many of the screws, and a build-up of rust on the sills has made this method ineffective (Fig. 14). To "fix" this, Drake unfortunately has had to resort to an unsightly solution of "floating" the new replacement glazing within its own 2-inch-wide rubberized gasket frame, caulked into place within the original Mies steel window system (Fig. 15). Currently, not all windows have been replaced in this manner, so there is an irregular pattern and expression to the exterior, a far cry from the clarity of image, careful attention to detail, and rightness of proportion anticipated by Mies, President Harmon, and Drake University.

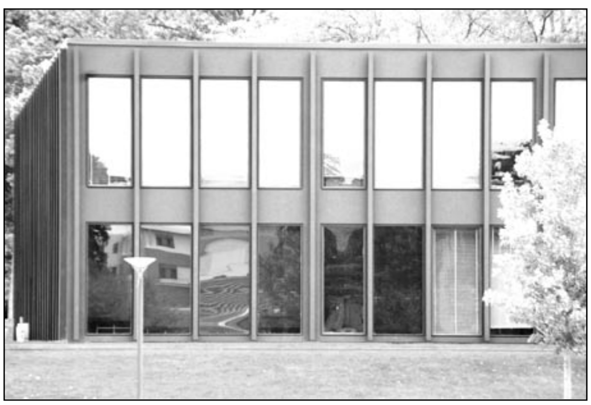

Fig. 12. Northwest exterior corner of Meredith Hall, showing variance in window size within a typical bay, 2008, Mies van der Rohe (Photograph by Robert Whitehead).

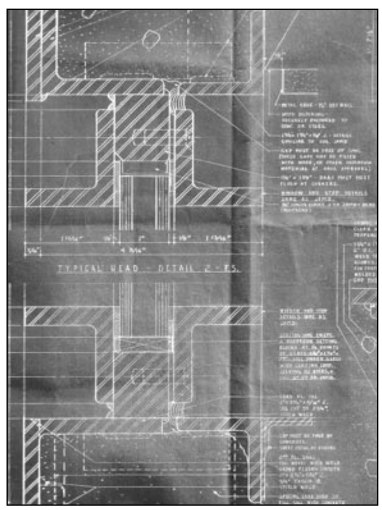

Fig. 13. Construction detail of window head and sill at Meredith Hall, 1965, Mies van der Rohe (Drawing by Mies van der Rohe's office. Reproduction courtesy of Drake University Facilities).

Fig. 14. Closeup of rust on interior face of frame, broken screws, and new gasket, 2008 (Photograph by Robert Whitehead).

Fig. 15. Enlarged view of original and revised window jamb detail (painted rubber gas-keting), 2008 (Photograph by Robert Whitehead).

STARTING AGAIN

The Women's Dormitory and Meredith Hall were designed by two different architects with two similar approaches to construction strategies. During the design of these projects, both architects inflected into their tightly controlled systems something innovative and untested, which became the source of failure for the buildings. When the essential components of a building's structure and skin are simultaneously the sources of failure and the means of expression, fixing these problems without changing the building's design is extremely difficult, and one of the central issues in the preservation and restoration of the buildings.

There are certainly lessons in how the buildings are composed and constructed that can be emulated in restoration efforts that incorporate contemporary, high-performance building materials. These approaches include sensitivity to the proportions, assemblies, colors, and profiles of the original exterior components. To support this approach, both architects aspired to use easily replaceable exterior building components, yet unfortunately, over time, the entire curtain wall and glass industry has changed so dramatically that any updating of the building exterior with standard off-the-shelf contemporary components risks creating dramatic changes to the building's expression, unanticipated by Saarinen or Mies.

A look back at President Harmon's value system reveals that maintaining these buildings in their original state may never have been the original intention either. Both projects took chances, which resulted in failures, but allowing for failures may have been a natural part of the original vision for this modern campus. In an interview with John McCaw, the former Dean of the Divinity School and a close friend of Harmon's, McCaw recounted his associate's candid thoughts about the campus development, stating that Harmon wanted to "start building on one end of campus all the way to the other end and then twenty-five years later, go back to the beginning and start again."While it is unclear if this was ever communicated to either architect, it may reveal Harmon's special attitude to the longevity of the campus building and represents a critical component in assessing the preservation challenges of these projects. From this perspective, making changes to the Women's Dormitories and Meredith Hall projects was more than just a way of fixing previous failures; it became a way of starting again.

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ENDNOTES

1. Henry Harmon memo to Drake Building Committee, July 27, 1961. Johnson's quote was recounted by Harmon (Presidential Files: "Mies Van Der Rohe Architect, Meredith Classroom Building").
2. Editors, December 1947. "College Planning: A University Campus Plan Under Way for Drake University, Des Moines, Iowa," *Architectural Record*, 71.
3. John McCaw interview by author, discussing Drake's planning priorities, October 2008.
4. The expansion of enrollment had already occurred at Drake. In the 1943-44 academic year, Drake's enrollment had more than doubled from 2,765 in 1940-41 to 6,104 students.
5. The designs for the buildings are not credited, but a note in the Board of Trustees minutes from September 19, 1944, suggests that the drawings could have been done by Proudfoot, Rawson, Brooks, and Borg. See "Executive Committee Meeting," Minutes, 192. The campus plan was created by the Minneapolis landscape architecture firm of Morrell & Nichols.
6. In a letter from Henry Harmon to Richard Dober, August 20, 1962. Presidential Files, Drake University.
7. Eliel Saarinen was already working in Des Moines at the Des Moines Art Center (completed 1948), and several members of the Board of Trustees were also familiar with his work there.
8. Drake initially hired the firm Saarinen and Swanson. The firm's name changed to Saarinen, Swanson, and Saarinen when Eero Saarinen joined the practice. The firm's name changed to Saarinen, Saarinen and Associates after Bob Swanson left the practice and then eventually Eero Saarinen and Associates after Eliel Saarinen's death in 1950.

9. In a letter from Henry Harmon to Eliel Saarinen dated January 7, 1946, Harmon explained his vision for a "new type of ultra-compact functional campus arrangement," and his happiness that "we have the creative genius of you and your firm…to demonstrate the maximum utility and artistic value that can be achieved within our necessarily restricted area" (Presidential Files: "Saarinen 1945-46," Drake University).
10. Saarinen, Swanson and Saarinen worked with a local associate architecture and engineering firm, Brooks & Borg from Des Moines, Iowa.
11. This system was featured in a trade magazine for Pittsburgh Plate Glass (1951).
12. The system was described in building specifications given to Drake, January 14, 1947. The timing of Saarinen's involvement with GM is confirmed by several sources (Presidential Files: File "Saarinen 1945-46").
13. In a letter from Eero Saarinen to Henry Harmon (November 25, 1946), Saarinen described how he had shortened the span to create a "smaller, more domestic looking (window) pane" (Presidential Files: "Saarinen 1945-46").
14. The information about the Jefferson Memorial Competition was noted in a letter dated February 24, 1948 (Presidential Files: "Saarinen 1945-46"). Regarding the closeness of their friendship, Harmon was one of the featured speakers at Saarinen's funeral in 1961 and received a thank-you letter from Joe Lacy recounting the event.
15. A faith that was well deserved, as by 1949, Saarinen had many years of experience working with "new materials, structural techniques, and manufacturing," including Pre-Assembled Component Housing in 1943, Case Study Houses 8 & 9, and the beginning stages of the General Motors headquarters (Merkel 2005).
16. George Shane (1954).
17. Editors, December 1947. *Architectural Record*, "A University Campus Plan Under Way for Drake University, Des Moines, Iowa," 82. These open-air bridges were part of the initial schematic for the dorms, which is why both Saarinens are credited with the observation. At the time the project was built, Eliel was deceased.
18. The balconies were used for horizontal egress between buildings, allowing only one interior stairway for each dormitory building—an egress system that would not be allowed currently but a system that greatly increased the efficiency of space used for dormitories.
19. The air gap was interrupted only by a 6" structural angle that tied the horizontal steel channel back to the concrete floor slab.
20. Interestingly, aluminum windows were add alternates for the original bid but were unaffordable. This discovery by Baldwin White Architects was a key factor in selecting aluminum for the remodel.
21. Dan Sloan, Baldwin White. Interview by author, Des Moines, Iowa, 7 October 2008.
22. Meredith Hall was put on hold again for several years until a new building search committee was convened in 1961, the year of Eero Saarinen's death.
23. Kahn was the only one of the nine architects contacted who did not respond to Drake (Memo to architectural selection committee from President Harmon, July 27, 1961).
24. An adjective used by President Harmon to describe Mies in his letter to the Building Committee.
25. Mies van der Rohe was Chair of the Department of Architecture at IIT from 1938-58.
26. The American Federal Bank is now owned by the Catholic archdiocese. There is an interesting correlation between the circumstances of how the two architects were hired, as Eliel Saarinen was also hired in part because of the work he had already completed in Des Moines.
27. Mies van der Rohe was quoting the physicist Schroedinger in an article for *Architectural Record* 134 (October 1963): 149. He went on to explain that the variations in the buildings at IIT were solutions based upon the same principles, "just as the Gothic men used the same principles for a cathedral as they would use for a barn."
28. This was one of the few personal letters that Mies wrote to President Harmon regarding the size and material of rock that was to fill up the plinth (Drake University Presidential Files: "Mies Van Der Rohe Architect, Meredith Classroom Building").
29. Harmon wanted Meredith Hall to use "the same kinds of methods that were used in all other buildings," but said this reservation wasn't shared by other members of the committee.
30. Mies wanted to have three windows at 7'4", not four at 5'6", even though this didn't work with the office layout they had long ago established. In a letter by Gene Summers to Carl Kastens, Drake's vice president, dated January 29, 1963, he stated that "Mies said today he would greatly appreciate your giving this revised office layout using a 7'4" module your serious consideration."
31. In a letter from Carl Kastens to Henry Harmon dated October 11, 1962. This was based on research Kastens had done regarding similar buildings at Grinnell and IIT. Kastens even recommended the potential for mirrored glass.
32. February 1963 letter from Gene Summers to Carl Kastens discussing glass size and color.
33. Bob Syroka, Syroka and Associates, interview by author, October 19, 2008.

REFERENCES

Blaser, Werner. 1972. *Mies van der Rohe*. Zurich: Verlag fur Architektur Artemis.

Blaser, Werner. 2002. *Mies Van Der Rohe, IIT-Campus: Illinois Institute of Technology, Chicago*. Basel, Boston, and Berlin: Birkhauser.

DeLong, David and Peatross C. Ford, eds., 2008. *Eero Saarinen: Buildings from the Balthazar Korab Archive*, New York and London: W.W. Norton & Company in Association with the Library of Congress.

Dober, Richard P. 1963. *Campus Planning*. New York: Mc-Graw-Hill.

Dober, Richard P. 1996. *Campus Architecture: Building in the Groves of Academe*. New York: McGraw-Hill.

Drake University. 2008. B*uilding a Modern Campus: Eliel and Eero Saarinen at Drake University*. Retrieved November 6, 2008, from http://buildingamoderncampus.com/masterplan.html.

Editors. 1947. "College Planning: A University Campus Plan Under Way for Drake University, Des Moines, Iowa," *Architectural Record* 102 (December 1947): 71-87.

Editors. 1950. "Science and Pharmacy Buildings for Drake University." *Progressive Architecture* 31 (November 1950): 65-89.

Editors. 1955. "Drake University Dormitories and Dining Hall." *Progressive Architecture* 36 (April 1955): 96-105.

Ford, Edward R. 1996. *The Details of Modern Architecture, Volume 2, 1928 to 1988.* Cambridge: The MIT Press.

Frampton, Kenneth. 1995. "Mies van der Rohe: Avant-Garde and Continuity." In *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, edited by John Cava, 159-207. Cambridge, MA: The MIT Press.

Henry Harmon. Presidential Papers, Files: *Saarinen 1945-46, Saarinen, Saarinen & Associates 1947-48-49. Mies Van Der Rohe Architect, Meredith Classroom Building*. Special Collections, Cowles Library, Drake University.

Kamin, Blair. 2005. "Crown Hall Dazzles in Mies Simplicity." *Chicago Tribune*, August 21, Section 7.

Kuhner, Robert A. 1975. *Eero Saarinen, His life and Work*. Monticello, Ill: Council of Planning Librarians.

Charles Leopold Engineers. 1962. *Resident Hall Repairs, June 14.* File: *Resident Hall Repairs & Improvements 1962* (including Dining Hall). Special Collections, Cowles Library, Drake University.

Lyons, Maura. Curator and Publication author. 2008. *Building a Modern Campus: Eliel and Eero Saarinen at Drake University.* Anderson Gallery, Des Moines, Drake University.

McCaw John, interview by author, October 10, 2008.

Merkel, Jayne. 2005. *Eero Saarinen*. London and New York: Phaidon Press.

Oishi, Masato. 1984 Extra Edition. *Architecture and Urbanism: Eero Saarinen*, Tokyo: A+U Publishing Co., Ltd.

Park, Norman L., ed. 1951. "New Trend in College Buidlings." *PPG Products* 59: 16-19.

Saarinen, Eero and Aline Saarinen. 1962. *Eero Saarinen on His Work; A Selection of Buildings Dating from 1947 to 1964 with Statements by the Architect*. New Haven: Yale University Press.

Sekler, Eduard. 1965. "Structure, Construction & Tectonics." In *Structure in Art and in Science*, edited by G. Kepes, 89-95. New York: Braziller.

Sexton Mark, Krueck + Sexton Architects, interview by author, June 2008.

Shane George. 1954. "New Drake Dorms Magnificent Examples of Beauty in Building," *Des Moines Register*, March 7, 1954.

Sloan Dan, Baldwin White Architects, interview by author, Des Moines, IA, October 7, 2008.

Syroka Bob, Syroka and Associates, interview by author, October 19, 2008.

Turner, Paul V. 1984. *Campus: An American Planning Tradition*. The Architectural History Foundation/MIT Press.