BERTRAND GOLDBERG

PRESERVING A VISION OF CONCRETE

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INTRODUCTION
Aims of Study

This thesis seeks to evaluate how an architect’s intentions play a role in preservation and conservation work on the exterior surface of modern concrete structures; more specifically, the impact coating has on exposed concrete structures. To do this, I will look the body of work of one significant but often less well recognized architect, Bertrand Goldberg. Continuously changing perceptions of architecture expressed in exposed concrete along with the growing acknowledgment of Goldberg as an influential architect of the 20th century are increasing the amount of attention that we place in understanding his use of concrete and his intentions for the finished work. This increased attention is changing how we determine treatment and preserve his buildings today and into the future. Through a methodology that involves studying Goldberg’s design strategy, use of concrete, and how a few of his projects have been conserved over the past half century, a greater understanding of Goldberg and his concrete buildings will arise. While there has been published research on the work of this architect, much of it focuses on exposing the vast array of his projects throughout his long career and on the innovative planning and design aspects of his work. There has been no collective or comparative study on the changes that his buildings have experienced since their initial construction, many of which have had their exteriors significantly altered. This thesis addresses this gap in published research by comparing exterior alterations to a selection of his highly recognized work: the Marina City towers, the Raymond Hilliard Homes, and the River City II complex.

Concrete is a material that possesses risk of degradation and high repair costs when building with it, potentially more so than with traditional building materials such as steel or masonry and especially when the exterior surface is left exposed as an architectural feature. Even when the deterioration of the concrete surface does not pose a significant threat to the structural integrity of the building, many see the aesthetic degradation of the surface as in need of repair or restoration. In either case, building professionals are left with a question of how to repair or preserve it, both technically in execution, and aesthetically in concept. An architect like Bertrand Goldberg who spent nearly an entire lifetime studying concrete most certainly understood this potential for repair in the not-so-distant future. However, what is not clear, is what Goldberg’s plans were to address this issue. The intention of this study
is, therefore, to question how one preserves the exterior of an architecturally significant, exposed concrete building or structure while addressing both the intentions of the architect and the practical or economic issues of concrete repair. The goal is to more appropriately treat the exterior surfaces of his buildings, at least more suitably based on the original architect’s intent, than what has been done in the past. Goldberg had a particular vision which has been lost or repudiated on many of his buildings to varying degrees throughout their life.

Relevance

Bertrand Goldberg’s architecture, characterized by monumental curvilinear concrete forms, has been the subject of both praise and scorn in recent years. This sentiment has been reflected in conflicting preservation decisions on two of his buildings: while the Prentice Women’s Hospital building lost its preservation battle and was razed in 2015, Marina City was granted landmark status by the city of Chicago in March 2016. Goldberg is among a generation of architects who designed their work in reinforced concrete for both the freedom of form that it permitted and the economy that it provided. Many of these buildings have gone through major restorations, renovations, and repairs throughout the years. Because the aesthetic of exposed concrete has generally been either dismissed or entirely despised, many of these buildings, including Goldberg’s, have been subject to coating treatments which completely transforming the character of the building. These “repairs” or “restorations” are often inconsistent with, and insensitive to, the intentions of the original architects who prioritized the surface of the concrete exterior as part of the

Figure 1: Architect Bertrand Goldberg in his office, 1967.
overall expression of the architectural work. Their appearance has changed through treatments which include the coating of concrete. Drexel Gardens and the Helstein Residence are two of his smaller, early works that have been received problematic or insensitive work over the years. Originally both featured exposed concrete but have been covered over with either layers of paint (Helstein) or other buildings materials such as siding and face brick (Drexel). Other larger and more well-known projects that have had their exteriors altered by coating campaigns have been the Astor Tower, Marina City, and the Hilliard Homes.

Figure 2: (Left) Original, exposed concrete exterior of the Helstein Residence in Hyde Park, Chicago.
Figure 3: (Right) The Helstein House in 2016 with concrete that has been painted over.

Figure 4: (Left) The Drexel Home and Gardens featuring concrete block, not uncommon for housing projects of the day.
Figure 5: (Right) Drexel Homes in 2016 with additional building materials added to the façade, over the concrete block.
Within the past few years there has been an increased intrigue surrounding modern, exposed concrete buildings, especially among the general public, as evidenced by the sheer number of books, articles, and blogs on the subject. This heightened attention is changing how we determine treatment and preserve these buildings today. Seemingly, now more than ever, restorations are honoring the intended exposed concrete surface, which in the past was subject of contempt, often coated over for aesthetic but also protective means.

Methodology

The devised methodology of studying particular aspects of the architect and their intentions provides a means to better understand and inform the physical conservation practices on the concrete buildings. The methodology is therefore a guide to research and study, going from concept through to physical actions on the building. The methodology becomes a study of the following:

1. The architect’s specific use of concrete, how they thought about and designed with concrete, and the reason behind using concrete as the main structural and finish material for their work
2. Case studies as evidence and proof that concrete played a significant role in design
3. The varied history of repair and restoration on each of the buildings put into context with other restoration projects of similar type and scale
4. The architect’s vision for their buildings in the future; if there was consideration for the weathering, deterioration, or failure of concrete

This thesis then takes this methodology of research and applies it to one particular architect and his body of work: Bertrand Goldberg. Through an in-depth study of Goldberg that includes looking at both first-hand sources and other professional papers of the time, a potentially better and alternative path to understanding how his buildings can be treated in the future can arise. Particular attention will be paid to Goldberg’s relationship with concrete, the buildings’ designs and use of concrete, and assessment of the physical repair work throughout several of his building’s life spans.
The work of this thesis reads in the order of the methodology. After a brief overview of Goldberg’s education and early career in Chapter 1, Chapter 2 will focus on studying Goldberg’s significance. This significance is centered on interpreting Goldberg’s particular use of reinforced concrete and how the material was integral with his structural concepts, function of space, and aesthetic design. Goldberg follows in line yet stands apart from other more commonly recognized early to mid-twentieth century architects and engineers and their use of concrete, both in how they designed their structures and the aesthetics of the concrete surface. Chapter 3 will then review case studies of three of Goldberg’s buildings to serve as examples for this narrative and provide evidence for how Goldberg designed, why the concrete played a significant role in design, and show the varied history of repair and restoration of his buildings. Chapter 4 will discuss the case studies’ repair and restoration campaigns in context with other related restoration projects. Chapter 5 will evaluate Goldberg’s intentions for the future of his buildings and seek to determine if his intentions were realized or not. Finally, a conclusion will determine what this means for the future of repairs on Goldberg’s significant works of architecture.

Explanations of Case Studies

Although this thesis makes references to a diverse array of Goldberg’s buildings that were constructed over the course of many decades, just three of his projects were chosen to be studied in-depth. The Marina City residential towers, the Raymond Hilliard Homes, and the River City II complex were chosen based on (1) their location within the same city, Chicago, (2) their similar building typology, large residential towers or complexes, part of at least a block-scale, mixed-use site, (3) the varied design and construction dates of the buildings, ranging from the mid-1950s through the mid-1980s, that exemplify the progression in the way Goldberg designed the concrete structure, from central core with columns and beams to a completely load bearing exterior concrete shell, and finally, (4) the varied histories of repair and renovations on each of the buildings as each has building has been treated at different times and with various repair methods showing varying preservation methodologies
applied when it came to their repair and preservation. In addition, these are considered “seminal” projects among Goldberg’s collection of work.¹

Each case study highlights specific aspects of the built works, taking a look at how concrete was used structurally, the new construction techniques and technologies that Goldberg employed, the interior spaces that were created because of the design flexibility concrete allowed, and the intentions for the surface texture and overall appearance of the concrete in order to establish the exposed concrete exterior as an integral part of the overall design. Lastly, the case studies outline a timeline of major repair work of the concrete exterior, highlighting both the reasons for the repair work and discussions surrounding why or why not the concrete exterior was coated.

01 GOLDBERG’S EDUCATION & EARLY CAREER
Bertrand Goldberg’s large and distinctive body of work displays the culmination of his ability to act as an engineer, planner, and socially conscious humanist in addition to his role as an architect. Goldberg’s buildings are a result of finding innovative solutions for structure, function, and aesthetic.

Education

In 1913 Bertrand Goldberg was born in Chicago, the same city he would later establish his practice. His life-long career in architecture began with his education at Harvard College where he decided to enroll in the Cambridge School of Landscape Architecture in 1932. At the time, prior to Joseph Hudnut’s arrival and the establishment of the Harvard School of Design in 1935, the three schools of architecture, landscape architecture, and city planning existed as separate entities. During Goldberg’s second year of courses, he felt it time to leave and study at the École des Beaux-Arts in Paris rather than follow the same traditional rhetoric, albeit further removed, in the United States. As Anthony Alofsin addresses in his essay on the history of American architectural schools, during the time immediately preceding Hudnut’s arrival to the school, “the design work coming out of the school displayed considerable stylistic ambivalence.” Whether Goldberg sensed this or not, he was ready to move and study in Europe. Henry Atherton Frost, the progressive dean at the Cambridge School who had worked with Goldberg while he was there, suggested that he go to the Bauhaus in Germany instead of following the Beaux-Arts path. Although modernism had not completely infiltrated the American architectural education system, educators in the field were already aware of the “experimental architectural pedagogy” set forth at the Bauhaus. The pragmatic, “anti-academic

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2 Footnote: The Cambridge School of Architecture and Landscape Architecture was founded in 1915 and developed in association with Harvard University. It was the first to produce women graduate training in those fields. It became affiliated with Smith College, as a Graduate School of Architecture and Landscape Architecture in 1934. “Cambridge School of Architecture and Landscape Architecture Records, 1919-1986,” Five College Archives and Manuscript Collections, http://asteria.fivecolleges.edu/findaids/smitharchives/manosca78.html#list-ser2
4 Betty J. Blum, Oral history of Bertrand Goldberg (Art Institute of Chicago: 1993), 12.
spirit” of the Bauhaus was alluring to American architectural educators because at that time the industrial nature of society in the country was clashing with the Beaux-Arts system.6 The Depression also added fuel to this new wave of thinking as it “intensified already existing doubts about whether traditional educational methods were sufficient to equip new architecture graduates to deal with the complexities of modern life.”7 It was not until 1937 that Walter Gropius took on the chair of the architecture program at Harvard’s newly formed Graduate School of Design on the invitation of Hudnut.8

In May 1932, Goldberg left for Germany, where he met Ludwig Mies van der Rohe at his office in Berlin. As an alternative to immediately starting classes at the school then still in Dessau, he began apprenticing at Mies’ office under the direction of Bruno Walter. The Bauhaus by this time was experiencing increasingly hostile political clashes and in the fall of 1932, the Nazi party’s proposal to stop the Bauhaus’ training was accepted in the Dessau council, thus closing the school. Mies moved the program to Berlin-Steglitz where he rented a building, converted it into a school, and continued to operate the Bauhaus as a private institution. Much of the faculty moved with the school including Wassily Kandinsky, Josef Albers, Ludwig Hilberseimer, Lilly Reich and Walter Peterhans, whom Goldberg studied under when he started classes in the winter of 1932.9 Not too long after, on April 11 1933, at the beginning of the summer semester, the Bauhaus building in Berlin was searched, sealed, and 32 students were temporarily arrested. With uncertainty and financial distress, a conference of teachers decided to dissolve the school. Many of the most influential instructors began emigrating elsewhere, some settling in the United States, including Josef Albers, Wassily Kandinsky, Paul Klee, Walter Gropius, László Moholy-Nagy, Walter Peterhans, and Marcel Breuer.10 Goldberg also left Germany shortly after the school closed. Although he only spent a short time in Berlin, he said of his time

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studying there, “When I left the Bauhaus, I think that the very few things that I carried with me were, one, that whatever architecture had to offer had to be offered with the use of an aesthetic and a value system that was based on industry. The origins, the roots, the materials, the methods for translating industry into aesthetics were not so clear to me.” Evidently, Goldberg’s interest in humanism and industrial design were rooted here as well as his receptiveness to ideas of prefabrication that defined the early portion of his career.

**Early Career**

Goldberg kept busy during the years following his return to the United States. He enrolled at Armour Institute, today the Illinois Institute of Technology, to study structural engineering. Around the same time, he began apprenticing for modernist architect George Fred Keck, whom he had met through Philip Johnson. After drafting in the office of Keck and Keck and assisting with designing houses for the 1933 Century of Progress International Exposition in Chicago, Goldberg left to work under Paul Schweikher where he met Scandinavian engineer Frank Nydam. Goldberg continued private engineering lessons with Nydam in lieu of continuing his education at Armour. Goldberg also worked in the office of Howard Fisher for a short time.

Goldberg’s independent early work consisted mainly of smaller scale projects including single-family residences, with an emphasis on interior spaces, explorations into prefabrication, and furniture design. Architect Geoff Goldberg, Goldberg’s son, said that his father’s early work “can be understood in light of his Chicago origins and his training at the Bauhaus. He believed in a progressive social agenda coupled with a strongly American, in some sense, Chicagoan sense of pragmatism.” Goldberg’s innovative and cutting edge use of the newest materials and techniques was apparent in his early work, especially through his early residential interiors and the furniture that he designed. His early work also shows an inclination for using curvilinear

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elements in design, “challenging the ubiquitous steel-and-glass International Style.”

By 1937 Goldberg organized and opened his own office.14

Goldberg designed his first house in 1934. The residence for Harriet Higginson displayed an initial example of the architect’s design ethic as he explored innovative solutions in dealing with budgetary constraints. Goldberg used prefabricated elements from catalog houses and added his own features to design a home with a modern aesthetic that was likely inspired by Mies and the Bauhaus training he received. Other early residences and a few small commercial projects, most scattered around the Chicagoland area, also featured standard elements from the modern architectural vocabulary such as open plans, areas of exposed structure, large floor-to-ceiling windows, and “other industrially derived elements.” The Ancell and Jacobs Residences were especially notable as they featured curvilinear forms in their design like the circular living room of the Jacobs’ house. In addition to custom homes, Goldberg designed a series of projects in the late 1930s, using industry to create innovative solutions for living, possibly inspired by what he saw at the Century of Progress exposition in 1933. These projects included a three wheeled car, a mobile ice cream car, and a gasoline station suspended from a central mast.16 Like other architects of the time, Goldberg designed furniture. He worked with the American Novelty Furniture Company to fabricate some of his designs. From chromed steel, Lucite, glass or wood for his chairs and tables, Goldberg seemed to leave no building material unexplored.17

16 Footnote: Around this time, Goldberg also became associated with Leland Atwood, a structural engineer who was instrumental in the design of Buckminster Fuller’s Dymaxion House. This tie furthered Goldberg’s connection to the world of architectural prefabrication.
Goldberg’s interest in prefabrication also extended to housing projects. He participated in a Housing Research Project at Purdue University in 1937 that resulted in a number of houses being built in 1939; one in Lafayette, Indiana and five more in Melrose Park, Illinois. Goldberg then formed a partnership with Gilmer Black called the Standard Houses Corporation for the purposes of continuing to build and market
the homes that had proven to be successful.\textsuperscript{18} During the years preceding World War II, the Standard House Corporation received federal contracts to build government-sponsored defense workers’ housing. Goldberg also joined the government’s Office of Strategic Services during the war years where he designed a mobile penicillin laboratory, a mobile delousing unit, and a convertible gum crate, although only the later was put into some degree of production.\textsuperscript{19} Following the war, Goldberg worked with the Pressed Steel Car Company and developed a railroad boxcar that was fabricated with stressed-skin plywood to respond to the war’s resulting steel shortage. His designs for the Unicel Prefab Freight Car, although never put into production, proved his innovative genius. Goldberg took the design for the plywood boxcars and developed other versions such as the Unishelter which were boxcar-like structures designed specifically to function as individual housing units.

\textbf{Mid-career and Introduction of Concrete}

After a brief partnership with Leland Atwood from 1949-1952, the firm of Bertrand Goldberg Associates was organized. Goldberg’s early and successful forays into industrial construction and prefabrication “represented the beginning of a commitment to approaching design and architecture through creative engineering

\textsuperscript{19} Ibid., 23.
and solutions and the first significant manifestations of a technical expertise.”20 The same shortage in steel that pushed the innovation of the pressed plywood boxcars also caused Goldberg and many other architects to design using innovative concrete designs. It was at this time that most of Goldberg’s projects started to incorporate concrete as a major construction material and feature as the surface of their designs. Examples of early concrete projects include the Helstein House, completed in 1950, where concrete was employed as structural slabs (similar to Le Corbusier’s Dom-ino House) and the Drexel Garden Apartments in 1954, built using concrete blocks, with the blocks acting as both solid masonry walls as well as architectural screen walls. While the house was a more ground-breaking use of concrete for a single family residential projects, the concrete blocks of the apartments were quite typical of the time for building inexpensive housing.

It was around this time, beginning in the mid 1950’s, that Goldberg’s iconic style took shape; a style that was monumental in scale and appearance and employed innovative designs and structural systems. His designs for curvilinear, cylindrical buildings also featured more prominently in his repertoire starting around this time after an exercise in designing a parking garage while attempting structural efficiency, as will be described later. Designs for Pineda Island and Motel 66 (never built) can be seen as predecessors to Marina City.21 The design for Astor Tower, initially designed just before Marina City, was meant to be circular in shape but was eventually changed because Goldberg considered the lot size too small to have the tower stand on its own and not be completely out of context with the surrounding rectilinear buildings.22 Once land was acquired for the Marina City project in 1955, Goldberg began design for the site. It was with this project that Goldberg’s career took off, continuing to exhibit an evolution in the structure of his larger works, always utilizing concrete in new ways.

Goldberg’s projects from 1960 onwards tended to be large scale, institutional projects including an elementary school, higher education facilities, health care centers, hospitals, commercial buildings, residential complexes, and mixed use

22 Ibid., 176.
communities. Although many projects never made it past conceptual stages, he did have a significant portfolio of built projects by the end of his career, which lasted until his death in 1997 at the age of 84. His built projects display a distinctive character and thoughtfulness. Each project built off of the one that came before it, evolving conceptually and physically in structure. This evolution and range of work utilizing reinforced concrete will be discussed further in Chapter 2.
Footnote: Chapter 2 is not intended to include a complete history of modern reinforced concrete. Instead, it provides context and a better sense of the architectural climate that preceded Goldberg through the mid-century when his major projects were being designed. Each section gives context and then orients Goldberg within that context, where he both fit in and stood out from other architects and engineers of the time.
Structural Design, Form, & Technology

By the time Goldberg began his foray into designing large structures with concrete, many innovators who came before him in the fields of architecture and engineering had drastically pushed the limits of reinforced concrete’s perceived capabilities. The late 19th century through the first half of the 20th century was an especially productive time as this new technology of reinforced concrete was invented, delivery systems were introduced, admixtures were developed, and structural systems were tried and tested. Designers eventually employed concrete in a way that went beyond that of the traditional post and beam influenced by steel construction.

Beginning in the 1850s, several French innovators were experimenting with iron embedded into cast stone and concrete as a means of reinforcement. François Coignet, Joseph Monier, and François Hennebique were among the first to combine iron with concrete. Although each of them implemented the solution in a different way, individually they recognized the economy concrete provided, the added tensile strength the metal delivered, the system’s ease in constructability, and the added benefit of concrete’s ability to fireproof the ferrous metal. From the late 19th century on, the idea of reinforcing concrete quickly took hold in engineering and architectural design, utilized first as a complete load bearing enclosure system and later as the structural framing system and used in conjunction with a curtain wall. Robert Maillart, a Swiss civil engineer, notably was the first to utilize the reinforced concrete in ways that completely broke “with the masonry past and put concrete into forms technically appropriate to its properties and yet visually surprising.” By 1900 Maillart was imagining bridges that took full advantage of concrete and he created forms not possible with other building materials. His Zuoz Bridge, completed in 1901, was a curved arch with a flat roadway atop connected by walls, exemplifying that structure and form could function as one entity.

Around the same time, the first concrete skyscraper was constructed in the United States. The Ingalls Building, built in 1903 in Cincinnati, Ohio by the architectural

26 Ibid., 156.
firm Elzner & Anderson, is considered the world’s first reinforced concrete skyscraper at 16-stories. The engineer on the project, Henry Hooper, utilized Ernest Ransome’s system of twisted iron bars to reinforce the concrete. Until this point reinforced concrete was only used for smaller scale buildings. While the structural principles used in the project were not unlike the post and beam structures of other tall buildings, this experiment was important for proving that concrete could be used to construct tall buildings.

The 1930s through the 1950s saw a number of other experimental reinforced concrete projects with a focus on creating forms that would be impossible or uneconomical to make with traditional building materials. Maillart’s thin shell vault for the National Exhibition in Zurich 1939, called “The Cement Hall,” was a breakthrough in creating a vault with concrete. In Italy, engineer Pier Luigi Nervi, created domes and barrel shells with concrete beam lattice work. The structures that he built from 1935 through 1959 were artistic works of building construction. Although Nervi’s forms arose from structural principles, there was a consciousness about the aesthetics. He called his forms “a unified structural system.” Another notable figure in the history of forming concrete is Felix Candela, a Spanish born builder, engineer, and architect who moved to Mexico in 1939. Influenced by Maillart and like Nervi was highly motivated by the aesthetic of the finished work, Candela was known for his thin shell reinforced concrete structures with forms that pushed the use of concrete further by incorporating the shape of hyperbolic paraboloids. While these concrete arched and domed forms were evolving, other engineers were testing reinforced concrete in tall building construction. One of the most renowned examples of this was Fazlur Kahn’s tube structural system, which he is credited as developing in the 1960s for use in both steel and concrete buildings, allowing for even greater height.27

Architects, considering the structural principals that were discovered, also envisioned forms and spaces to follow from the concrete masses. Carl Condit stated in *American Building Art of the 20th Century*, “The invention of construction in slabs, shells, or thin ribs, or combinations thereof, has made possible the closest approach to the organic ideal – that is, the structural form in which the distribution of material corresponds exactly to this distribution and kind of stress.” Expressionist architecture was just one form that emerged and showed off the malleable capabilities of concrete. Often, Goldberg’s work falls into the category of “expressionism” or “neo-expressionism” as the designation reports for Marina City and the National Register nomination for the Hilliard Center indicate respectively. Although Goldberg did not consider some of the forms of these buildings to be architecture of the industrial age, the structures were nonetheless made possible through the advancement of understanding concrete by the middle of the 20th century. In the United States, Eero

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30 Footnote: “BG: I think, really, that when one looks at my plans he should know what the building looks like. I think that, in a time of industrialization, a plan should carry this kind of communication. Much of the East Coast architecture today does not. I think to this extent it is a throwback to Beaux Arts architecture. JC: What about the TWA Building by Saarinen, which cannot be understood by looking at the plan, but has to be experienced as a kind of monumental sculpture? BG: I cannot accept it as an industrial or a contemporary form.”
Saarinen’s TWA Terminal at JFK Airport (1955-1962), Frank Lloyd Wright’s Guggenheim Museum (1956-1959), and Louis Kahn’s Salk Institute (1959-1965) are all stand-out examples expressive exterior forms all constructed of and made possible through the use of reinforced concrete.

The forms that Goldberg created, although circular and expressive, came out of a rigorous study of structure, material, form, and function. In fact, Goldberg was recognized by both the engineering and concrete communities throughout his career and was a licensed professional engineer in addition to being a Fellow at the American Concrete Institute.31 As preservationist Daniel Bluestone describes in his nomination for the Hilliard Center, “For his part, Goldberg felt that he was more of a structural rationalist than the architects who treated building form as sculpture. He drew on his

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31 Footnote: Goldberg published articles for magazine and trade magazines such as “Concrete: Old Earth for New Designs” in Concrete Construction magazine 1980 and “Truth in Concrete” in Concrete International magazine in 1988. He received awards such as an Excellence in Concrete award from the Arizona Rock Products Association in 1982, an honorary membership award from the American Concrete Institute in 1987, and was also named a Fellow of the American Concrete Institute. He spoke often on the subject of concrete, including a speech called “The Right Mix” at the Portland Cement Institute’s spring meeting in Chicago in 1985, and delivered the keynote speech entitled “Truth in Concrete” (the basis for his article in Concrete Construction) at the American Concrete Institute’s annual convention in 1988, and presented “Form and Forming” at the Forming Economical Concrete Buildings Fourth International Conference, also in 1988. All of these can be found in the bibliography.
Bauhaus training and his early affinity for Mies van der Rohe to insist that there was a structural and spatial rationale for the key elements of his design, quite apart from issues of formal expression.”32 While aesthetics played a role in his design, he seemed to insist that his architecture was very much rooted in the structural principles. Goldberg stands out as a designer who thought of both the structure and the architectural form. Although skyscrapers and bridges follow different design principles for the loads that they are meant to resist and carry, Goldberg designed a number of tall concrete buildings, taking a page from the early bridge designers such as Maillart in his attempt to create structure in form as one. A title that might suit Goldberg well is that of the “structural artist” as defined by David P. Billington in The Tower and the Bridge. According to Billington, the three leading ideals of “structural art” are efficiency, economy, and elegance. Likewise, the three dimensions of structure are scientific (economy), social (forms for people) and symbolic (studies of appearance, aesthetics).33

Goldberg’s strong interest and training in structural engineering and focus on the principles of industrialization led him to the forms he created and the use of concrete as the main structural material. The principles of industrialization that he learned early on in his career doing architectural prefabrication, such as the repeatability of members as made possible through the processes of industry, were key in designing based on economy. His tower designs draw from this idea. For example, reusing formwork repeatedly on every floor level of the building saved on construction costs. According to Goldberg, the steel structures born out of the Bauhaus tradition no longer offered “the perfect solution to our search for an industrialized system.”34 In fact, in his Oral History, Goldberg credits a simple exercise in steel design to landing on the cylindrical shape of a structure as the most efficient means of building an “industrialized structure”:

“My moment came in about 1955, and I was designing a rather simple building. It may have even been a garage. ... On this occasion I decided to do my own

34 Bertrand Goldberg, “Concrete, Old Earth for New Designs” (Aberdeen Group, February 1, 1980), 1.
steel detailing because I thought the building was so simple that it would only have perhaps one or two sizes of columns and one or two sizes of beams. I started to design the steel, and suddenly I was confronted with the fact that the corner columns carried loads that were quite different from the perimeter columns. Which gave me three, four, five, six, seven, eight sizes of beams by the time I got in my bracing members for the diagonals to keep the building rigid. ... Suddenly this concept of industrialized structure erupted as a myth, really, as a revelation. ... Suddenly it occurred to me that this vast variety of sizes and types no longer was an industrialized form. ... And then almost at that same moment I began to investigate any other spatial form which would have produced a repetitive regularity of structural members, and the only thing that I could find was either a shell, which by itself would have unity or an egg, for example – an egg is quite an industrialized form. ... The only form for a garage I could find was, in a sense, a drum – a column at the center from which radial beams emerged. I had a regularity. Then I began to examine that form versus a rectilinear form in terms of wind stresses in terms of usefulness, in terms of lots and lots of other values. Then I tried to discover whether living spaces could be designed in some of those spaces, and then I tried to discover if there were other ways of constructing a unified space other than with posts and beams. That was the way in which I first immersed myself in forms that had little or nothing to do with the rectangle, with the right angle. Nevertheless, having discovered how to build those forms, the disciplines and the necessity for creating a unity of structure that I had learned from Mies was quite apparent."35

Goldberg discovered that the circular form provided much more than just streamlining and economy of material. In addition, the circle in plan offered “the highest ratio of usable floor space to exterior skin,” reduced wind loads through aerodynamics of the curved shape, and efficiently brought mechanical, electrical, plumbing utilities to all the units by having a central core to disperse from, and in structural design, eliminating special corner conditions. But why specifically use concrete to build this form? Goldberg also had an answer for this question. He answered,

"Because it has the greatest flexibility for adapting to the various conditions and forms that we find necessary or at least desirable to develop in this story of space. Steel is not a readily flexible material. Detroit has understood that you can take steel and turn it into virtually a new material by stamping it. You get strength out of the shape of steel sheets, just as you can get strength out of the shape of concrete shells. But whereas you need big presses and you need big dies and you need much more quantity in order to make steel in these special forms, a practical element in a building budget, the methods of

35 Blum, Oral history of Bertrand Goldberg (Art Institute of Chicago: 1993), 49-51.
using concrete in these various forms are much more readily available, and so it’s a material of choice."

Another inspiration for building the cylindrical form in reinforced concrete could have been what Goldberg saw being constructed on industrial sites. For example, in the mid-1950s Goldberg photographed a below ground concrete treatment tank in Nashville, Tennessee. This picture, taken around the same time that Astor Tower and Marina City were going through the early stages of schematic design, could very well have played an important role in those two buildings’ design. The purely industrial facility that Goldberg photographed was built entirely of reinforced concrete with wooden formwork. The economical nature of concrete as a building material as well as the structure of a curved concrete wall that could act as a load bearing wall without the use of internal columns, may have triggered something in Goldberg’s mind.

But Goldberg was not just satisfied with reproducing this cylindrical form, instead his career exhibits an evolution in concrete structural design. Goldberg’s designs from the mid to late 1950’s can be identified as the beginning of this evolution in form. Around this time, Goldberg’s diverse interests and influences throughout his education and career came to form a more unified architectural approach. The way in which he employed the concrete was always changing, whether as a skeleton, a plate, a shell, as structural or non-structural skin, sometimes combining various techniques.

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Footnote: It is uncertain as to whether or not Goldberg was involved in the design or management of the Nashville treatment tank project or simply photographed the site while travelling.
Goldberg said, “In our best work, we use concrete as if it were a living material, a biological material. The form of the concrete grows to become the message explaining the design. In providing this expression, concrete has never failed us.”

Concrete's capabilities for ultimate malleability is what ultimately driven Goldberg to use it over and over in each of his designs. Goldberg acknowledged this process and evolution when he said,

“In the nature of the process of building major structures, and sometimes smaller buildings, you learn from the creativity. You frequently wish you could do it all over again, but that generally is impossible. On the other hand, as you move along, you change your ideas and improve them, you hope. The extent to which that happens or is possible depends on the stage of development when you can make that improvement. At Prentice Hospital, for example, we were able to early on conceive of a cantilevered form and try to engineer that form so that we would know that we had it available.”

In 1956 Goldberg received a commission to design a recreation center in Mobile, Alabama called Pineda Island (1956-1960). Goldberg’s open-air pavilion structure that featured a monolithic, curvilinear concrete shell awning, was the highlight of the campus. While this project did not require the structural engineering that most of his later, much larger, projects involved, it was an early indication of the forms that his later work would take on. Another project around this time, although not conceived of in concrete and never built was a proposal for Motel 66 in 1958. The rendering featured two cylindrical hotel room towers. The Astor Tower (1958-1960) in Chicago’s Gold Coast neighborhood, originally a luxury hotel and today condominium units, was a single high-rise building that although square in plan today, was originally designed as a circular tower. The high-rise, as it stands today, features a central slip-formed concrete core housing vertical circulation and utilities surrounded by four units on each floor that cantilever off the core and are supported by cylindrical concrete perimeter columns. This core is left exposed at the base of the building, making the concrete structure the feature of the architectural design.

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37 Bertrand Goldberg, “Concrete, Old Earth for New Designs” (Aberdeen Group, February 1, 1980), 3.
41 Footnote: The Astor Tower project also shows one of the ways in which Goldberg thought creatively about construction, inventing new ways to build with concrete. To build the basement levels, slabs were cast on grade and dug out from underneath (using a small bulldozer used in mining) to create the below-grade levels and drilling and casting the perimeter tubular columns instead of using conventional sheet piling.
Figure 17: (Left) Pineda Island during construction.
Figure 18: (Right) Motel 66 rendering.

Figure 19: (Left) Astor Tower during construction.
Figure 20: (Right) Astor Tower in 2016.
In 1959, aspects from each of these earlier works culminated in the design of the Marina City residential towers. The towers’ structure functioned much like that of the Astor Tower which was under construction at the same time. The towers were building with a central concrete core and perimeter columns supporting the floor slabs. The only two residential complexes to follow were the Hilliard Homes and River City. The evolution of Goldberg’s tower design is evident in these projects and is especially evident since the three projects follow linearly in time. The Raymond Hilliard Center, built between 1963 and 1966, was unlike Marina City in that Goldberg was able to free himself of the traditional post and beam structure and utilize the exterior walls as loadbearing “shells” supporting the structure. The cores of the circular towers were then open, allowing the space to be used for community activity. Goldberg saw this move to use what he referred to as a “shell structure” as a more efficient use of a form. River City II, constructed in the mid-1980s, although much more complex in form than the towers of Marina City or Hilliard Home, also utilized cast-in-place concrete for construction of the snake-like mass of the structure. Goldberg used concrete as an exterior shell as structure in more than just residential buildings. Another project where Goldberg featured the shell structure was with the Elgin Hospital Laundry building in Elgin, Illinois, built from 1962 to 1964. The hangar-like space is a simple long span rectangular building, more orthogonal than most of Goldberg’s work, features side walls of cast-in-place columns and trusses spanning 100’ across the building without the use of interior columns. The concrete, in an accordion fold plan, stretches across the beams in the same manner, as the trusses are concrete as well.

Goldberg not only used concrete as the shell and structure of the building, but also as a skeleton structure. The West Palm Beach Auditorium project which began design in 1958 was a tent-like building. Precast concrete roof rafters were spaced radially around a central core, angling upwards to establish the tent form. The entryway to the auditorium featured concrete vaults which were said to be similar to the vaulting underneath Marina City’s Office Building. The Marina City office building located to the north of the towers was a “largely exoskeletal” building. The rectilinear

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office building was raised 5 stories into the air by “continuous, uniquely-shaped load-bearing concrete mullions.” The transition of the structure at the 5th floor featured gothic-shaped vaults. One source attributed this design to engineer Frank Kornacker who was working for Bertrand Goldberg Associates in the early 1960s.44

Figure 21: (Left) Elgin Laundry Building. Figure 22: (Right) West Palm Beach Auditorium during construction.

Figure 23: (Left) Vaults at Marina City office building. Figure 24: (Right) Marina City with office building in the foreground.

44 Footnote: Frank Kornacker is most well known as being responsible for the engineering of Mies' Crown Hall and 860 Lake Shore Drive.
Another method of building with concrete that Goldberg experimented with was the use of thin-shell construction in which he utilized spray-on concrete, also known by tradenames such as Gunite or Shotcrete. The Brennemann Elementary School, designed and built from 1960 through 1963, was a departure from the large residential, commercial, and auditorium buildings that Goldberg completed until then. However, it was another opportunity to explore the potentials of concrete. Modeled after one-room schoolhouses, individual classroom units were clustered together. However, instead of lying beneath one continuous roof structure, each classroom had its own curved concave roof structure constructed from steel reinforcing and sprayed concrete. In effect, each roof was a shell above the classroom. Likewise, the theater building on the site of Marina City, occupied in 1967, also featured a thin-shell arched roof in which large arches of steel beams were covered with a triangular shaped structural grid taking on the form of a “saddle.” This doubly curved space truss structure was then sprayed with concrete and clad in lead sheathing for sound isolation.45


Footnote: The structural character and visible form of this lead-sheathed enclosure was primarily the work of Hanskarl Bandel of Severud Associates engineering firm.
Most of Goldberg’s later works consisted of hospital and health care facilities. Like his residential towers and complexes, these buildings feature cast-in-place reinforced concrete “shell” construction. Unlike the residential tower projects, these towers featured a cluster design in plan, organizing patient rooms around central nurse’s stations forming one cluster. The clusters were then organized around a central core. The Elgin hospital was the first of Goldberg’s medical care facilities to be completed in 1967 and featured a round tower. However, it was the design of the Affiliated Hospitals of Harvard University in Boston, Massachusetts between 1964 and 1971 that set the stage for his evolution in health care facilities as several proposals for this project were presented here and used in subsequent projects. The original idea that featured three cloverleaf-shaped concrete shell towers supported on piers atop a 3-story rectilinear building below was not built exactly to that plan. One of the other design proposals featured a shell structure cantilevered from the core, much like the original idea for Marina City. This then became the final design for Prentice Hospital in Chicago, completed in 1975, which featured a “quatrefoil bed tower of monolithic concrete shell construction” atop a box-like, traditional steel post and beam structure. Prentice’s cantilevered floor slabs achieved what Goldberg set out to do with Marina City: have a concrete exterior shell that was completely cantilevered off a central core, eliminating any columns within the tower. Yet another proposal featured exterior cast-in-place concrete walls that draped all the way down to the ground with punched through circular window openings. This design was eventually used for the Good Samaritan Hospital in Phoenix, completed in 1982.
Structure also played into how Goldberg conceived of and designed the forms of his buildings. He retrospectively categorized the forms of his projects into categories such as geocentric forms (Marina City and Hilliard Homes), cluster forms (the hospitals), and cellular forms (River City). The overall form had an effect on the interior spaces. In fact, the two influenced and informed each other as part of a dynamic and constantly evolving relationship. He claimed that these forms were only possible because of the flexibility that concrete provided.46

Goldberg wanted to emphasize that industrialization, principles of structural engineering, and building functionality were not fundamentally separate from good design and architecture.47 Goldberg’s interior spaces were also a result of striving for functionality and humanism.48 While the influence of Mies and the Bauhaus may have played a role in the industrial nature of Goldberg’s designs, his interest in humanism, or the way people experienced and were affected by the spaces that they lived in, set him in a much different direction. Goldberg payed special attention to the interior spaces that he was creating for people to live and work in. Although Goldberg had designed residences and interiors earlier in his career, Marina City was the first of many projects in which the form of the overall structure translated into unconventional, flower petal-shaped units. Goldberg’s design capabilities allowed him to create lively and unique spaces that were still functional, livable, and all the while still not so far removed from traditional spaces, making it easy for people to adopt to this new form of living space. He noted, “We found that spatial forms for apartments, if designed in the interests of livability, economy and energy conservation, could no longer be boxes.”49

46 Bertrand Goldberg, “Form and Forming,” Speech at the Fourth International Conference of Forming Economical Concrete Buildings, New York, December 6, 1988, 2. Ryerson and Burnham Library at the Art Institute, Bertrand Goldberg Collection.
47 “I would like to emphasize that we have made a very extensive exploration of functional space and its effect on man.” Betty J. Blum, Oral history of Bertrand Goldberg (Art Institute of Chicago: 1993), 131.
48 “The shapes were both influenced by the function, and in turn influenced the function.” Betty J. Blum, Oral history of Bertrand Goldberg (Art Institute of Chicago: 1993), 221.
In a similar manner to Paul Rudolph, Goldberg went so far as to say that these spaces were a “psychological answer to human needs.” \(^{50}\) The experiment with Marina City proved that people did not necessarily need to or want to live in traditional boxes. \(^{51}\) Goldberg used what he learned from his experiences designing Marina City to then design the spaces in Hilliard Homes, intended for an economically disenfranchised segment of society. The difference between Goldberg’s family homes and the standard of public housing preceding this was vast. The uniquely shaped spaces gave people a sense of individualism and pride in their homes and the areas at the cores of the circular towers provided community space. Goldberg attributed this success to the form and therefore to the concrete that created the form. He said, “As we see River City take form, it becomes clear that concrete can solve not only building problems, but community problems. Architecture, engineering, concrete social planning have become a synergism which can rejuvenate our cities.” \(^{52}\)

With the hospital programs the cluster arrangement for rooms formed groups around the nursing stations, allowing for a greater welfare for patient needs than in a linearly designed hospital. “The new forms of space wove more closely the relationship between patient and nurse, increased the efficiency of care, and provided better organization patterns for medical care – all made possible by the flexible engineering inherent in concrete plasma.” \(^{53}\)

In addition to constantly evolving the structure of the building, Goldberg actively explored the latest in technology surrounding concrete construction and celebrate what utilizing the latest in materials could do for the finished product of his concrete buildings. From the use of slip-form construction methods, to using fiberglass formwork, to experimenting with various forms of concrete such as precast, cast-in-place, and sprayed on concrete, Goldberg displayed a passion for incorporating

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\(^{51}\) “We even discovered that certain shapes of space made people feel better than other shapes. The shape of space affects behavior.” Bertrand Goldberg, “The Right Mix,” Speech at the Portland Cement Institute’s spring meeting, Drake Hotel Chicago, April 16, 1985. Ryerson and Burnham Library at the Art Institute, Bertrand Goldberg Collection.

\(^{52}\) Ibid.

\(^{53}\) Bertrand Goldberg, “Truth is Concrete,” *Concrete International* (Sept. 1988, Vol. 10, No. 9), 26-30.
emerging technology into the architecture. Innovative uses of already existing technology also allowed for economical building. Notably, Goldberg’s firm was early to adopt architectural modeling programs and finite element analysis to study how the curving mass forms would perform during a time when the technique was mainly applied to large dam projects and in aviation.54

Aesthetics of Concrete
While structure, form, and the overall massing of the buildings were major factors in Goldberg’s design and often the most visually striking features of his works, he also paid close attention to the surface quality of the concrete. Although the history of concrete in the modern era begins with concrete utilized purely as structure, often intended to be covered over with a more decorative and traditional façade material, a shift occurred beginning in the early 20th century. Leading modernist architects, and often more specifically architects designing in a brutalist expression, searching for greater honesty and truth in material expression, began to leave the concrete exposed as the architectural finish. They were concerned with the aesthetic of the concrete, what it could show and what it would mean.

In March 1855, François Coignet (previously mentioned as being the first to build a structure of iron-reinforced concrete) took out a patent describing the method he used to build with “béton,” meaning concrete in French, and thus claimed sole ownership to build in this method for the ensuing 15 years. In December that same year, he placed an addendum on his original patent, stating.

“Concrete walls need no facing materials in stone, brick or any other material whatsoever. The hollow part of the mould, in which the concrete is poured, should have the form to be given to the mass, whether the walls be plain or with projections such as cornices, ramps, attics, string-courses, entablatures, balconies, or any kind of ornament, etc. By this means, the hollow of the mould gives moulded and compressed concrete forms in relief, without the need to employ any covering or exterior facing, nor any supporting framework, the whole being in concrete, moulded in place on the wall itself.”

While this is an early claim that argued in favor of exposing the concrete surface, in practice Coignet contradicted himself. Ultimately he found the cinder aggregate concrete’s surface appearance “ugly.”

According to Peter Collins, Ernest Ransome, the early innovator in rebar design, was the first to design a reinforced concrete building in which the concrete was left to be exposed as the architectural finish. His Junior Museum of Stanford University, built between 1889 and 1891, was not coated with a layer of cement which was typical at the time. Instead the concrete was treated as having an architectural quality. For the first time, concrete was not only used as inexpensive infill or backing material and roughly constructed, it was actually meant to be handled by craftsman and show off its finish.

This early intentional display of the concrete is not only important in that it showed the material but also what was presumably expressed was the formwork, or rather the marks left by the formwork.

But this early example did not start a trend in buildings with this aesthetic. Reinforced concrete grew only in popularity as a structural system due to its inherent fireproof capabilities and due to the fact that its construction was economical. Concrete as structure largely continued to be disguised beneath facades of stone, cast stone, brick, or terracotta. Leading professionals in the field of building construction advocated that concrete be covered.

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56 Ibid., 30.
57 Ibid., 62.
58 Footnote: In an 1868 article in Building News the author states, “A great, and, many would assert, a fundamental objection to all descriptions of building in concrete, whether fluid or solid, is the unsightly appearance the walls present. We will say nothing about the want of any architectural effect, by which is not meant, as is usually considered in this country, the mere outline or proportions of a design, but simply refer to the rough, crude, hard, and raw appearance afforded by the sight of a concrete building, in which the walls stand naked as they
stated that concrete had some “objectionable features” which included “form-marks, unsightly rough surfaces and monotonous deadness of appearance.” The author then went on to give solutions for how to treat the concrete for an “agreeable” surface.59

Even the early modernists of the 20th century covered concrete. Their tendency to cover the concrete with stucco was meant “to stress an ideal geometry.” While the methods and materials to cover the concrete might have changed, the fact remained that the concrete was still largely hidden. “To the modern movement, the integrity and purity of surfaces represented also their ideals regarding the relation between appearance and content.”60 It was in this context that early modern movement was associated more with form than with an emphasis on materiality. For the most part the only structures with an exposed concrete surface were buildings with industrial or utilitarian uses. August Perret’s garage project on Rue de Ponthieu in Paris constructed from 1905-1906 had only a thin “whitewash” over the concrete surface.61 Engineer and architect Albert Kahn designed factories that were an exemplary case in point of industrial structures that displayed simplified modernist form combined with the aesthetic of concrete as an exposed exterior surface.

There were of course exceptions to this unstated rule that only industrial buildings could be left with a bare concrete surface. For example, the Bahá’í House of Worship in Wilmette, Illinois, built in several phases from 1920 to 1952 and designed by architect Louis J. Bourgeois and engineer Allen B. McDaniel, utilized a highly decorative concrete by designing the mix to include white cement, ground quartz crystal, and white granite aggregate.62 Auguste Perret’s Église Notre-Dame du Raincy, a concrete cathedral in Le Raincy, France completed in 1923, was also an early example of decorative exposed concrete. Perret was a French architect who largely contributed
to the narrative of exposed concrete in the early 20th century, helping to lead the way for concrete as an acceptable architectural material. His use of textured precast blocks completely changed the image of how concrete could be used instead of a rough board form appearance with connotations of the industrial. Another early exception was the Rudolph Steiner’s Goetheanum II in Dornach, Switzerland built from 1925 to 1927.

It was not until the 1930s that concrete structures further broke away as a material used to imitate more classical styles and began to take on a style of its own, a more modern aesthetic. In fact, past president of the AIA, Irving Pond, heralded this sentiment years earlier in an address to the National Conference on Concrete Housing in 1920, in which he advocated for the respect of concrete as a material, and that it is untruthful to use concrete to build traditional buildings, imitating other materials such as stone or wood. In the 1950s the “sculptural articulation of concrete” became increasingly apparent, as well as the expressiveness of the material itself. These architects practicing in the mid-century were following the early modernist’s ideal of truth in architecture but achieving the concept on a more literal level, exposing the

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surface of the concrete and using it to display the formwork from which it was constructed.

Perhaps the most influential and most exemplary cases of this expressiveness was Le Corbusier’s use of board form concrete. Although Corbusier’s early works were structures that were coated in white stucco, after the war his buildings displayed bare concrete. As a student of Perret, Corbusier learned about the expression of concrete, and utilized raw exposed concrete, or “béton brut,” on his modernists projects such as the Unité d’habitation (1947-1952) and La Tourette (1956-1960). These were important moments for the aesthetic of exposed concrete as this pattern of board marks later became a hallmark of an architectural style. Eventually the term béton brut was translated, and perhaps misinterpreted, as “brutalism.” Architectural critic and theorist Reyner Banham in The New Brutalism described the stylistic movement as “an ethic, not an aesthetic”\textsuperscript{65} For example, the Smithsons claimed their work’s honesty as what “brutal” referred to, not the concrete material itself that was brutal. However, as the book \textit{Heroic} points out, “In its American translation, Brutalism became even more dissociated from its ethical connotations, coming to stand solely for the aesthetic efforts of those working to develop a concrete idiom, a group that included Louis Kahn, Paul Rudolph, and I.M. Pei.”\textsuperscript{66} These architects along with others of their generation moved away from the glass and steel of the early modern, international style, and were creating massive forms of monumentality “often inspired by the robust postwar buildings of the Smithsons, Le Corbusier, and others.”\textsuperscript{67}

During the post-war period, several architects emerged who frequently used concrete and designed the exposed, finished surface as part of an overall architectural aesthetic. True, concrete was economical after World War II and widely available compared to steel of which there were often shortages, but the symbolism behind building with exposed concrete had important implications. Concrete, in its raw and monolithic form, represented a boldness and humbleness at the same time. The rough surfaces also gave a sense of hand-craftsmanship, largely lost in the industrial

\textsuperscript{67} Ibid., 17.
Architects designing in concrete worked in a way that was different than the modernists who designed in the International style aesthetic. The ruinous qualities of concrete differed greatly from the shiny, smooth, clean lines of the glass and steel rectilinear buildings.

Architects who were inspired by the board form, created their own signature concrete aesthetics. Notably, Paul Rudolph’s projects often featured a vertical ribbed, bush hammered textured surface as seen on the Yale University Art and Architecture Building (1963). The technique of bush hammering, also used historically on stone, used impact tools to remove the outer cement and expose the fractured aggregate on surface of the concrete, creating a highly textured façade. At the other end of the spectrum was Louis Kahn, an architect who also used concrete for to form massive geometric structures but his aesthetic differed from Rudolph. His smooth, monolithic concrete surfaces were a bold statement on what concrete could achieve. An example of this is on his Salk Institute of Biological Studies in La Jolla, California (1965).


Footnote: Rudolph was not so intent on only exploring concrete as he said, “Every material has its own intrinsic values and uses. And I’m interested in every material, not just one. It’s wrong to think that I’m only interested in concrete. ... I’m fascinated with the idea of how to make a building dominant in the city scale. I used to think that it could best be accomplished by making it relatively heavy and solid. I now explore ways to make it very light in terms of steel construction and still make it dominant.” John W. Cook and Heinrich Klotz, Conversations with Architects (New York: Praeger, 1973), 102.
Goldberg’s material of choice was concrete and he consistently used the material as the structure and exterior façade in his designs from the mid-1950s on. Like other architects of the mid-century who were also experimenting with the same materials for both the freedom of shape that it allowed and its economic cost, he created his own particular aesthetic with concrete. However, the constantly changing ways in which he employed the concrete and the variety of building types, led him to experiment with many different surface treatments for the concrete.

Although not verified, there is sufficient reason to believe that Goldberg designed nearly all of his concrete buildings with the intention of leaving an exposed, architectural concrete finish. However, in his constant experiment with innovative concrete techniques, he did not rely heavily on any singular mode of construction or fabrication of his concrete. Therefore, his concrete is not synonymous for having one appearance. While other architects do tend to be associated with a particular concrete aesthetic, Goldberg is not. For example, Le Corbusier with board forms, Rudolph with bush hammer, and Kahn with monolithic smooth concrete panels. Goldberg experimented with a range of concrete forming methods and technology, thus leading to a variety of final surface textures.

For cast-in-place concrete, Goldberg used various types of formwork (some of which will be described further in the case studies). Wood was the standard material used to make the formwork. The board form aesthetic seems only to have been used once on the four towers that compose the Hilliard Homes while other, less organic shapes were created on other projects like the ribbed surface of River City, also created with plywood in which vertical v-shaped channels were notched out. Although it remains unclear as to what the formwork was for Astor Tower, the rough surface of the perimeter concrete columns, since coated with a white opaque paint, are highly textured. This is in stark contrast to the very smooth appearance of the concrete on the Marina City’s residential towers and office building which utilized fiberglass forms, designed in house. Goldberg also used precast concrete panels, especially in his hospital buildings, creating a smooth concrete façade on buildings such as Brigham, St. Mary’s, and Wright College. Finally, he used spray concrete as seen on the Health Sciences Center at Stony Brook in New York, and the Brennemann Elementary School.
Figure 36: Detail of Astor Tower concrete column featuring rough aggregate.
Figure 37: Detail of Hilliard Homes concrete featuring board form concrete.

Figure 38: Detail of Marina City’s smooth concrete surface texture.
Figure 39: Detail of River City concrete’s vertical surface ribs.

Figure 40: Detail of Wright College precast concrete panels.
03 CASE STUDIES
Case Study 1: Marina City

Figure 41: Marina City
Historic Overview

The Marina City towers, the most recognizable of Goldberg’s built projects, play an important role in the history of concrete construction and city planning in Chicago. At the time they were completed, the towers were not only the tallest residential buildings, but the tallest reinforced concrete structures in the world topping out at a total of 588 feet. 70 According to historian Ross Miller, the Marina City buildings were also “the first major non-Miesian buildings in the commercial core of Chicago.” 71 The iconic towers stood on a 3.1 acre development project bordering the north side of the Chicago River that included a theater and office building, all of which remain standing today. Although each of these structures are interesting for their display of advanced concrete engineering, the twin towers are the most visually striking structures on the site. The first residents of the towers were pioneers who experienced what Goldberg referred to as “a new concept in urban living” and a “city-within-a-city.” 72 Marina City was designated a City of Chicago Landmark as of March 16, 2016.


Figure 42: (Left) Site plan of Marina City. Figure 43: (Center) Marina City residential towers apartment layouts. Figure 44: (Right) Marina City section.
Concrete Structure, Technology, and Surface Design

Concrete is a key building material that serves as both the structure and exterior surface of the residential towers. Initially, Goldberg conceived of the tower floors as “apartment petals,” totally supported and cantilevered off a central core. However, Fred Severud and Hannskari Bandel of Severud-Elstad-Kruger Associates in New York worked with Goldberg on the structure and advised on the risk of this scheme. Severud and Bandel considered the large scale of the project and the fact that the construction method had never been tested before. Instead, they suggested that Goldberg employ perimeter columns to support the floors at the exterior. Therefore, the towers’ construction was typical of a standard high rise building, using piers and beams, only in this case, the structural members were tied into a central cylindrical core that stabilized the structure. Severud’s solution was adopted; the beams that support the floors branch out from the central core in a radial pattern and are supported by two rings of 16 perimeter columns. The central, cylindrical reinforced concrete core supports the building’s structure and houses key vertical transportation systems, which include the stairs and elevators and the main mechanical, electrical, and plumbing systems that then feed into the individual apartments. The core has an inside diameter of 21 ft. and the wall thickness ranges from 30 inches near the bottom to 12 inches at the upper floors. Each of the towers is 105 ft. in diameter. Structural light-weight concrete was used to construct all floors and beams. Expanded shale was utilized as a lower-weight aggregate, providing a “more efficient strength-to-weight ratio” and allowing for thinner structural columns throughout the building. Frank Kornacker headed structural engineering at Bertrand Goldberg Associates at the time.

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Goldberg designed the Marina Towers with the intention that the finished surface of the concrete structure would be an exposed, smooth concrete surface. As part of a description of the building sent by Goldberg to Architectural Record, Goldberg described the structure built of a “monolithic concrete” frame with the exterior wall surface composed of “exposed concrete, glass, and sprayed plaster.” 76 A Portland Cement Association news release read, “Smooth, off-the-form exterior concrete surfaces left exposed, thus maximizing the economy of a structural system with architectural qualities.” 77 The “self-finished” concrete supposedly saved 10 to 15 percent of the cost compared with a similar building erected with steel construction. In addition, using formwork to create the finished structure and surface, “embedded the innovative design in a financially invulnerable phase of the project – once the curvilinear forms of the core and floors of the residential towers were poured in place, these could not be compromised by later budget cuts inevitable in any project.” 78

Therefore, concrete was part of the formal design and structure but also a key financial strategy.

The formwork used to achieve the smooth exterior concrete surface finish was constructed from lightweight fiberglass. In the early 1960s the use of fiberglass to make forms became an increasingly popular technique in the building industry. The sudden popularity of the material for producing formwork was due to several factors. The fiberglass forms provided a means of producing a finished concrete surface without additional work of grinding, allowed for any special pattern or design to be directly set into the concrete, were economical when reused repeatedly throughout construction, and withstood multiple pours without deformation.\textsuperscript{79} The fiberglass forms, composed of polyester resin, used to construct the Marina City towers were successful for these reasons. While the forms were expensive to construct and laborious to produce, hand-crafted by construction crews acting as artists to produce the forms, economy was recovered through speed of construction. The forms manufactured by Engineered Concrete Forms of Chicago were reinforced with steel and wood and were so well-constructed that they were reused 67 times. The external reinforcement on the forms allowed them to be self-stabilizing, no longer requiring through-the-wall form ties or spreaders.\textsuperscript{80} Without ties, the finish surface was without unsightly holes that would require fills, maintaining the smooth concrete aesthetic that Goldberg was aiming for. The various formwork pieces shaped the ramps, columns, walls, beams, and floors of the towers. The success of the formwork was proven when they were removed and “revealed concrete with a dense finish, sharp corners, and handsome detailed columns.”\textsuperscript{81}

Fiberglass was not a new material for Goldberg as he had experimented with it earlier in his career and employed it in earlier designs, although in much different applications than concrete formwork. In the late 1930s Goldberg worked with Milo Ozuk on a fiberglass car. Interestingly, Ozuk’s son then came to work on the Marina where he “solved various mechanical problems with his abilities as a fabricator and

\textsuperscript{80} Katerina Ruedi Ray and Igor Marjanovic, Marina City: Bertrand Goldberg’s Urban Vision (New York: Princeton Architectural Press, 2010), 76-78.
\textsuperscript{81} “This is Marina City,” (Portland Cement Association, 1960), video file, http://digital-libraries.saic.edu/cdm/singleitem/collection/mqc/id/11140/rec/2
welder” on the Marina City project.\textsuperscript{82} Goldberg also designed fiberglass screen walls to enclose a bridge kitchen as part of a courtyard addition, connecting two still extant townhouses in Chicago’s Gold Coast neighborhood for the Florsheim family in 1952.

Concrete Repair, Maintenance, and Restoration

In August 1977, the property management company, as part of the towers’ conversion to condominium units, embarked on a major “improvement” campaign. As part of this, the concrete was repaired with high modulus epoxy and the entire surface of the buildings was coated with Modac, an acrylic solvent based waterproofing coating, thus changing the color of the towers from gray to light tan. \textsuperscript{83} According to a report on the state of the towers’ concrete published in 1989 by Wiss, Janney, Elstner Associates’ Northbrook, Illinois office, sometime between 1977 and 1979, the concrete on the exterior of the Marina City towers was repaired with high modulus epoxy and coated with a product called "Modac," an acrylic solvent based waterproofing coating.\textsuperscript{84} While a variety of concrete coatings have been applied to

\textsuperscript{82} Katerina Ruedi Ray and Igor Marjanovic, \textit{Marina City: Bertrand Goldberg’s Urban Vision} (New York: Princeton Architectural Press, 2010), 73.
\textsuperscript{83} “The End is Coming: Marina City goes Condo,” The Biography of Chicago’s Marina City, http://www.marinacity.org/history/story/goes_condo.htm
\textsuperscript{84} Footnote: According to Modac F100 Product data, Modac is “a pigmented, high build, acrylic waterproof sealer that is recommended for use on concrete block, cinder block, cast in place, precast and tilt-up concrete, brick and previously painted surfaces. The product has a history of years of proven durability and resistance to acid rain, chemical attack, salt spray, ultraviolet light, alkali and efflorescence. MODAC® F-100 acrylic coatings far outlast other coating systems.
concrete structures over the years as a protectant, the painting of the towers in this case was primarily an aesthetic choice by the owner, completed in conjunction with the condominium conversion. Bob Joyce, who is today the President of Quality Restorations Inc., the company that has executed the facade repair work on Marina City over the past few decades, worked for the general contractor who painted the towers in 1979. He “noted that the painting was primarily performed for aesthetics to update the look of the towers at the time of the conversion, and that the water resistance provided by the Modac coating was considered a secondary benefit to protect the concrete and reduce the rate of deterioration.”

While a change of management provided the original impetus for painting the towers in an attempt to revitalize or refresh the look of the building and entice buyers, by the late 1980s the concrete and coating were in a state of major deterioration. The 1989 WJE report attributed the concrete failure to two main sources: inadequate concrete cover over the reinforcement in certain locations and even more deleterious, “the presence of chloride ion in the concrete.” Chlorides were historically introduced into concrete as an admixture to increase the setting rate in cold weather climates, to speed up the construction time when using formwork, or to set into the concrete when de-icing salts were used on or near the surface. Advancements in concrete technology and studies of the effects of the chlorides have led to the decline in this practice, and instead other admixtures are employed that do not have the same corrosion-inducing effects on steel. In Marina City, and in other structures where chlorides were found to be present, the chloride ions often destroyed the protective

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85 Brian Greve, email to author, February 24, 2017.
87 Susan MacDonald, The Investigation and Repair of Historic Concrete (Parramatta N.S.W.: NSW Heritage Office, 2003), 9.
oxide layer on the steel reinforcement, in turn causing corrosion of the steel and leading to cracking, delamination and eventually spalling of the concrete.\textsuperscript{88} In response to the 1989 report which found chloride ions to be present in the concrete, Goldberg’s office sent a letter to WJE insisting that their office policy had always been to “forbid the use of chlorides.” However, they acknowledged that the chlorides could have been introduced by the extensive use of salts to remove snow and ice over the years, or most likely that they were added into the concrete mix on site by a construction foreman after the concrete was delivered to the site.\textsuperscript{89}

By the early 1990s any epoxy fill and coating work that had been completed since the initial coating application began to fail. The major repairs recommended by WJE in their report which called for concrete replacement in areas of severe deterioration and an application of a new coating were executed. The tower balconies, which make up the entirety of the building’s exterior from the 21\textsuperscript{st} through 60\textsuperscript{th} story, were especially in need of repairs and in some locations required replacement of whole sections of concrete.\textsuperscript{90} Areas of the concrete surface were sandblasted prior to concrete placement in order to clean the rusted steel, remove surface contamination, and roughen the concrete surface for better adhesion to the new concrete. The reinforcing steel members were coated with an epoxy paint to inhibit future corrosion and new supplemental reinforcement was installed to better anchor the repair areas. The new patches of concrete consisted of site-batched polymer modified concrete, advantageous for its low permeability, bonding abilities, and increased durability. Previously, epoxy was used as the main infill material but newer industry standards have changed this practice. After the concrete repair work was completed, waterproofing membranes were then applied to some of the balconies (but not all,\textsuperscript{88,90}


\textsuperscript{89} Letter from Bertrand Goldberg to Dr. Paul Urbanick, November 15, 1989; Bertrand Goldberg Archive, Ryerson and Burnham Library at the Art Institute of Chicago, Series VI, Folder 4.10 (accessed Thursday March 16, 2017).

leading to a problem that persists to this day) and an architectural coating was re-applied to the façade to reduce the moisture content of the concrete. This re-applied coating, meant to retain the appearance resulting from the initial coating in the late 1970s, reduced the ongoing corrosion of the embedded reinforcement. While not completely preventing any future façade repair work, this repair campaign slowed down the rate of deterioration.

Marina City was last painted in 2003 using Modac F100 and Modur F Smooth Coating. Like the Modac coating, the Modur is a solvent-based coating. However, Modur is much lighter in its application weight and thickness, making it better for recoats of a surface. Overall, the rate of repairs over the years have considerably dropped following the major repairs of the early 1990s. This can be attributed to the application of waterproofing coatings that have reduced the rate of concrete deterioration. Causes for the deterioration today remain the same mechanisms of failure, the chloride content in the concrete and localized areas where the rebar was placed too close to the exterior surface of the concrete. In addition, some of the current repairs include fixing or replacing the patch repairs from earlier campaigns. Overall, the repair work on the façade has sought to retain the appearance of the building when it was coated in the late 1970s. Today the building has a smooth, light tan colored, coated concrete appearance.

Figure 50: Image from the 1989 WJE report of the spalled concrete on a spandrel from. Figure 51: Images from concrete replacement repair in 2010 on balcony.

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91 Letter from Bertrand Goldberg to Dr. Paul Urbanick, November 15, 1989; Bertrand Goldberg Archive, Ryerson and Burnham Library at the Art Institute of Chicago, Series VI, Folder 4.10 (accessed Thursday March 16, 2017).
Figure 52: (Left) Rust stains on the Marina City balconies.
Figure 53: (Right) View of concrete from street level looking up at parking garage ceilings.
Case Study 2: Raymond Hilliard Center

Figure 54: Raymond Hilliard Center
Historic Overview

Bertrand Goldberg designed the Raymond Hilliard Center as part of a project for the Chicago Housing Authority (CHA) built from 1962 to 1966. The CHA asked Goldberg, who had recently finished the Marina City project with great acclaim, to design their newest site, in part as a strategy for boosting the reputation of increasingly unpopular housing projects. In the complicated history of public housing in Chicago, the Hilliard Center has stood out as relatively successful over the years. Goldberg attributed the “success” to careful attention in design for community building with respect for “humanism.” 92 Goldberg’s scheme for the project involved four concrete towers: two circular towers for elderly housing and two curved, “unfolded” towers for families. The design also included a low-lying glass and steel box-like building for community activities and an outdoor concrete auditorium in the central courtyard space.

92 Betty J. Blum, Oral history of Bertrand Goldberg (Art Institute of Chicago: 1993), 185.
Concrete Structure, Technology, and Surface Design

While the layout and exterior appearance were the most apparent innovative features of the buildings, the towers were also original in part for their exterior loadbearing “shell” of concrete that provided structural support. With the Hilliard towers, Goldberg was successful in his attempt to overcome the traditional post and beam structure. By eliminating the need for a central structural core, as was the case for the cylindrical towers for the elderly residents, the outer shell and the structure became one, therefore making it more efficient. Goldberg said that he was “trying to achieve optimal structure and living space within one shell form.” The hallway around the core area was able to open up and become a larger circulation and community space for the residents on each floor. The interiors of the individual apartment units were petal shaped like Marina City’s units, but with variations to the layout especially in the curved tower family buildings. The “dynamic” curving interiors

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93 Footnote: This is not to be confused with “core and shell” construction, a term generally used to describe a method of commercial construction. Rather the shell in this case is referring to the exterior load-bearing walls of the tower buildings.

were successful for the residents in public housing as the spaces created a sense of individuality in a public housing climate that tended to create lifeless boxes for living quarters.95

The Hilliard towers were built using the slip-form construction technique. This method of construction involves continuously pouring concrete into a system of formwork or molds that ascends vertically with the assistance of hydraulic or screw jacks. While originally used in the 1920s and 1930s as a method for constructing grain silos and other tall industrial structures, this technique was not common for building residential or commercial towers. The Hilliard buildings and the Astor Tower were among the first non-industrial buildings to use the slip form method in the United States. Carl Condit credits the architect J. Marion Gutnayer as the first in Chicago to use slip forming to construct his apartment building at 5740 Sheridan Road in 1961. Interestingly, Frank Kornacker was the engineer on this project before going to work at Bertrand Goldberg Associates where he was a part of the Marina City project team.96 Goldberg had originally intended to use this technique to construct the cores of the Marina City towers but was unsuccessful due to push back from the contractor, McHugh Construction, who ended up building with a “chimney-like construction method” in exchange for a credit.97 The relatively fast construction time and the accuracy that the slip form method provides, combined with the economical reuse of forms, made the technique perfect for the Hilliard project.

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Footnote: “Chimneylike” may mean that they used a jump form method of construction, different from slip forming in that it relies on more traditional concrete forming techniques to build the shell on an incremental basis.
At Hilliard, the finish texture on the concrete that resulted from the form work was a board-form texture with the boards running in a vertical direction. Goldberg intended for the finished surface to be readily apparent and remain exposed. The specifications for the project under Division 4A Cast-in-place Concrete stated that “concrete work in permanently exposed beams, walls, slabs, etc. constitutes the finished surface.” The expressed board form was an aesthetic choice made by the architect. In an interview, Goldberg explained that they could have easily called for smooth forms with the technology available at the time. He stated,

“We can build a far better concrete by having the smoothest forms we can achieve. So which shall we do? It finally is a matter of finding a vocabulary which will please us. At the moment, we use the outside texture because we don’t have any other forms which please us. We did not need a striation at the Marina Towers because of the lively pattern of the balconies, whereas the solid walls of the Hilliard Towers called for some texture.”

The expression and aesthetics of the concrete was thoroughly designed and then materialized through the use of board forming. In this case, the lack of drama in the form, due to the relatively flat façade with window openings, was compensated for, by a highly textured surface created by the wooden boards. Daniel Bluestone, in the Hilliard site’s nomination form for National Register designation, also made note of the

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98 “Spec section: Division D-4A Cast-in-place Concrete: 4A-09.5 Exposed-Finished Surfaces,” Art Institute of Chicago, Ryerson and Burnham Libraries, Bertrand Goldberg Archive.
when he stated, “With its space-age modern style, the Hilliard Center has little in the ways of traditional architectural ornament. The modern neo-expressionist architectural form is established with simple reeded concrete bays that terminate the unusual petal like interior spaces. Transcending the post-and-beam rectilinear forms of both traditional and modern architecture, Goldberg took advantage of the plastic and highly expressive qualities of reinforced concrete.” 

Concrete Repair, Maintenance, and Restoration

The Hilliard buildings’ exposed concrete surface remained until the early 21st century. Although this public housing site fared better than others, by the mid-1990s, the state of the Hilliard Center, including the towers, was in complete disrepair. Two of the towers were fully mothballed while the other two remained partially occupied. Large sections of the concrete surface had spalled. Richard Monocchio, Executive Director of the Housing Authority of Cook County, explained that even with the disastrous state of the buildings, there was a sense that Goldberg’s buildings should be preserved due to their architecture. Joseph Shuldiner, the head of the CHA at the

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time, admitted that the complex needed to be sold to a private bidder because public funds could not support the upgrades and repairs that were needed.101

Peter Holsten, a Chicago developer, purchased the property. Holsten was interested in mixed-income projects, the new federally and locally preferred model of creating subsidized housing at the time. Holstein’s concerns for social justice and his reputation for rehabilitating historic buildings into affordable housing led him to be known as the “anti-gentrifier.” To a developer, Hilliard Center seemed like a worthwhile rehabilitation project to pursue; the unique character of the buildings, the location near market-rate housing to make mixed-income housing work, and the potential of the site for National Register status and therefore eligible for preservation tax credits, made the project appealing.102 Holsten’s project moved forward with the scope of renovating the buildings and reconstituting 654 affordable family and senior apartments with associated programmed spaces and offices. A National Register nomination was written by Daniel Bluestone and the site was listed on the National Register on June 30, 1999. As planned, the developer pursued restoration work with Federal Historic Tax Credits and the National Park Service and Illinois Historic

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101 Richard Monocchio said, “By the time of HUD’s takeover in the mid-90s, Hilliard "was just like everything else in CHA—it was pretty much a disaster... [but] Because of the architecture, there was a definite sense that [the buildings] should be preserved.” Maya Dukmasova, “The Goldberg Variation: High-rise Public Housing That Works.” Chicago Reader (Nov. 5, 2016), http://www.chicagoreader.com/chicago/hilliard-homes-goldberg-public-housing-high-rise/Content?oid=23812560

102 Ibid.
Preservation Agency then approved the proposed rehabilitation work, ensuring that the Standards were followed appropriately and the integrity of the buildings remained. Lisec Architects was enlisted as the AOR, Linn-Mathes, Inc. served as the General Contractors, and Eskanazi, Farrell and Fodor were the structural engineers.

According to Carol Dyson, chief architect at the Illinois State Historic Preservation Agency and the person responsible for reviewing the project, the original structure was built in such a manner that the steel rebar had been set too close to the exterior surface of the concrete. Dyson asserted that realistically, without a coating to prevent moisture from penetrating the concrete and causing the rebar to rust and expand, the newly patched concrete would spall again within a few years. Therefore, coating the concrete was determined to be a requirement of the rehabilitation work. Clear coatings or sealants were tested as part of the review of the project. However, the products tested were considered too glossy and did match the original surface of the concrete, as opposed to an opaque coating which, when color matched, more closely resembled the original, clean concrete. The natural dirt accumulation, especially at the tops of the towers, was not taken into consideration during the color matching, and the color eventually chosen appeared significantly lighter than the concrete did at the time of restoration. Although, according to Dyson, no reviewer on the project wanted Hilliard to be opaquely coated, NPS made the final approval of the coating. The issue was brought to Sharon Park, Chief of the Tax Credit Section of NPS,

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105 Footnote: Standards for minimum concrete cover on rebar, or the minimum distance from the edge of the concrete surface to the rebar, vary depending on building application and size of the rebar. Minimum standards have changed. Presently, The American Concrete Institute Building Code recommends the following. Whether this was built according to plans or this was faulty construction was not investigated.

<table>
<thead>
<tr>
<th>Rebar Rules for Distance to Edge of Concrete</th>
<th>Min. Concrete Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete cast against and permanently exposed to earth</td>
<td>3”</td>
</tr>
<tr>
<td>Formed concrete exposed to earth or weather: #5 bar and smaller</td>
<td>1 1/2”</td>
</tr>
<tr>
<td>Formed concrete exposed to earth or weather: #6 through #18 bars</td>
<td>2”</td>
</tr>
<tr>
<td>Formed concrete not exposed to earth or weather: slabs, walls, joists: #14 &amp; #18 bars</td>
<td>1 1/2”</td>
</tr>
<tr>
<td>Formed concrete not exposed to earth or weather: slabs, walls, joists: #11 and smaller bars</td>
<td>3/4”</td>
</tr>
<tr>
<td>Formed concrete not exposed to earth or weather: beams and columns</td>
<td>1 1/2”</td>
</tr>
</tbody>
</table>

106 Carol Dyson, email to author, December 1, 2016.
for judgment and she approved the practice as complying with professional standards.107

TammsCoat, a high performance, water-based acrylic coating used for both protection and “decoration” of masonry and concrete walls, was selected.108 Thom Greene, the architect who specified the product, consulted with the Illinois SHPO and understood their concerns about the appearance of finish, vertical board striations, caulking, and color. Illinois SHPO’s recommendation of the product followed testing of Tamms and other products. This specific coating was ultimately chosen based on its ability to retain the concrete texture and visibility of the vertical board formed ribbing.109 Although Hilliard was coated, the debate, testing of samples, and selection of the product that was eventually chosen, all make it clear that the parties involved were conscious and respectful of the concrete surface of the building. However, had the Secretary of Interiors Standards been followed directly, this coating treatment should not have been allowed as part of the rehabilitation of this historically significant building. For instance, Standard 5 states, “Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.” In this case, the application of an opaque coating can be interpreted as violating this clause.

In the end, the parties involved in the project did not retain Goldberg’s intended appearance of the exposed concrete exterior. Several factors accounted for this decision, including (1) inherent flaws in the original construction, (2) the state of conservation technology and conventional practice at the time of rehabilitation, and (3) the typology of the building as low income housing with a relatively low budget. While the coating did help prevent increased deterioration of the façade, it also lost the intended aesthetic of the concrete. Today, according to Holsten, sporadic patching

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107 Footnote: According to Dyson, in 1999, NPS was more accepting of opaque coatings for concrete patching than they are today. She noted that a judgement on the issue might have a different outcome today as different concrete coating products are available and professional practice in dealing with exposed concrete has evolved. Carol Dyson, email to author, December 1, 2016.
is required on the buildings’ surfaces but not to the extent that was necessary in the early 2000s prior to the major renovation and coating.\textsuperscript{110}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{hilliard-concrete-exterior}
\caption{Hilliard concrete exterior today.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{hilliard-towers}
\caption{(Left) Hilliard curved tower, 2016. (Right) Hilliard cylindrical tower, 2016.}
\end{figure}

\textsuperscript{110} Peter Holsten, email to author, December 4, 2016.
Case Study 3: River City II

Figure 66: River City II
**Historic Overview**

River City is considered a culmination of Goldberg’s previous forays into housing and mixed-use design and planning. This stand-alone complex located south of the “loop” area in Chicago was, according to architectural critic Ross Miller, an opportunity for Goldberg “to develop and refine an engineering, architectural and sociological program on a grand scale.” The complex was constructed between 1983 and 1986. However, the designs and conceptions for the project had started in the early 1970s as part of a larger, more “radical” proposal. After more than a decade and several iterations, some features of the original design involving towers and a longer “snake-like” plan were eliminated or refined. Eventually only a portion of the “snake” was constructed. The mid-rise housing complex featured commercial, retail, restaurant, health-club, educational, and recreation space as well as 446 residences. Unlike previous housing projects, the units came in a variety of sizes and types, including multi-story townhomes and penthouse-like units.

The medium-rise housing development is composed of two snake-like forms winding parallel to each other and connected by an interior atrium. Each of the residential units is accessed through hallways along the sky-lit atrium, supposedly modeled after European streetscapes. The atrium space, named River Road, is intended to function as a community space, and is “probably the most dramatic interior [Goldberg] ever designed,” as recounted by Goldberg’s son Geoffrey.

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111 Betty J. Blum, Oral history of Bertrand Goldberg (Art Institute of Chicago: 1993), 254.
Concrete Structure, Technology, and Surface Design

By the spring of 1985, construction, engineering, and architectural magazines were heralding Goldberg's use of concrete. The Concrete Reinforcing Steel Institute's promotional material from spring 1985 even advertised a graduate course and tour entitled “River City: Design and Construction, A Modern Marvel of Cast-in-Place Reinforced Concrete.” The brochure stated, “The designs of famed architect Bertrand Goldberg always lead in new directions, calling for new techniques [for the latest in concrete construction].”113 The structure of River City functions similarly to that of the Hilliard towers, in that the exterior concrete shell provides much of the structural support for the building. Once again, Goldberg was able to build without the use of perimeter columns. The cast-in-place concrete was built using formwork that was designed and detailed by BGA.

Like with his works in concrete, at River City Goldberg payed close attention to surface texture. While small portions of the exterior are painted EIFS and relatively smooth in texture, the vast majority of the building’s surface is a highly textured concrete. “V”-shaped protruding ribs in concrete, resulting from the formwork, ascend vertically up the building’s surface. The specifications for the structural concrete included a section for the “Form Types” and it called out for “Temporary boards with “V” joints spaced as shown for use at the outside faces of apartment towers, ramp walls, outside faces of shaft walls, and exterior tower.” 114 The specifications also call for the finished concrete to be left exposed, stating, “Exterior architectural concrete and limited portions of interior architectural concrete will be “natural”, utilizing available aggregates and cement.” 115

113 “Invitation to attend a seminar,” Concrete Reinforcing Steel Institute, Art Institute of Chicago, Ryerson and Burnham Libraries, Bertrand Goldberg Archive, Series XIV, Folder 14.16.
114 Specifications Section 03300 Structural Concrete: Section 4.1.5 Form Types, Art Institute of Chicago, Ryerson and Burnham Libraries, Bertrand Goldberg Archive, Series VIII Folder 25.8.
115 Specifications Section 03300 Structural Concrete: Section 13.2, Art Institute of Chicago, Ryerson and Burnham Libraries, Bertrand Goldberg Archive, Series VIII Folder 24.23.
Concrete Repair, Maintenance, and Restoration

Although River City was constructed more recently than Marina City and Hilliard Center, poor construction management combined with poor workmanship led to issues with the concrete. For example, the team managing the project in Goldberg’s office found that the contractor used grooved finform plywood instead of the approved formwork with a grooved fiberglass liner. This unauthorized substitute was recorded in meeting minutes from the project in which it was stated that Ed Center, one of the central architects in BGA’s office, did not approve of this substitution and requested that the office would need to approve all forming before it was used. In addition, a contentious field report from November 1984 noted the general poor quality of workmanship, the fact that the forms were not cleaned between pours, and where forms had been placed against existing slab edges there were obvious gaps between form and concrete. Finally, patching material was applied in freezing temperatures. The report concluded with a straightforward statement saying that the overall attitude is “unacceptable” to the architect.

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\(^{116}\) “River City II Project Meeting Minutes” June 26\(^{th}\), 1984 (Tuesday) 8:30AM, Art Institute of Chicago, Ryerson and Burnham Libraries, Bertrand Goldberg Archive, Series VIII, Folder 23.20.

\(^{117}\) “No attempt is being made to improve concrete quality. A. We witnessed installation of wall forms that had not been cleaned out of all dry concrete from the previous pour. B. Where forms had been placed against existing slab edges there were obvious gaps between form and concrete which will obviously leak water, cement and fine aggregate. This is a major cause of poor concrete over the rustication joints. We were told those joints could be filled with rod or sealant to prevent leaking; however, this had not been done, and the reinforcing was being placed. C. Broken bits of concrete were laying in the bottom of the form with no way of removing it. Attempts were being made to apply patching materials both on the inside and
From the time the River City was completed until today, many of the patches and cracks in the concrete shell exterior were filled in with an epoxy sealant. Donald Moore, the current president of the condominium association at River City, acknowledges the recent effort to make major repairs to the building’s structural components. One of these repair projects, likely beginning next year, will remove the unsightly fills and patches, and replace them with a highly compatible concrete fill. The new repairs are intended to adequately adhere to the existing concrete and to aesthetically match the surface of the concrete.

The interior atrium space, which was intended to feel like an outdoor street, was finished using the same techniques as the exterior to create a seamless transition. While originally this space was to have exposed concrete walls, as the exterior does, the lowest two stories were painted over. However, the concrete remains exposed from this level on up to the glass block ceiling. When the concrete was painted and the reasons behind the work are unknown. There are no current plans to change this area or paint further up the walls.

outside of the walls. The material being used was a mixture of cement, sand and Thoro Company’s Acryl 60. The bucket containing the Acryl 60 specifically noted that the material was not to be applied when the temperature was 45° or less. The temperature at the time was about 38° and the applier said they had been working since 8:30a.m.... Note: Subsequent to this inspection, I have been informed that Messrs. Gerald McCollam and “Buzz” Paschen have assured the concrete will be smoothed and finished to a satisfactory condition acceptable to the architect. Previously, the architect’s representative, Mr. Donald Behike, had been told by Mr. Frank Maratea that the concrete had been finished as well as could be expected and no further work could be done.”

Figure 71: (Left) River City atrium c. 1980s. 
Figure 72: (Right) River City atrium today with lowest two levels painted over.

Figure 73: River City, 2016.
Figure 74: River City, 2016.
Concrete failure is the result of a variety of factors. The case studies indicated just a few potential causes including harmful substances in the concrete mix itself, construction-related issues, and weather-related natural deterioration. Surface issues can take the form of small, localized deterioration or to major failures throughout the building structure. While “failure” often implies more physically deleterious issues with the building that would eventually lead to structural damage, some might even consider failure to include less serious, surface weathering which can be called “aesthetic deterioration” which on a typical concrete building in most conditions is completely unavoidable and natural. Whatever the case may be, concrete failures set interventions and conservation actions in motion. When it comes to repair of significant exposed concrete structures, two general approaches to dealing with deteriorating concrete have emerged: (1) patching the concrete with a compatible material and coating the entirety of the exposed surface to retain a uniform appearance, or (2) patching and replacing concrete with a cementitious mix that is both visually and physically harmonious with the original concrete surface. This second approach is often more costly as it requires a greater level of skill to both develop the treatment to make the repair match the existing concrete and in the artful execution of the treatment. The art involved in this method involves taking into account the soiling and the random discoloration of the original concrete and other times the overall surface is cleaned and the patch is made to match what was presumably the original appearance in color and texture. While other approaches do exist, such as electro-chemical techniques or large scale replacement of the entire concrete surface, with a new surface that matches in pattern and texture of the original concrete, these are costly and used less frequently, often in extreme cases.  

Footnote: An example of this later technique was used for two religious structures in Switzerland, the Antonius Church (Karl Moser, 1927) and the Goetheanum (Rudolph Steiner, 1928) The first to have this action taken was the Antonius Church and work took place in phases from 1985-1991. After a decision was made that the church should be kept in “original form” and all parties involved wanted to avoid “unsightly mortar patches,” the plan developed was to replaced the entire concrete surface. The outer 40mm (just over 1 ½”) layer of carbonated concrete was completely removed and replaced by a new 50mm (nearly 2”) thick façade layer, placed in situ. The surface pattern of the board form concrete was reconstructed in both pattern and texture “by means of rubber impressions that were applied inside the formwork as moulds.”

decision to use one or the other of the two standard approaches listed above is based on a number of factors including project budget, severity of deterioration, cause of the deterioration, and sometimes the significance of the building.

Preference between these two techniques has seen a major shift in the past few decades. Whereas a coating might have been acceptable in the past, common practice in the preservation and conservation of these buildings has shifted to a focus in trying to retain the architectural significance of the concrete surface. This shift also corresponds with advancements in technology surrounding the products used or the science behind and maybe more importantly, with a growing understanding and significance placed on modern reinforced concrete building that was for some time ignored, underappreciated, and generally unloved.

This evolution in approach and procedure plays itself out in written documents and preservation guidelines. One such place in American preservation is Preservation Briefs that are published by the National Park Service. A careful reading of the last two versions of the National Park Services’ Preservation Brief 15: Preservation of History Concrete illustrates this point. The Brief written by William Coney and published in 1987 does not include any language in it that restricts the use of coatings on repairs. However, the updated Brief written by Paul Gaudette and Deborah Slaton, published in 2007, just after the completion of Hilliard’s rehabilitation, is more explicit in the use of opaque coatings on historically significant concrete buildings. It states that “film-forming coatings are often inappropriate for use on a historic structure...where the uncoated exposed surface contributes significantly to the historic character of the concrete.” [Both versions of the Brief can be found in Appendix A]

The NPS Standards and Briefs do not discriminate based on architectural style meaning that the Brief for concrete is meant to be applicable for buildings of any age dealing with these issues of concrete restoration. They also do not differentiate between perception of concrete deterioration and actual, structurally-threatening

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deterioration. However, modernist concrete buildings from about the mid-century onward pose a particular question of how to treat. For years, architecturally expressed concrete buildings, particularly those with a “brutalist” aesthetic were generally disliked by the public and largely ignored by the preservation community. Perception has played a major role in the restoration approaches to concrete buildings which do not acquire the same romantic weathered, patinated, Ruskinian “golden stain of time” that traditional building materials acquire. Carolina di Biase states, “The unattractive appearance it takes on as a result of such alterations has made reinforced concrete the veritable metaphor and embodiment of decline. ... And such deterioration and decay results in highly costly and difficult procedures of maintenance. The very rigidity of structures in reinforced concrete seems to oppose any sort of renovation or redevelopment. True, research is underway into procedures of maintenance, repair and restoration, but we are yet to develop the full range of techniques that is available for so-called pre-modern architecture.” However, as with all trends in popular architectural style, the concrete buildings of the mid-century and a little later are now a major focus of preservation.

It is important to keep in mind that the coating treatments, which completely transform the original building, are done for both aesthetic and protective purposes. Because the surface quality of the concrete, often enhanced by the way in which it weathers, is often a key element to the general public’s dislike of exposed concrete buildings, coatings have sought to fix this issue. This was the case with Marina City. However, coatings are also practical and sometimes a last measure in reducing the amount of future repairs to a building and extending the structure’s useful life, as was the case with the Hilliard rehabilitation project.

The buildings by Goldberg’s contemporaries whose work included a large number of exposed concrete structures have also experienced major renovations and repairs throughout the years. Comparisons can be made between the repair work that has been done to their buildings and on Goldberg’s buildings. Since the case studies buildings all focused on large residential structures, the following will look at some buildings that are similar. As the evaluation will discuss, the type of building and the

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entities involved often play a major role in deciding how the building gets treated and which of the two general approaches are followed.

**Concrete Restorations with Patching**

Paul Rudolph, a notable architect who designed many buildings with a brutalist aesthetic, presents an interesting comparison. Like Goldberg, some of his work has been demolished in recent years, most notably the partial demolition of the corduroy block Orange County Government Center in Goshen, New York. And also like Goldberg, a large majority of his mature work was designed using concrete. Rudolph’s Yale University Art and Architecture building completed 1963 and located in New Haven, Connecticut went through a meticulous concrete repair and cleaning in 2008. Special attention was placed on reproducing the original bush-hammered surface technique and matching the concrete’s color and texture to the original.\(^{122}\)

The concrete restoration of Mies van der Rohe’s Promontory Apartment building might offer an even closer comparison. The apartment building in the Hyde Park neighborhood of Chicago was Mies’ first constructed high-rise building, completed in 1949. While the form of the tower is reminiscent of architect’s later work, the materiality is quite different. Due to a post-war shortage in steel, Mies was required to design this tower using concrete. An exposed reinforced concrete frame is infilled with light color bricks on the sides, and aluminum framed windows on the longer, front façade. The concrete on the exterior was meticulously restored in the mid-1990s. Like with Hilliard Homes, the concrete deterioration at the Promontory apartments was mainly due to inadequate concrete cover over the embedded reinforcement, as was determined by a thorough investigation and analysis of the concrete frame. A conscious effort was made to match the finish, texture, and color of the existing concrete, going so far as to develop a system and techniques to allow the

contractor to adjust the finish texture of the patch in order to match the particular area around where it was placed.123

Two other very similar building types and concrete restoration strategies occurred on Kips Bay Towers in New York City and Peabody Terrace Apartments in Cambridge, Massachusetts. Kips Bay Towers in New York City, two 21-story concrete towers, designed by I. M. Pei in the 1960s and completed in 1965 were the city’s first exposed cast-in-place concrete apartment buildings. The repairs in the 1990s included carefully matching the concrete color and retaining original detailing when patching the spalled concrete on the columns and spandrel beams. Many of the precast sills were also replaced.124 Similarly, Peabody Terrace located in Cambridge, Massachusetts also went under renovations in the early 1990s. The residential towers designed by renowned Spanish architect Josep Luis Sert, who was serving as dean of the School of Design at Harvard University at the time, were constructed from 1962 through 1964 and designed for married graduate students. The concrete was patched and repaired haphazardly throughout the year years but in 1993 a major restoration began. The

123 Paul Gaudette, Jason Aspen, and Deborah Slaton, “Repairing Historic Concrete” (Aberdeen Group, 1999).
Concrete that was spalled and deteriorated, mostly due to insufficient rebar cover, was carefully analyzed and the best visual match possible was chosen. The patches were even designed to be shaped in such a manner as to avoid the often “haphazard look” of previous concrete repairs. Like issues with Hilliard, the spalling was caused by faults in original design and construction, inadequate reinforcement cover, and without a coating the surface will continue to fail but to a lesser degree.125

In contrast to the previous examples, there were other restorations involving architecturally exposed concrete buildings in which the concrete repairs did not involve careful matching, instead the patches were made and the building was painted or coated, similar to the result of Hilliard Homes. In 2006, the Metropolitan Correctional Facility, a jail building in the Loop designed by notable Chicago-based architect Harry Weese, was coated. Completed in 1975, this prism shaped tower with a triangular plan, was similar to the Hilliard towers in that it was slip form construction

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126 Footnote: The term “coating” is a general term and a large variety of products exist with different finish aesthetics. Although not discussed in this thesis, there is also the option to use stains which are different in viscosity and thickness. Staining, which changing the coloration of the surface, does not completely hide cementitious patches but rather makes them more muted. Staining will also allow the original surface texture of the concrete to show through as opposed to an opaque coating which depending on the type could partially or completely hide the surface texture. This thesis uses “coatings” to mean an opaque, essentially non-reversible covering over a building’s surface.

Figure 77: (Left) Kips Bay Towers in New York City following extensive concrete restoration. Figure 78: (Right) Peabody Terrace in Cambridge.
and the architect intended that the building have an exposed concrete exterior surface. Again this design intent was ignored during rehabilitation and covered with an opaque protective coating. Critics noted that, “The current light tan paint was a jarring change for many when it was applied to the exterior following repairs.” Needless to say, the coating was not well received by the local preservation community. While this previous coating example was done due to severe deterioration and as a less expensive, preventative measure to be taken, another one of Weese’s projects was recently coated for more cosmetic reasons. His vaulted Washington DC Metro Union Station has been in the news during 2017 as crews have started painting the exposed concrete white, a stark contrast as can be seen in the photos of the half completed work. The decision for this was made to coat the concrete as part of the city’s “Back2Good” initiative, a major revitalization effort. Because of the public nature of the project and the growing awareness and appreciation for exposed concrete modern architecture, many have spoken out against the work that has been done.

An example of a residential tower that received this same treatment are the Chatham Towers located near the civic center of New York City. These brutalist residential towers were designed by the New York based firm of Kelly & Gruzen and completed in 1965. The concrete appearance, much inspired from the work of Le Corbusier, was coated over in the 1990s when repair work to the towers was completed. “The buildings have been well-maintained, and the exteriors have recently been treated with a mineral silicate coating that disguises necessary patching while retaining the surface color variation of exposed concrete. Otherwise, Chatham

Towers remains very much in its original condition, down to nameplate graphics and exterior lighting. “

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Among the examples given by the case studies for coating concrete and the few other examples above, one can see that there are several factors involved in the decision to coat the concrete or leave it exposed, thus honoring its architectural character specifically designed by the architect. One major factor in the decision is the sophistication of the client. Whereas apartment buildings tend to get covered, a major university such as the case with the Yale Art and Architecture building, was able to have the proper care taken to retain the concrete surface. This brings up the issue of budget and project scope as well. Realistically, there are times when a suitable patch repair project is not affordable and does not see any returns for the client.

The institutional buildings mentioned, such as the Yale Art and Architecture Building and Peabody Terrace, represent cases where the client was a high profile entity that could support a massive concrete patching restoration project. However, in the cases of the government supported buildings, such as the Metropolitan Correctional Facility and the Hilliard Homes (although the later had the support of a private developer), the budget played a larger role in decision making. This is not to mention that the degree of concrete deterioration also garnered a reason for coating. Finally, the condominium buildings listed, such as the Kips Bay Towers and the Promontory apartments, along with River City, chose to retain the original concrete surface intended by their architects and sensitively patch the exposed concrete facades. However, some of the residential buildings, such as Chatham Towers and Marina City, did get coated. In these cases the clients wanted to change the aesthetics of the building by coating the concrete and thus opting for a “cleaner” façade. \[133\] As River City indicates, there may be a shift in recent years. A larger array of would need to be looked at to verify this sentiment.

\[133\] Footnote: Yet another factor behind deciding to coat a building or not could be the surface texture of the concrete. Whereas Rudolph’s heavily textured bush-hammered concrete surface did not lend itself to easily be painted, a smoother surface such as the board-formed Hilliard or fiberglass mold formed Marina City towers offered a flat canvas to be painted over.
05 INTERPRETING GOLDBERG’S INTENTIONS
Tension between the architect’s intentions for their building’s design and the realities of the building industry plays itself out during construction and again throughout the life of the building. During construction, the tension is between the architect’s design and what actually gets built. Between transferring concepts into construction documents and later taking those drawings to execute a construction plan, the myriad of processes, regulations, and parties involved result in a somewhat modified version of the originally intended design. During restoration, the original architect’s intentions are often further removed from the process. Often the original designer may no longer be alive and the task to restore their work ends up in the hands of modern day people. Once again, many parties are involved in the process including other architects, engineers, owners, developers, preservationists, etc. With restoration and conservation there is often an added layer of complexity: continuing the useful life of the building physically and programmatically while dealing with modern day tastes and values of design.

The reality of this tension between intention and actualization has shown itself in each of the case study buildings. The case studies provide a narrative to describe the restoration, repair, and preservation work that has been performed to the exterior of Goldberg’s buildings. The evaluation in this chapter will analyze the repair and restoration work and whether the owners of the buildings have sought to look back at the intentions Goldberg’s designs or not. The final step before making conclusions and helping to inform what comes next in terms of preservation and conservation work to Goldberg’s buildings.

Goldberg’s Intended Design v. Construction Realities

Based on what can be inferred about Goldberg’s attitude towards concrete, particular uses and reasons for designing with concrete, and the care in design of the surface texture and treatment as was outlined in Chapter 2, Goldberg cared greatly that the concrete was ‘finished’ in the exposed, ‘unfinished’ state. Especially with the case study buildings that were studied, they were never conceived of having a coated appearance. Goldberg played around with surface textures and there was always a specification on how the surface finish of the concrete should be, making the exposed concrete surface was always intentional and deliberate. Marina City was intended to
have a smooth concrete finish created by fiberglass formwork, Hilliard’s board form façade was created by wooden formwork, and River City’s vertical rib texture was also created utilizing formwork. These three examples are all poured in place reinforced concrete structures, not to mention that the variety of other surface textures and construction methods utilizing reinforced concrete that Goldberg built his architecture with.

What the case studies also exemplified were the variety of construction practices and missteps that play a role in how the buildings fare over time. In Marina City, the main cause for spalling of the concrete came from chlorides added into the concrete mix. Hilliard’s issues came from placing reinforcement without adequate concrete cover and finally River City’s concrete has experienced issues caused by poor workmanship and construction oversight that seemed to have plagued the entirety of the complex’s construction. In terms of workmanship and concrete mixes, quality of building concrete has increased over the years. Is it safe to say that the buildings could have fared better or not needed as much repair work / the repair work didn’t have to be so invasive had the original construction lacked some of the issues that were discussed?

**Goldberg’s Intentions for Future Repair v. Conservation Realities**

What were Goldberg’s intentions for how the concrete surfaces would be treated in the future when it came time for repair? Would it have mattered to Goldberg that some of his intentionally exposed concrete facades were painted over?

Other architects such as Carlo Scarpa and Marcel Breuer were expressive about how they saw their exposed concrete buildings evolving in the future, especially how they would weather, stain, and aesthetically deteriorate over time. Scarpa specifically detailed his buildings in the locations where he predicted the deterioration might occur. For example, on the Verona Bank, he incorporated traditional Venetian construction techniques and placed a vertical line at the bottom of each of the windows of the Verona bank in the location where rainwater would likely flow. With the Brion-Vega cemetery, Scarpa designed a large, blank exterior chapel wall that

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dramatically showed the effects of weathering by allowing a gap for water to run through the middle of the parapet and leave a black stain in the middle of the wall. As Mohsen Mostafavi and David Leatherbarrow share in *On Weathering*, “It seems possible to argue that Scarpa designed the blank wall as the possibility for showing the life of a building in time, which was a creative reinterpretation of the fact of weathering.” Marcel Breuer took the concept a step further by writing extensively on the subject of concrete weathering. He studied how buildings weathered, what were successful or unsuccessful qualities of weathering on extant buildings, what worked and what did not. Breuer then designed structures that would anticipate the weathering and work successfully with it over time. He criticized glass and steel buildings for their lack of sun, shadow, contrast, and texture as they weathered.

In contrast to Scarpa or Breuer, Goldberg showed no explicit indication that he designed with future weathering in mind. Although he was aware that time would inevitably leave its stain on his concrete surfaces, he instead focused his writings on the present day reasons for designing with concrete; the plastic properties of concrete, its ability to create an industrial form, the economy of the material, and the evolution of structure based on the abilities of concrete. In addition, he was very pragmatic in his design approach, incorporating industrial efficiency principles and striving for ideal structural forms. While no writings emerged during research that indicated Goldberg’s thoughts on the inevitable deterioration of his concrete buildings and how they might potentially be treated in the future, his personal photographs of stone and masonry weathering give insight. Photographs taken by Goldberg while traveling reveal that the architect looked closely at the deterioration of material. These photographs, provided by his son, architect Geoffrey Goldberg are all varied in subject matter but all show stone, masonry, and concrete work, ranging from man-made to natural, from ancient to more recent construction that have aged and weathered. They portray colorful examples of the effects of time on material. The black and white especially captures that contrast when the materials age, weather, and decay. The photographs might be the most definitive support the theory he payed close attention to surface detail of the concrete.

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135 Ibid., 103.
On the other hand, it can also be reasoned that Goldberg’s pragmatic nature might have led him to agree with some fellow architects who saw the inevitability that the concrete would one day need to be coated in order to retain the structural integrity of the buildings; siding with practical necessities of coating concrete to extend the building’s life over the aesthetics of the concrete itself. In 2007 Landmarks Illinois and the AIA Chicago chapter hosted a Mid-Century Modern Architects Panel. While this conversation took place among a very narrow group of architects, most of whom having practiced mainly in Chicago, it is interesting to note their attitudes on preservation, and when it comes to concrete buildings in particular. And of course in ten years much has changed. Jack Hartray, an architect who had worked for Weese’s office, spoke about the correctional facility saying, "they had no choice" and because of the concrete spalling and failing that “they would have to do that. That building was quite unusual in that we got away with, for about 25 years, without painting it. And most of the concrete buildings that we have done wind up getting painted, because that’s the only sure way of getting the façade to not misbehave.” These opposite viewpoints on the subject of coating exposed concrete lead to a variety in beliefs in

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how to properly address and treat the concrete surface when it comes time to do such work.

Regardless of what Goldberg’s definitive stance on coating exposed concrete may have been, it is necessary to evaluate the tension between original design intent and how preservation and conservation efforts have incorporated these ideas or not into the process. In light of the findings of the case study buildings. Questions include:

1. Has the repair work on the three case studies in this analysis kept the original finish of the concrete consistent with the original vision?
2. Were Goldberg’s design intentions adhered to or influential in the decision making for restoring the buildings’ facades?

For two out of the three case studies, the buildings were painted over with an architectural coating. At Marina City, the coating was originally applied in 1977 for aesthetic reasons to go along with the conversion of the residential units to condominiums. Since then, repair work and renovations have sought to keep consistent with the original coated finish. Marina City’s early coating clearly went against the original intentions for the towers’ design. No reports of public backlash from this decision was found in newspapers of the time. Today, more of a discussion would occur, especially within the preservation community. The fact that the coating was done to beautify and update the building’s appearance makes it clear that the surface quality of the concrete was not valued nor were Goldberg’s intentions for this aesthetic.

Hilliard Center had a coating applied in 2003 following much debate surrounding the matter. In the end, coating represented a more economical approach to fixing the concrete deterioration when concern for original intent was not a feasible option. There was a point to match the color of the opaque coating to the original concrete and make sure the coating was thin enough to allow for the board-form marks to show through. The buildings were recognized as significant as indicated by their listing on the National Register. However, due to more practical reasons such as money and inherent issues with the concrete construction, it was deemed acceptable
to coat. The discussion surrounding concrete coatings at the time in the late 1990’s made the option to coat more viable and acceptable in terms of preservation work. With recoatings of Hilliard an inevitability, it will be harder and harder to retain the board form marks that are somewhat still apparent today on a close inspection. Recoating also welcomes the possibility that the color will not be as closely matched to the original surface as it was the first time it was done.

River City still retains its original exposed concrete appearance. Cracks and spalls were simply filled and patched with epoxy over the years and current work on the building is seeking to remove epoxy fills with a cementitious fill that matches the existing surface appearance of the concrete. The history of these repairs portray the change in attitude in how to maintain concrete buildings and the growing acknowledgement of significance of Goldberg’s architecture. While the exterior of River City has not been coated, recent discussions of how to complete necessary repairs have brought up the possibility. However, the owners and community living in the complex have deliberately chosen to honor the original appearance and intentions of the design. While the interior atrium was meant to have this same cohesive concrete appearance as the exterior, the lowest two levels of concrete in the interior atrium were painted, presumably without considering architect’s intentions.
CONCLUSION
As time goes on, the preservation community and society at large is not only recognizing the significance of Goldberg’s architecture, as demonstrated by the outcry from the demolition of Prentice Women’s Hospital in 2014 and the subsequent landmarking of Marina City in 2016, but coming to appreciate the aesthetic of exposed concrete architecture and embrace the narrative that modern concrete buildings can be significant and worth saving. Thus, when it comes to rehabilitation work to the exterior of Goldberg’s buildings, we will now look back to the intentions for the building. A building’s exterior surface, especially when it is expressed in one solid material (in this case concrete) is often integral with the building’s design, often highly designed, as was the case with Bertrand Goldberg’s buildings. The preceding chapters establish this fact in detail, but we see that technical questions then arise as to how we should treat the concrete surface when it requires repair. The state of Goldberg’s architecture embodies these issues and offers the best lessons to learn from when addressing restoration of modern concrete buildings.

With the case study buildings, treatment decisions throughout the years were based on a number of factors ranging from owner’s taste (Marina City, late 1970s) to economy in repair costs (Hilliard, early 2000s) and finally now to make concrete patch repairs that match the original surface’s aesthetic (River City, 2017). In the instances of Marina City and Hilliard, the reasons for coating was to “clean up” the surface but with Marina City it was done as a way to deny the concrete surface whereas Hilliard’s coating mitigated future repairs. The differences in decisions made over a span of 40 years is indicative of a nuanced understanding of modern concrete architecture that has taken root in recent times and the growing significance of the architecture of Bertrand Goldberg. The contemporary reaction today, therefore, seems to be to treat Goldberg’s buildings in such a way that is in line with the original intentions for the design of the concrete building. This last statement implying that a thorough investigation of the architects’ intentions is indispensable.

After applying the methodology to a study of Bertrand Goldberg and his buildings, we can attempt to answer these preservation questions: What does this

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137 The methodology as outlined in the Introduction is as follows: 1. The architect’s specific use of concrete, how they thought about and designed with concrete, and the reason behind using concrete as the main structural and finish material for their work. 2. Case studies as evidence and proof that concrete played a significant role in design. 3. The varied history of repair and
mean for the future of repairs on Goldberg buildings? Does it matter how we repair the concrete, whether it is coated, painted, or treated?

After this investigation of Goldberg, what emerges is that he was overtly pragmatic in his approach to design and in the reasons he chose to work in concrete. However, evidence also emerged that cared greatly for the aesthetics of the concrete surface and seemed to think about the way that it would inevitably deteriorate. Therein lies the contradiction. On one hand, Goldberg, as evidenced through his structural design, displayed a pragmatism that might have carried through to how he thought about preserving his buildings into the future. On the other hand, it can be inferred that he would have wanted his buildings to retain their concrete exterior to weather and aesthetically deteriorate overtime just like masonry or stone might be allowed to do on more traditional structures.

Goldberg’s buildings are typically admired for their bold massing and curvilinear forms, but a great part of their significance also lies in the concrete itself and what the exposed concrete communicates. The surface of the concrete is thus equally significant as the structure that it creates, not only for its appearance, but also for the fact that the impressions left on it by forming give insight into how Goldberg instructed the building’s construction method. These methods were some of the most innovative work of Goldberg and his firm.

Coating a building makes a tremendous impact on the overall aesthetic of the architectural work. Not only that, a coating must be maintained and reapplied over time and the buildup of coats could diminish any surface texture that was once visible on the concrete. What is left of Goldberg’s exposed concrete is significant and worth protecting. While realistically nothing could, or should, be done to reverse any of the coating campaigns that have already been placed on Goldberg’s buildings, moving forward preservationists should seek to maintain the concrete surfaces that do remain, allowing them to weather and accumulate as time goes on. Luckily, it does seem that more appropriate decisions are being made as evidenced by the recent and future work on River City.
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Figure 1: Bertrand Goldberg  

Figure 2: Helstein Residence  

Figure 3: Helstein Residence  
October 10, 2016, photo by author.

Figure 4: Drexel Home and Gardens  

Figure 5: Drexel Home and Gardens  
October 10, 2016, photo by author.

Figure 6: Abrahms Residence  

Figure 7: Jacobs Residence  
HB-07725-F, Chicago History Museum, Hedrich-Blessing Collection.

Figure 8: Bent Plywood Chair, Bertrand Goldberg  

Figure 9: Chair Design, Bertrand Goldberg  

Figure 10: Standard Houses  

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Figure 12: Zuoz Bridge  
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Figure 13: Zurich: Cement Hall  
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Figure 14: Trans World Airlines Terminal, exterior
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Figure 15: Solomon R. Guggenheim Museum
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Figure 16: Treatment Tanks in Nashville

Figure 17: Pineda Island
Art Institute of Chicago, Bertrand Goldberg Collection, Archival Image Collection.

Figure 18: Motel 66
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Figure 19: Astor Tower
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Figure 20: Astor Tower
October 16, 2016, photo by author.

Figure 21: Elgin Laundry Building
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Figure 22: West Palm Beach Auditorium
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Figure 23: Marina City
Bertrand Goldberg, photo courtesy of Geoffrey Goldberg.

Figure 24: Marina City
March 16, 2017, photo by author.

Figure 25: Brennemann School
Art Institute of Chicago, Bertrand Goldberg Collection, Archival Image Collection.

Figure 26: Brennemann School
Art Institute of Chicago, Bertrand Goldberg Collection, Archival Image Collection.

Figure 27: Affiliated Hospitals, Boston
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Figure 28: Prentice Women’s Hospital, Chicago
https://en.wikipedia.org/wiki/Prentice_Women%27s_Hospital_Building#/media/File:Prentice_Women%27s_Hospital_Chicago.JPG
Figure 29: Good Samaritan Hospital, Phoenix  
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Figure 30: River City computer modeling  
Art Institute of Chicago, Bertrand Goldberg Collection, Series II, Box 11.

Figure 31: Bahá’í House of Worship, Evanston, IL  
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Figure 32: Église Notre-Dame du Raincy  
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Figure 33: Goetheanum  

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Figure 35: Salk Institute  

Figure 36: Detail: Astor Tower  
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Figure 37: Detail: Hilliard Homes  
October 10, 2016, photo by author.

Figure 38: Detail: Marina City  
March 17, 2017, photo by author.

Figure 39: Detail: River City  
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Figure 40: Detail: Wright College  
November 26, 2016, photo by author.

Figure 41: Marina City, exterior view  
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Figure 42: Marina City, site plan  
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Figure 43: Marina City, tower floor plan  
Art Institute of Chicago, Bertrand Goldberg Collection, Archival Image Collection, Series 1, Box FF 9.8
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Figure 45: Marina City, core construction

Figure 46: Marina City, floor slab construction

Figure 47: Marina City, fiberglass forms
Richard J. Kirby from “Fiberglass Forms, A Progress Report”

Figure 48: Marina City, fiberglass forms
Richard J. Kirby from “Fiberglass Forms, A Progress Report”

Figure 49: Marina City

Figure 50: Marina City, spalled concrete
1989 WJE Report

Figure 51: Marina City, concrete repairs

Figure 52: Marina City
March 17, 2017, photo by author.

Figure 53: Marina City
March 17, 2017, photo by author.

Figure 54: Hilliard Homes
March 16, 2017, photo by author.

Figure 55: Hilliard Homes, site plan

Figure 56: Hilliard Homes, section
Art Institute of Chicago, Ryerson and Burnham Libraries, Bertrand Goldberg Archive.

Figure 57: Hilliard Homes, apartment unit floor plans

Figure 58:
Figure 59: Hilliard Homes, construction
Art Institute of Chicago, Bertrand Goldberg Collection, Series II, Box 6.

Figure 60: Hilliard Homes, construction
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Figure 61: Hilliard Homes, exterior
Orlando Cabanban, Art Institute of Chicago, Ryerson & Burnham Libraries.

Figure 62: Hilliard Homes, spalled concrete

Figure 63: Hilliard Homes, exterior surface today
October 16, 2016, photo by author.

Figure 64: Hilliard, Family tower
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Figure 65: Hilliard, Elderly tower
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Figure 66: River City
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Figure 67: River City, plan
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Figure 68: River City, section and elevation
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Figure 69: River City, construction
Kay Bennett, November 1984 found in Art Institute of Chicago, Bertrand Goldberg Collection, Series II, Box 12.

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Figure 71: River City atrium

Figure 72: River City atrium
January 4, 2016, photo by author.

Figure 73: River City, exterior
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Figure 74: River City, exterior
October 10, 2016, photo by author.

Figure 75: Yale Art and Architecture Building

Figure 76: Promontory Apartments
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Figure 77: Kips Bay Towers

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Figure 79: Metropolitan Correctional Facility
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Figure 80: Metro Station, Washington DC

Figure 81: Chatham Towers
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Figure 82: Chatham Towers

Figure 83: Mexican Stone Figure
Bertrand Goldberg, photo courtesy of Geoffrey Goldberg.

Figure 84: Walls in Italy
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