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The Fallacies of Intent: "Finishing" Frank Lloyd Wright's Guggenheim Museum

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The Fallacies of Intent: "Finishing" Frank Lloyd Wright's Guggenheim Museum

FRANK G. MATERO and ROBERT FITZGERALD

In the realm of architectural-conservation controversies in America in the late-twentieth century, perhaps none created greater or longer discussion than the expansion and restoration of Frank Lloyd Wright's Solomon R. Guggenheim Museum in New York City.

Preserving the Modern

The ongoing preservation and rehabilitation of the Solomon R. Guggenheim Museum affords an excellent opportunity to examine many of the issues associated with the conservation of modern architecture. Beginning in 1986 with the debate surrounding the tower addition and the difficulties of retrofitting the original interior to contemporary museum standards, the current work is finally addressing the restoration of the building's exterior. Of particular relevance is the growing argument for a preservation philosophy that privileges conceptual aesthetics and the architect's intent over the constructed realities. This particular discussion focuses on conservation's long-standing debate on whether to present the work according to the artist's original intention or rather as an edited record of continuity and change.[1] In literary and philosophical circles during the 1950s, similar issues of intent were debated as Reception or Fallacy Theory, which addresses the readers' judgment and grasp of the meaning of the text and the interaction of the text with its readers.[2] Although Reception Theory is implicit in all architectural-conservation interventions, the subtle exploration of intent in all its meanings has hardly been addressed in the professional literature.[3] In this regard, the "finishing" of the Guggenheim Museum in New York City is considered here both in the context of Wright's original design and the problems of its realization, as well as in relation to the equally complex issues related to its restoration.

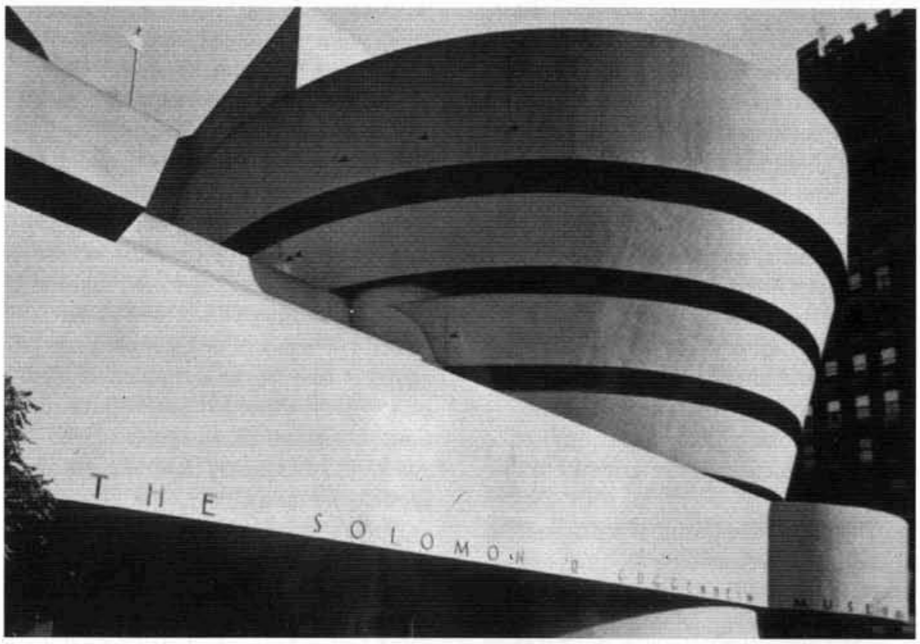

Fig. 1. Exterior of the Solomon R. Guggenheim Museum after opening, c. 1959. Note the expansion cracks in the rotunda (arrows) and the imperfections in the Rotunda's concrete skin, emphasized by the gloss of the painted finish. From Wayne Andrews, *Architecture of New York: A Photographic History.*

Since the late 1970s almost every discussion on the preservation of the recent past has raised the question of whether such works of art and architecture require different principles, or at least different practices of intervention, from those developed for older or more traditional heritage. Arguments in favor of making this distinction have identified a number of factors, including a lack of temporal distance, sheer quantity of surviving examples, greater access to original design intent, shorter life span (both planned and unintentional obsolescence), and limited public appeal.[4] These perceived differences have set up unexplored and unresolved dilemmas in the growing discourse on the preservation of modern art and architecture of the period following World War I.

Today the recent past can be safely relegated to the preceding century, yet how much time must pass for a building or site to qualify for heritage status?[5] Age alone is immaterial in establishing historical significance unless rarity prevails.[6] However, age does establish a critical distance from the present, deemed necessary for historical evaluation.

Both age and style are critical factors in the reception of any work. Recognition that different styles of the past were formal systems with their own character led to revivals of past styles as Historicism in the nineteenth century. As Paul Phillipot has noted, this recognition in turn opened the door for restoration as a new activity different from creation but based on an understanding of the logic of the style and therefore its potential for re-creation.[7] Of course modern architecture in the twentieth century was not a monolithic style in itself. Throughout the century, modernity had many faces. In attempting to better define modern architecture, recent writers have identified the period after World War I as the beginning of modern society and the rise of modernism or the modern movement, characterized as employing new formal modes of expression or innovative technology with a clear social agenda. The period after World War II, in turn, witnessed rapid urban and suburban development, and a proliferation of building forms emerged: the shopping mall, superhighway, curtain-wall skyscraper, airport, housing development, edge city, and suburb.[8] With the recognition of the postmodern around 1960, the modern movement now has a *terminus ante quem*, and a temporal and ideological distance has been established, thus transforming these buildings into potential "heritage."

Despite modernity's variety of expressions, preservation of modern-movement buildings has tended to focus on the avant-garde, the monuments of experimental modernism rather than the mainstream.[9] As Richard Longstreth has argued, "If our perspective on much of the twentieth century may be tinged with a connoisseurs' prejudice toward what new things have value, so many preservation concerns have been shaped by an antiquarian bias toward things old."[10] No doubt both the recognition of the end of the modern period and the preferential selection of certain avant-garde work as representing the period is partly responsible for the current ambiguities in recent efforts to preserve buildings and sites from the 1960s and 1970s, as well as the adoption of the phrase *recent past* as a neutral way to embrace all expressions of an even-closer time period.[11]

Preferential selection withstanding, the conservation of the twentieth century's avant-garde and its surviving offspring have caused a variety of problems. First, what was once programmatically or technologically innovative and experimental has often become accepted practice today, especially in the use of materials and methods. Preservation of these buildings, whether simply as obsolescent structures or as failed experiments, is often achieved by repair or replacement with the same or the next generation of technology. This approach has in many cases challenged conservation's longstanding principles of material authenticity and visible age-value, which have directed the intervention of historic structures in Europe since the late-nineteenth century and since at least the mid-twentieth century in this country. Conversely, what was once traditional mainstream more closely conforms in treatment today to notions and practices of intervention for older buildings of similar materials and style, if not exactly in construction.

Secondly, the interpretation of most modern-movement architecture has revived the once-fierce debate on original design intent versus historical evolution. Similar to nineteenth-century restoration arguments for stylistic unity, creative intent has been favored in the interpretation and treatment of many works of the modern movement because more is known about their design, designers, and clients, and perhaps as a result of the celebrity status of many twentieth-century architects, some of whom are still living. Even intent itself has been turned upside down recently where, in some cases, the dominance of functionalist ideology and intended "transitoriness" of a building have been argued as the most important aspect of intent to honor, even if destruction of the structure is the end result.[12]

Thirdly, conservation as a proposition is dedicated to extending the physical and social life of buildings and sites, regardless of the original intent or physical realities of degradation. Failed experimental technologies, as well as unavoidable obsolescence due to the inflexibility of certain building types or the now-obsolete programs they housed, have created tremendous challenges in the repair and reuse of many modern-movement buildings. Related to this notion of intolerance to change is the problem of weathering and age-value for modernist structures.

The indicators and qualities of age, defined most directly by weathering, became major issues in eighteenth- and nineteenth-century aesthetic theory, art history, and restoration philosophy, linking the worlds of new art and architecture with historic buildings and monuments.[13] Weathering as time and nature's finishing touches to human works was a major element in the aesthetic principles of the Picturesque. However, it was John Ruskin who gave a moral voice to weathering in his definition of historical monuments and their preservation.[14]

If creative intent has been elevated in our approach to monuments of the recent past, then age-value has been banished by our inability to negotiate a new aesthetic for the weathering of concrete, glass, steel, and plastics. While the problem may be justly cited for its corruption of a particular streamlined, minimalist aesthetic popular between the World Wars, the development of new building materials and construction technology has always been a part of the establishment of new formal and spatial concepts in architecture. Moreover, many modernist works displayed contemporary forms using traditional materials and practices, such as in the moderate modernism of Frank Lloyd Wright. The problems with the acceptance of age for these structures may have more to do with temporal proximity than anything else. As early as 1903 the Austrian art historian Alois Riegl observed that the twentieth-century viewer was as disturbed by "signs of decay [premature aging] in new works...as much as signs of new production [conspicuous restorations] in old works, and particularly enjoy(ed)...the purely natural cycle of growth and decay."[15]

Some practitioners and theorists have therefore argued for a more "dynamic" and critical approach in the preservation of works of the modern movement, based on a fuller understanding of creative intent, the built reality, and the reception of the work.[16] This approach is understandable given preservation's long tradition of defining authenticity almost exclusively through the form and fabric of the work.[17] But it is not only the architecture of the recent past that demands this approach. All visual works, and especially those by acknowledged designers, can benefit from this type of analysis prior to intervention.[18] Although most scholars agree that the modern movement was founded on theories of social engagement, it was not unique in its deployment of theory, innovation, or even social program. In attempting to extend the physical and social life of buildings and sites, preservation can only position itself as a conscious critical act divorced from the past motives of that under study.

The Solomon R. Guggenheim Museum

As one of the twentieth century's iconic masterworks, the Guggenheim Museum is considered Wright's crowning achievement, representing the summation of his architectural thought and being the building by which, as Neil Levine has noted, the world would judge Wright's ultimate significance for modern architecture.[19] According to Bruce Brooks Pfeiffer, the design and construction of the building was "a saga of quintessential drama," even for Wright who labored 17 years on the project, from 1943-1959, produced 749 drawings, and did not live to see it completed.[20]

The rehabilitation, addition, and restoration of the building proved no less controversial, resulting in more than 66 major critical essays published in professional journals during and after completion of the expansion and restoration program in 1992. Of the many issues raised, that of Wright's original design intent and its realization, both initially and in conjunction with the ongoing restoration, are of great interest. Especially important is Wright's attempts to create a "museum of non-objective painting" through the adoption of new forms and technologies, including one of the first large-scale uses of gunite concrete and the application of an applied elastomeric, synthetic-resin skin.[21]

Completed in October 1959 on a site bounded by East Eighty-eighth Street, Fifth Avenue, and East Eighty-ninth Street in New York City, the museum is one of the last buildings designed by Wright and is considered one of his masterworks (Fig. 1). A landmark of concrete's expressive potential for curvilinear design, the building's exterior has long exhibited structural problems. Specifically, thermal cracks in the exterior concrete walls, associated with failure of the original and subsequent finishes, are not merely a cosmetic problem. These breaks in the concrete surface and its coatings pose the risk of water penetration to the steel reinforcements embedded in the walls, which could lead to serious corrosion of the steel. It has therefore generally been considered necessary to close such cracks. However, in the case of the Guggenheim Museum the choice of how to seal the concrete surface is far from straightforward.

Fig. 2. Surface damage resulting from expansion cracks and subsequent repairs and repainting on the rotunda's concrete skin, 1996. Courtesy of the University of Pennsylvania's Architectural Conservation Laboratory.

Wright's vision for the design of the museum is well documented. From the beginning he conceived of the structure as a concrete monolith; however, the exterior treatment changed over time. Wright always intended the spiral walls of the rotunda to flow in unbroken curves and for the interior and exterior to be one continuous surface free of joints. In 1946 he wrote that "to understand the situation as it exists in the scheme...all you have to do is imagine clean beautiful surfaces throughout the building all beautifully proportioned to human scale."[22] And again in 1952 he reiterated his interest in an architecture of continuous form, mass, and volume, stating that "the whole building cast in concrete is more like an egg shell...the net result of such construction is a greater repose, the atmosphere of the quiet unbroken wave..."[23]

According to the building's contractor, expansion joints were deliberately omitted, although it is not clear exactly how Wright and his engineer, Jacob Feld, intended the walls to accommodate thermal expansion, especially in the rotunda.[24] By 1960, one year after completion, regular cracks began to appear in the gunite walls of the upper rotunda (Fig. 2).[25] In preparation for the restoration, a 1988 engineering study had advocated the conversion of major exterior cracks into true expansion joints by saw-cutting of the concrete, installation of backer rods, and application of elastomeric sealant. Such an approach, while consistent with standard practice, raised major concerns regarding the impact that such modifications would have on the original intent and appearance of the building as a continuous mass and free-flowing surface. This concern was considered no small issue in the ongoing efforts to conserve and restore what has been called the single most important object in the Guggenheim's collection, its building.[26] Furthermore, the potential reversibility of alternative treatments was considered in the hope and expectation that other options would become available in the future.

The Exterior Surface and Its Finish

Wright's intention for the exterior treatment of the museum and the subsequent changes in the final choice of finish that occurred up until completion of the building are fairly well documented in correspondence and other archival materials in the possession of the museum and the Frank Lloyd Wright Archives.[27] Those sources indicate that at least by the time of commencement of construction in August 1956, Wright had decided that the interior and exterior surfaces of the building would be painted.

Although the building had been conceived in reinforced concrete from the start, the treatment of the exterior finish

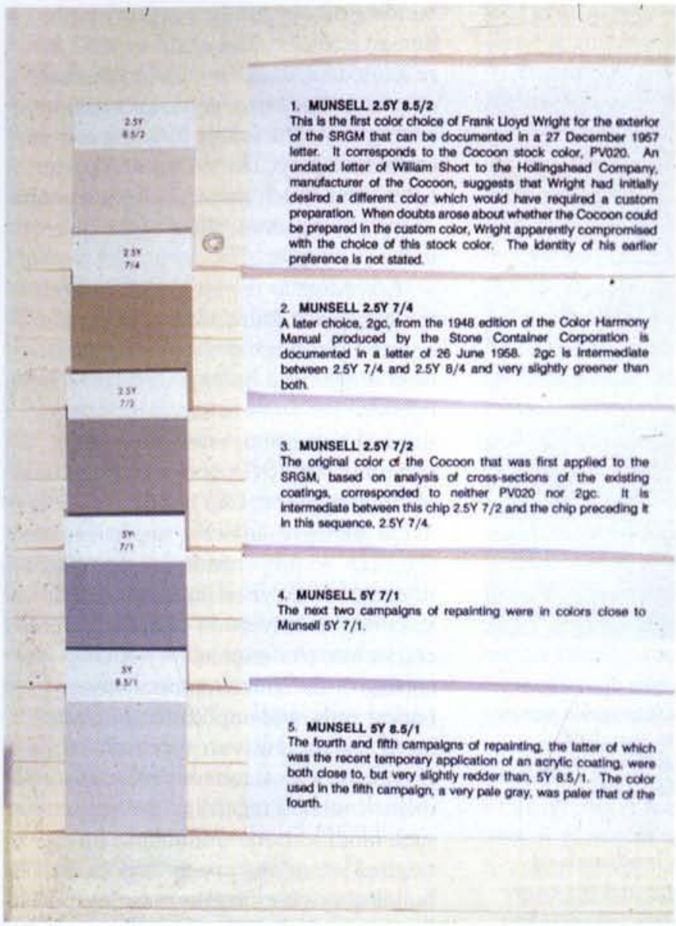

Fig. 3. Exterior color sequence of the Guggenheim Museum as determined from cross-sectional analysis and archival documents. Courtesy of the Architectural Conservation Laboratory.

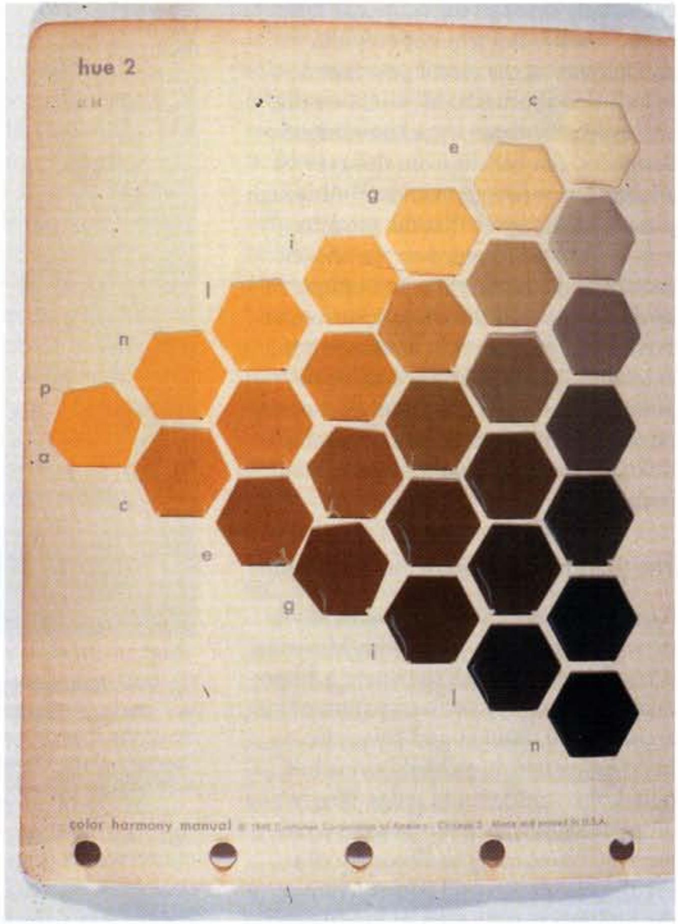

Fig. 4. Illustration from the 1948 *Color Harmony Manual* showing Frank Lloyd Wright's second color choice (2 gc) in 1958. Courtesy of Fisher Furness Fine Arts Library, University of Pennsylvania.

went through several renditions, first employing marble-panel cladding and later exposed marble aggregate. Wright's earliest schemes from 1943 to 1944 employed the use of brightly colored red, white, or orange marble cladding (each a separate scheme) with verdigris copper banding on the top and bottom. By 1945, however, the marble veneer had been replaced with a polished or matte, sand-blasted ivory marble-aggregate surface, to avoid the joint lines of a stone veneer.[28] An integral exposed-aggregate exterior finish was assumed until at least 1952; however, with cost overruns of over one million dollars in 1957, this finish eventually gave way to paint (Fig. 3).

Wright's views about concrete as a building material were formally expressed in his series "In the Cause of Architecture," published in *The Architectural Record* in 1928. In his essays on the meaning of materials, Wright branded concrete as having aesthetically "neither song nor any story." In his view, its potential as a building material instead rested in its great strength, durability, and potential for variability of form. Its misuse, however, was often due to its treatment as an imitation material. In 1904 at Unity Church, his first large-scale exploration of concrete as a monolithic building material, Wright purposely exposed the concrete aggregate to reveal the intrinsic nature of the material's composition. Also at this early date, he was quite aware of the visually intrusive effects of wooden formwork used for the placement of the concrete. Despite his shift from a rectilinear to curvilinear expression of concrete's plasticity in his later work, Wright always paid close attention to the finishing of the concrete surface. In this regard, his treatment of concrete was completely different from that advocated by Le Corbusier, who exploited the brutal harshness of the raw surfaces of the material. In later work, beginning in the 1930s, Wright began to explore applied finishes to his concrete masses (see below). However, his desire to finish the exterior concrete of the Guggenheim Museum by exposing the light-colored marble aggregate harkens back to his earliest experiments with the material and its unified expression as a massive material.

Concrete and Post-War Paint Technology

With the steady rise in the use of reinforced concrete for commercial and residential structures beginning in the early-twentieth century, specifically formulated coating systems for both decoration and protection were quickly developed. Surface "sealing" with clear or colored waterproof compounds

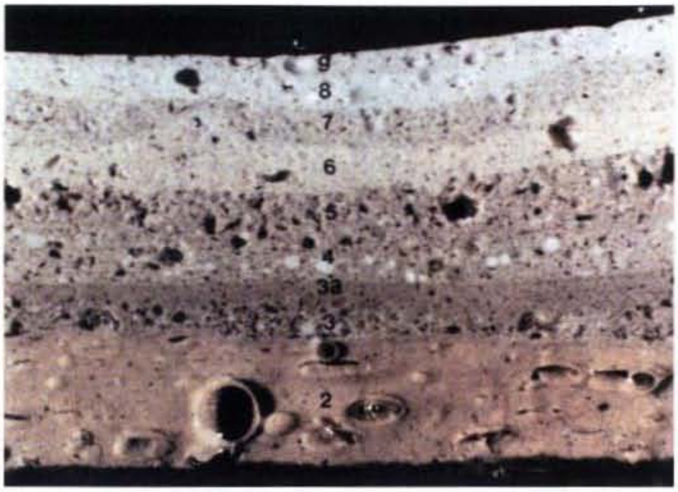

Fig. 5. Cross section of representative stratigraphy of the exterior finishes from the rotunda (Web VIII, Level 5) in normal reflected light at 20x magnification. Layers 1 and 2 are the original Cocoon primer and finish. Courtesy of the Architectural Conservation Laboratory.

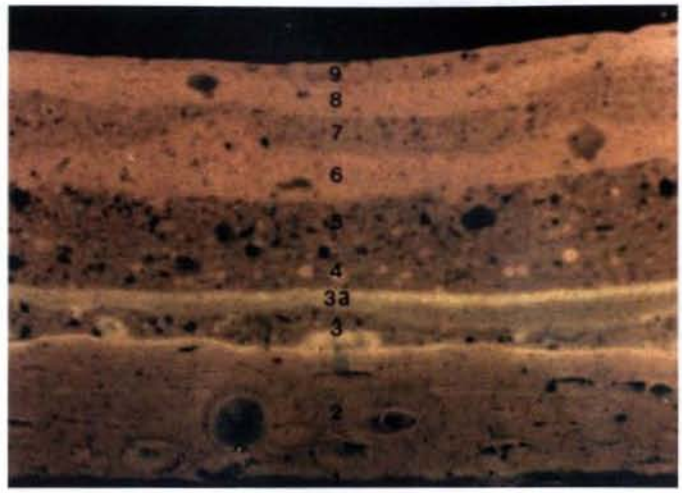

Fig. 6. Cross section of representative stratigraphy of the exterior finishes from the rotunda (Web VIII, Level 5) in ultraviolet fluorescent illumination at 20x magnification. Layers 1 and 2 are the original Cocoon primer and finish. Courtesy of the Architectural Conservation Laboratory.

gained in interest as existing reinforced-concrete buildings began to exhibit deterioration from rebar corrosion due to improper construction and de-alkalization of the concrete over time. As with all painting, surface preparation was paramount to good coating performance. For new masonry, and especially concrete structures, surface alkalinity, moisture, and efflorescence presented serious problems, particularly for traditional oil- and alkyd-based coatings. This situation required the cleaning and neutralization or lowering of the surface pH by drying and carbonation and the use of sealers based on zinc sulfate and fluosilicates.[29]

Between 1924 and 1939 great advances were made in the development of architectural paints and industrial coatings. These advancements, the outcome of applied chemical research following World War I, resulted in the perfection of synthetic resins and oils and of new pigments and solvents, which in turn revolutionized coating-application methods, drying time, and durability. Prior to 1929 vegetable oils, such as linseed and tung oil, were the major paint vehicles. In the 1920s the introduction of phenol-formaldehyde, nitrocellulose, and new solvents resulted in fast-drying lacquers for automobiles and the development of spray-gun applications.[30] However, the most important achievement of this period was the development of high-performance alkyd resins. Alkyds, developed in the 1930s, were derived from the synthesis of alcohol (glycerol) and acid (pthalic anhydride) in combination with linseed and soya oils. The result was a paint binder superior in performance to natural oils and oleoresins.

During the 1930s increased understanding in copolymerization resulted in the introduction of the vinyls and thermoplastic polymers and copolymers of vinyl acetate and chloride. Later in the decade, acrylic, chlorinated rubber, and rubber hydrocarbon resins were also developed. By 1943 due to wartime need, 75 percent of the production of the paint industry was directed toward military use. As a result of an acute shortage of drying oils, paint manufacturers were forced to research alternative materials and systems for civilian use.[31] These alternatives included the production of bodied linseed oil to allow reduced-oil paint formulations, alkyd resin/oil combinations, and the reintroduction of cement and casein paints.

After the war, chemical companies explored new consumer markets for the fruits of their research labors. Synthetic resins suitable for coatings and adhesives were introduced and refined, including silicones, epoxies, and styrene and butadiene, the latter responsible for the first water-based "latex" dispersion paints in 1948.[32] This trend continued into the 1950s with the introduction of polyvinyl acetate and, in 1953, acrylics, both better suited for exterior applications than many traditional paint formulations.

This plethora of new products presented architects and engineers with new, albeit confusing, options. As a result, industry and professional associations and the government offered much on the subject of new paints and coatings to assist designers and the public in the selection and specification of these new materials.[33] For architectural use, commercial classification of paints and coatings was largely based on the dispersant or vehicle used to deliver the system. Solvent-thinned or non-water-based paints were expanded from the traditional vegetable oils alone to oleoresin combinations and synthetic binders, namely alkyds and vinyls.

During the 1930s and 1940s chlorinated rubbers and alkyd-resin-based solvent paints were among the finishes of choice for concrete, where a water-repellent elastic coating was required. After the war, these products received much competition from polyvinyl (vinyl chloride/vinyl acetate copolymer) paints, which were marketed as sprayed-on plastic sheetings. The surface produced by these paints promised to remain new-looking with minimum maintenance and to "form a continuous sheeting or 'skin' of any size or shape, following all the movements of the structure."[34] Moreover, the vinyl-based paints were not affected by the alkalinity of new concrete.

Polyvinyl Chloride (PVC)

The first method for the preparation of vinyl chloride was devised in Germany in 1835, using hydrochloric acid and ethylene. Eight decades later a second method utilizing acetylene was patented, in 1912; due to the lower cost of monomer production, it remained the dominant method of industrial production until after World War II. What began as the experimental exploitation of acetylene as a modern illuminant in the late-nineteenth century eventually led to an industrial interest by chemical companies in a new rubber-like polymer.[35]

Early production of polyvinyl chloride (PVC) resulted in a polymer that was intractable, insoluble, and unstable in heat and light. Like other known synthetic polymers at the time, such as cellulose nitrate, the use of stabilizers and plasticizers offered some benefit. However, it was in the modification of the structure of the polymer itself through two methods — increased post-chlorination and copolymerization — that a polymer of enhanced mechanical strength and improved solubility (lower molecular weight), especially in such low-cost solvents as aromatic hydrocarbons, was possible. This development resulted in PVC's first applications for fibers and films during the 1930s. It was, however, in the increased understanding of the manipulation of the polymer by copolymerization in the late 1920s that German and American companies saw the potential of PVC as a coating.[36]

Prior to the discovery of the benefits of copolymerization of vinyl acetate and vinyl chloride to create a new material, the individual polymers displayed poor properties for use as coatings. Vinyl chloride was hard, insoluble, brittle, poor in cohesive and adhesive bond strength, and darkened when exposed to light. Vinyl acetate displayed good adhesion but was soft, had a low melting point, and was too easily soluble in common solvents.[37] The first commercial vinyl chloride polymers were copolymers of vinyl chloride and methyl acrylate, marketed in the United States as Vinylite and in Germany as Troluloid in 1931.[38] With advances in the understanding of the mechanisms of copolymerization, chemists gained more control over product consistency and variety. By 1935 PVC was being manufactured as cable insulation, molding material, leather and rubber substitutes, adhesive films, and a substitute for celluloid.[39]

Painting the Guggenheim

According to *Sweet's Architectural Catalogue* of 1957, a select range of both new and traditional coating systems would have been available to Wright for painting the Guggenheim. The most commonly cited paint systems included water-based vinyl "latex" dispersion coatings, hydraulic-cement powder paints, and alkyd solvent paints. Vinyl chloride–vinyl acetate solution coatings, such as that used on the Guggenheim, were not included, probably because of their specificity for industrial applications. However, Wright's concern with surface cracking and formwork blemishes argued for the use of an uncommon and costly paint system of limited color options and difficult application, thus suggesting that he believed that protection, elasticity, and durability were critical.

Unlike his earlier treatment of exposed textured concrete at Unity Church (1904) and Midway Gardens (1913), Wright began to paint the concrete elements of his buildings beginning in the 1930s. For the exterior treatment of the concrete at the Johnson Wax Administration Building (1936-39), Wright used an alkyd-oil paint called Lithotex, manufactured by A. C. Horn, on the concrete. At Fallingwater (1934-37), Wright offset the rusticated-limestone-masonry masses with horizontal slabs of concrete painted a "warm, light ochre, almost pale apricot in color." Originally the concrete surfaces were to have been gilded and then, after reconsideration, aluminum leafed; however, neither treatment occurred.[40]

Wright first specified an alkyd-oil paint for the Guggenheim exterior based on its earlier use at Johnson Wax; however, after much discussion, he selected a vinyl-plastic coating system called Cocoon instead.[41] Wright believed Cocoon's ability to function as a "waterproof, jointless skin with an innate elasticity" would help to realize the intended finish of the building, which was not insignificant given the importance of the concrete surface in defining the building's form and massing.[42]

After much consideration Cocoon was eventually chosen for the exterior coating of the museum, but only with the assurance from the manufacturer that the paint could be made to order in any color. Wright's first documented color choice for the exterior of the building was selected from the Cocoon manufacturer's existing palette: No. PV020–Buff.[43] According to further correspondence, Wright selected a new color, "2gc dull (matte)" using the 1948 edition of the *Color Harmony Manual*, a collection of charts of removable color chips arranged according to the Ostwald system, produced by the Container Corporation of America (Fig. 4).[44]

Comparison of 2gc and PV020 indicate they are quite different colors; Wright had clearly changed his mind. There is further documentation that Wright had favored one or the other of these colors at different times. On July 24, 1958, Wright's field architect, William Short, wrote to the contractor stating that the approved color of Cocoon was PV020–Buff and added that this was the color of the middle of the three test patches applied to the northeast side of the monitor wall. He requested confirmation, however, that the middle sample patch was indeed PV020.

Short must have been in communication with Wright's office at Taliesin by telephone shortly before writing this last letter, because an undated letter from Wes Peters was stamped on its reverse side as having been received in Wright's New York office on July 28, 1958. Peters confirmed Wright's final choice of PV020 and stated that he was enclosing the original Hollingshead Cocoon brochure. That brochure is still in the possession of the Guggenheim Museum. The chip of PV020 is stamped "APPROVED JUL 24 1958" and the letters "OK FLW" are written across the chip in Wright's own hand. This is the latest and strongest document of Wright's final intentions for the exterior color of the museum.

Nevertheless, the exterior of the building was not painted with PV020. On the same day that Wes Peters' letter and the Hollingshead brochure were received in the New York office, Short wrote to the contractor stating that, in the opinion of the painting subcontractor, the middle paint sample on the monitor building was not PV020. In his attempt to clarify the choice of paint color, Short appears to have made an error when he concludes his letter with the statement, "Therefore the approved color is the middle sample noted above." Regardless of these color changes, it is important to note that none of these colors were white. Wright abhorred white. In response to efforts by the new museum curator, James Johnson Sweeney, to change the interiors to dead white, Wright wrote, "White, itself, the loudest color of all, is the sum of all colors...But soft ivory... is luminous, receptive, sympathetic, self-effacing instead of competitive and antagonistic."[45]

The authors examined many exterior paint samples taken from the exterior of the museum (see analysis below). Color matches were prepared according to ASTM standard D1535-89. Those studies indicated that the building was, in fact, originally painted a color corresponding to neither PV020 nor 2gc. It could be interpreted as a middle value between PV020 and 2gc (it is intermediate between Munsell 2.5Y 7/2 and 2.5Y 7/4). There is no way to know, short of finding the sample patches on the wall of the monitor building, whether the original color of the museum corresponds to the middle of the three color patches or to any of them, for that matter. The reason that the museum's original color does not correspond to Wright's final choice probably goes back ultimately to the confusion about which sample patch on the monitor actually corresponded to PV020. The seemingly contradictory statements in Short's July 28, 1958, letter support this hypothesis.

Archival texts, historical photographs, and eyewitness accounts also indicate that the original Cocoon finish was quite glossy after application. The glossiness accentuated the rough and irregular pattern of the wooden formwork left in the surfaces of the poured concrete and sprayed gunite. Despite the contractor's defense of the visible form marks as a sign of truth and honesty of construction, the result was so disturbing to the public, Wright, and his client that methods of building up the surface with a sandy textured material were considered.[46] However, this mitigation was never executed due to extreme cost overruns by this date.[47]

Surface-Finish Analysis

Light microscopy. Cross sections of seven samples of the finish coatings taken from different locations on the building were examined with plain reflected and ultraviolet-fluorescence light microscopy (Figs. 5 and 6). There was good correlation in sequence of layers among the samples, thus suggesting that the stratigraphies represented five campaigns of painting and repainting (nine layers), including the most recent temporary recoating. This conclusion is in agreement with earlier findings, although more layers were observed than in earlier research, which probably represent multiple coats of paint applied during various repainting campaigns.

Cross-sectional analysis identified the original Cocoon finish as composed of two layers: a transparent priming layer, approximately 0.02 mm thick, of bluish-green color with discreet particles of blue-green pigment followed by a thick, glossy finish layer, 0.4-0.5 mm thick, of a buff color intermediate between Munsell 2.5Y 7/2 and 2.5Y 7/4 with discernable yellow, red, and blue-black pigment particles. Analysis by plasma-phase spectroscopy, scanning electron microscopy, and Fourier transform infrared spectroscopy identified the media of all five layers as vinyl-based and found only a very small amount of lead in the coatings (0.02 percent), the principal pigment in all of the layers being titanium white.[48] Small amounts of the tinting pigments cadmium and antimony in the original Cocoon layer were also identified.

Also visible were distinct elliptical vacuoles, probably formed during spray application and cure. In some locations on some specimens there was a faint suggestion of internal layering attributable to the wet-on-wet application of multiple layers, as specified. Most specimens exhibited a decolorization in the last few microns of the finish layer toward its original surface. This phenomenon is associated with an apparent condensation of the resin binder at the surface of the Cocoon layer, which makes this zone fluoresce more intensely under ultraviolet light than the deeper levels of the Cocoon layer. There is no distinct demarcation of this zone from the deeper levels of the Cocoon layer, and this zone is particularly apparent on the samples that would have had especially intense exposure. This phenomenon therefore probably represents a photochemical alteration of the uppermost surface from sunlight exposure. Additionally, a thin dirt layer was visible on the Cocoon surface in some locations, confirming it as the exposed finish.

Scanning electron microscopy and X-ray analysis. Cross sections of a surface sample of the exterior rotunda gunite with the full sequence of coatings intact were prepared for scanning electron microscopy and X-ray analysis (Figs. 7 through 9).[49] Of special interest was the zone of interaction between the vinylic primer layer and the gunite surface. The entire length of this zone on the specimen was examined at several different magnifications up to 2,700×. A thin layer of disaggregated cementitious material was observed on the surface of the gunite distinct from the dense, homogeneous gunite; this layer varied from 50 to 100 μm in thickness. This layer probably represents laitance of the gunite, which became dehydrated before curing due to its apposition to the wooden formwork. It may also represent a powdery residue present on the surface of the wooden formwork that was transferred to the outside surface of the gunite when it was sprayed against the forms.

Elemental mapping was performed on different sections of this zone at 250× and 500× to further clarify the interaction of the vinyl and gunite phases (Figs. 7 through 9). The primer was relatively rich in chlorine, confirming earlier studies identifying this layer as a (poly)vinyl chloride-based paint. In contrast, there was very little chlorine present in the disaggregated or gunite layers. Silicon was present in the disaggregated layer suggesting a cementitious origin, but at lower concentrations than in the gunite phase, consistent with its disaggregation. The authors detected no penetration of the primer itself into either the disaggregated or gunite layers at any power up to 2,700×.

The exterior of the Guggenheim Museum has always been painted, yet Wright's exterior finish of choice until 1957 was an exposed cream-colored marble aggregate. The evidence is clear that cost overruns alone forced the decision to apply a buff-colored, spray-

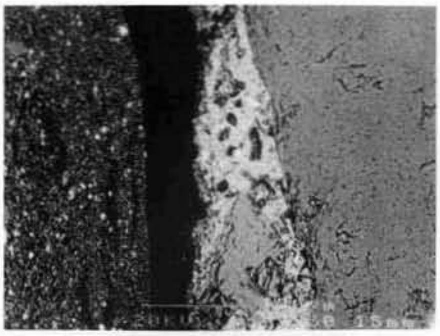

Fig. 7. Scanning electron micrograph and electron dot mapping of original Cocoon layers and gunite substrate (500x magnification). Note from left to right, the speckled Cocoon layer; dark primer layer; pale, disaggregated surface deposit; and dense, homogeneous gunite. Courtesy of the Architectural Conservation Laboratory.

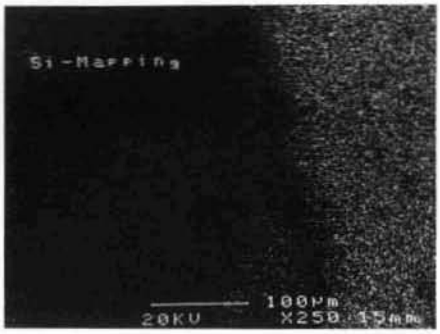

Fig. 8. Scanning electron micrograph and electron dot mapping of original Cocoon layers and gunite substrate (500x magnification). Silicon mapping indicates the gunite layers. Courtesy of the Architectural Conservation Laboratory.

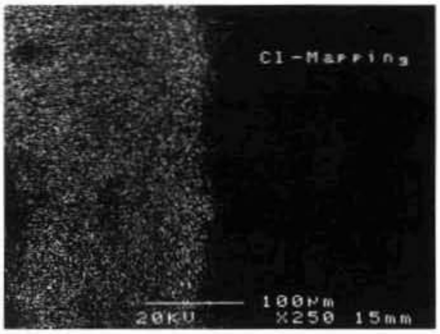

Fig. 9. Scanning electron micrograph and electron dot mapping of original Cocoon layers and gunite substrate (500x magnification). Chlorine mapping indicates the polyvinyl chloride–based Cocoon layers. Courtesy of the Architectural Conservation Laboratory.

applied synthetic-resin skin instead. While it is attractive to consider the aesthetic and functional implications of returning to Wright's original preferred finish, the technical difficulties would make it impossible given the intrinsic nature of such a treatment with the original poured and sprayed concrete. Thin aggregate panels could, no doubt, be fabricated and applied to the existing surface; however, the presence of regular joints, no matter how discreet, and their possible thermal distortion, would negate the intended effect of the surface as a continuous skin.

The reapplication of a new spray-applied finish is therefore the only reasonable option to restore the building's realized exterior treatment, yet one with its own range of choices. Qualities such as color, gloss, and texture of the coating are of paramount importance to the selection process. In addition, performance characteristics, such as durability and rate and mode of failure, need to be considered. As stated above, the necessity for crack repair and mitigation will also influence the ultimate choice of coating materials because of compatibility considerations.

At the Guggenheim, exterior surface appearance is also determined by the texture of the concrete, as well as the choice of surface coating. Because of the irregular and rough surface of the concrete created by the formwork, and especially that for the gunite-applied rotunda, the geometric forms and flowing surfaces of the building are visually broken by irregular diagonal patterns of boarding. Unlike the years of accumulated crack repairs, these surface-texture anomalies are original and an integral part of the construction of the building; they were cited in their time as expressions of an honest and noble construction method.[50] On the other hand, clear documentation exists confirming Wright's displeasure with this surface texture and his desire for a smooth, continuous building skin.

As discussed above, the exterior finish has become steadily lighter in color over time with the application of subsequent paintings. Its current white cast is not at all what Wright had intended, but then neither was the first color that was applied to the building. The exterior color has been misunderstood since the first repainting. Even Bruce Brooks Pfieffer referred to the original color as "grey and overcast," arguing that Wright had had the walls "painted that color in keeping with the [New York] weather."[51] It may at first seem that a quarter century of nonadherence to Wright's intentions would only confuse the issue of an appropriate finish for the restoration of the exterior. This ambiguity can actually be looked upon as a positive opportunity as it allows some flexibility in the choice of color for the museum's exterior skin while remaining within the bounds of historical accuracy. Two legitimate options therefore exist: the color that Wright intended the building to be painted and the actual original color applied.

While color can be assigned to any paint system selected, gloss is more difficult to control, as it is a function of the binder type, binder-to-pigment ratio, vehicle, and application method. Like the concrete's surface texture, Wright was not pleased with Cocoon's gloss, if for no other reason than it accentuated the imperfections in the concrete surface. Any film-forming coating can be made matte; however, here again, the issue is whether to replicate intent or reality. A matte or textured paint would reduce the visual impact of the concrete's visible formwork. Moreover, even the original Cocoon eventually lost its gloss over time due to weathering.

Conclusions

The dilemma of how to interpret the exterior of the Guggenheim Museum centers around the decision to reinstate with new materials either what Wright intended or what was actually delivered. Such choices are not new in the history of preservation; however, in this case the subordinate role so often assigned to the surface finish comes to the forefront in the interpretation and protection of the building. Since the original painted skin must be replaced, performance requirements can be set as necessary regarding durability, compatibility, and maintainability. These criteria would apply to the coating's contribution in protecting the concrete, as well as to its own weathering. Appearance, however, is no small issue given the enormous surface area that defines the form and mass of the building, a fact Wright well understood.

Restoration of the exterior skin will allow consideration of the same issues again but now as an act of conservation, given the building's preeminent position in the history of twentieth-century American architecture. Solutions to reinstate design intent while preserving the physical and technological realities of execution will need to find a balance. While it may be obvious today that the insertion of visible expansion joints across the building's surfaces would seriously compromise and disfigure Wright's vision, removal or concealment of the concrete's formwork would favor his aesthetic intent while impacting the integrity and authenticity of the building in different ways. Both would deny the construction realities that were and remain still a component of every building project.

The less-than-satisfactory achievement of Wright's intentions for the exterior of the Guggenheim as discussed above bring into sharp focus the ambiguities of artistic intent. As outlined by Kuhns, an artist's intention goes beyond artistic motivations and creative processes.[52] Intention can also include the participation and resultant expression in the chosen medium, successful or not, as well as the work's overall effect or presence on the public long after the artist is dead. Such issues should be of concern to all of us in our continual efforts to conserve and interpret great works of art and architecture, the Guggenheim Museum included.

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Notes

1. For a discussion on conservation and artist intent, see Stephen Dykstra, "The Artist's Intentions and Intentional Fallacy in Fine Arts Conservation," *Journal of the American Institute for Conservation* 35, no. 3 (1996): 197–218.

2. Reception Theory resulted in two positions, or fallacy theories: Intentional Fallacy and Affective Fallacy. Intentional Fallacy, or anti-intentionalism, warns the reader to avoid using implied or actual authorial explanations of intent in literary analysis and involves the reader in determining meanings. Intentional Fallacy argues that the artist's intentions are neither available nor desirable as a standard for understanding or assessing the work. In contrast, Affective Fallacy, or intentionalism, repudiates confusions between the text and its emotional effects on the reader. For intentionalists, the meaning occurs objectively in the mind of the reader, not emotionally, and the artist's intention, no matter how obscure, could be useful in understanding the work intellectually.

3. For a discussion of the variations in meaning of artistic intent, see Richard Kuhns, "Criticism and the Problem of Intention," *Journal of Philosophy* 57, no. 1 (1960): 5–23.

4. Andrew Saint, "Philosophical Principles of Modern Construction," in *Modern Matters: Principles and Practice in Conserving Recent Architecture*, ed. Susan Macdonald, 15–28 (Dorset: English Heritage and Donhead, 1996).

5. Recognized time spans vary according to individual country. In the United States 50 years from the present is required, as determined by the National Preservation Act in 1966, unless exceptional significance can be established according to the existing criteria. In the United Kingdom 30 years is required unless exceptional significance can be demonstrated, reducing the period to a mere 10 years for listing. In France the only requirement for designating a recent building as a heritage site is that the architect must be deceased. It is interesting to note that UNESCO's World Heritage Committee first considered and listed buildings of the twentieth century in 1984, with the listing of three Antonio Gaudi structures, the Old City of Warsaw (reconstructed starting in the 1950s), and Auschwitz. At the ICOMOS seminar on twentieth-century heritage in Helsinki (June 18-19, 1995), it was agreed that a minimum age of 25 years would be required for inclusion to the World Heritage List properties.

6. Richard Longstreth, "The Significance of the Recent Past," *APT Bulletin* 22, no. 2 (1991): 17.

7. Paul Phillipot, foreword to Jukka Jokhileto, *A History of Conservation in Europe* (Oxford: Butterworth-Heinemann, 1999).

8. Deborah Slaton and Rebecca Shiffer, eds., *Preserving the Recent Past* (Washington, D.C.: Historic Preservation Education Foundation, 1995).

9. Susan Macdonald, foreword to *Modern Matters*.

10. Longstreth, 14.

11. This issue of the inherited bias of preserving only modernism's orthodoxy is clearly visible in the fight to save Edward Durrell Stone's Huntington Hartford Gallery at 2 Columbus Circle in New York City.

12. See the example of the Zonestraal Sanitorium in the Netherlands.

13. Paul Phillipot, "Restoration from the Perspective of the Humanities," in *Historical and Philosophical Issues in the Conservation of Cultural Heritage*, ed. N. Stanley Price, M. K. Talley Jr., and A. M. Vaccaro, 217 (Los Angeles: The Getty Conservation Institute, 1996).

14. See "The Lamp of Memory" in John Ruskin's *The Seven Lamps of Architecture* (London: Smith, Elder, and Co., 1849). *Monument* is from the Latin *monere*, to remind.

15. Alois Riegl, "The Modern Cult of Monuments: Its Essence and Its Development," in *Historical and Philosophical Issues in the Conservation of Cultural Heritage*, 69–83. More recently, at the Science Museum in London, this distinction was observed where visitors were disturbed to see expensive old motorcars looking shabby, whereas when the Museum of London opened its stores to the public, the horse-drawn carriages that looked old were preferred to the newly restored ones.

16. David Fixler, "The Renovation of Baker House at MIT: Modernism, Materiality, and the Factor of Intent in Preservation," *APT Bulletin* 32, no. 2-3 (2001): 4. Distinctions between the fallacy theories mentioned earlier have not been sufficiently explored in their application to conservation. See Dykstra, 197–218.

17. Ruskin defined authenticity as the indelible imprint of the craftsman or artist upon the thing in question, while Walter Benjamin defined authenticity through his concept of *aura*, the presence of a radiant physical materiality in art. Conversely, Henket defines an authenticity for architecture of the modern movement that must extend from material concerns to social, technical, and aesthetic ideas embodied in the work.

18. While this division has been shamelessly exploited as the new paradigm in the discourse on heritage, it is buildings and sites of the recent past, as well as traditional and indigenous cultural properties, that have begun to recenter preservation's obsession with materiality over agency and intent. See Alan Powers, "Style over Substance: What are We Trying to Conserve?" in *Preserving Post-War Heritage: The Care and Conservation of Mid-Twentieth Century Architecture*, ed. Susan Macdonald, 3–11 (Dorset: English Heritage and Donhead, 2001).

19. Neil Levine, *The Architecture of Frank Lloyd Wright* (Princeton: Princeton University Press, 1996), 300. The Guggenheim Museum is

consistently named as one of the most important buildings of the twentieth century.

20. Bruce Brooks Pfeiffer, *Frank Lloyd Wright, The Guggenheim Correspondence* (Carbondale, Ill.: Southern Illinois University Press, 1986), 10.

21. Letter from Hilla Rebay to Frank Lloyd Wright, June 1, 1943, quoted in Pfeiffer, *Frank Lloyd Wright, The Guggenheim Correspondence*.

22. Letter from Frank Lloyd Wright to Solomon R. Guggenheim, Aug. 14, 1946, quoted in Pfeiffer, *Frank Lloyd Wright, The Guggenheim Correspondence*.

23. Solomon R. Guggenheim Foundation, *The Solomon R. Guggenheim Museum. Architect: Frank Lloyd Wright* (New York: Solomon R. Guggenheim Foundation and Horizon Press, 1960), 16.

24. George N. Cohen, *Concrete Construction*, March 1958. George Cohen, commentary upon the exterior of the Solomon R. Guggenheim Museum, Dec. 8, 1958, typescript, Frank Lloyd Wright Archives of the Frank Lloyd Wright Foundation.

25. Letter from Glenn Easton Jr. to Harry F. Guggenheim, June 7, 1960, quoted in Pfeiffer, *Frank Lloyd Wright, The Guggenheim Correspondence*.

26. This opinion was stated by Paul Swartzbaum, chief of conservation for the Guggenheim's collection, at a meeting in 1991.

27. For a compilation of archival documents outlining the project, see Pfeiffer, *Frank Lloyd Wright, The Guggenheim Correspondence*.

28. On July 17, 1945, Wright wrote to curator Hilla Rebay regarding the original design concept: "The construction of the Museum could only be concrete and steel. But the surface is a remarkable solid aggregate of ground marble, sand blasted smooth and polished if we so desire or left honed surfaces...This gives us a monolith without joints, whereas if the surface was veneered with thin slabs of marble, it would be covered with joints and be ordinary like the other commercial structures in New York — say Bonwit Teller stores." And again, in March 1952, he stated, "The structure itself, extremely light and strong, will consist of a monolithic casting of glistening white plastic — aggregate formed of a white cement and crushed white marble in various sizes — in general a matte-finished surface, polished wherever desired." In *The Solomon R. Guggenheim Museum. Architect: Frank Lloyd Wright*, 17.

29. Maximilian Toch, *The Protection and Decoration of Concrete* (New York: D. van Nostrand, 1931), 47–48.

30. "Market Report: The Paint Industry," *Chemical and Engineering News* 41 (1963): 1.

31. Despite the reduction in new nonmilitary construction (i.e., housing) during World War II, maintenance and repair of existing structures still required the availability and use of traditional materials. Linseed oil, the most common of domestic drying oils, became scarce not only due to military need but also due to increasing demand for its food value through the lend-lease program. Burr Price, "Paints: Present and Postwar," *Architectural Record* 93, no. 6 (1943): 81.

32. "Latex Fatten on Water-Based Paints," *Chemical and Engineering News* 38, no. 7 (1960): 40.

33. Price, 81. J. S. Long et al., "Postwar Paint," *Architectural Record* 96, no. 4 (1944): 68–70, 134–136. Harold R. Harlan, "Paints of Tomorrow," *Journal of the A.I.A.* 5, no. 3 (1946): 142–44. Joseph J. Matiello, "Protection," *Chemical and Engineering News* 41 (1963): 1.

34. Guy G. Rotherstein. "A Report on Sprayed-on Plastic Sheetings," n.d. Copy sent to Wright's New York office, November 29, 1957, Solomon R. Guggenheim Museum building archives.

35. For a history of the material, see Morris Kaufman, *The History of PVC: The Chemistry and Industrial Production of Polyvinyl Chloride* (New York: Gordon and Breach, 1960).

36. Kaufman, 84.

37. Kaufman, 85.

38. Kaufman, 88.

39. Kaufman, 170-71.

40. Levine, p. 237 and note 64. The decision not to leaf the exterior may have been based on the family's wish to avoid any conspicuous display of wealth during the Great Depression: personal communication to the author from David De Long, based on personal communication from Edgar Kauffman to David DeLong.

41. The consideration of flexible vinyl coatings for the exterior of the Guggenheim Museum first appears in the correspondence during the summer or early autumn of 1957. The manufacturer's literature described the product as a "vinyl resin base with added plasticizers, solvents, and coloring." The brochure stated that the material was to be spray-applied. It did not indicate whether the material was a water-based dispersion or a solution; however, it appears to have been a resin solution. Physical properties included a tensile strength of 1,500 psi with elongation of 200 percent minimum and vapor permeability from 0.90 perms at 15 mils to 0.20 perms at 35 mils. Cocoon specifications, AIA No. 24B, R. M. Hollingshead Corporation, n.d., Solomon R. Guggenheim Museum building archives.

42. Letter from William Short to the trustees of the Guggenheim Museum, November 14, 1957. The application of Cocoon at the Guggenheim was specified to meet the minimum thickness of 20 mils at 6 passes, which was guaranteed to accommodate 1/32-inch cracks. Cocoon Specifications, AIA No. 24B, R. M. Hollingshead Corporation, n.d., Solomon R. Guggenheim Museum building archives.

43. This color choice is first mentioned in a letter from William Short to George N. Cohen, president of Euclid, Dec. 27, 1957, Solomon R. Guggenheim Museum building archives.

44. Letter from George Cohen to Albert Thiele, June 26, 1958, Solomon R. Guggenheim Museum building archives.

45. Sweeney's preference for white prompted Wright to dub him "Johnson and Johnson Sweeney" because of his affinity to the sterile white of a gauze bandage. Letter from Frank Lloyd Wright to Harry F. Guggenheim, March 17, 1958, quoted in Pfeiffer, *Frank Lloyd Wright, The Guggenheim Correspondence*. Only Sweeney's office was to be painted white, according to the specifications in the Solomon R. Guggenheim Museum building archives; the other interior spaces were designated to be painted 2gc from the *Color Harmony Manual*.

46. George Cohen, commentary upon the exterior of the Solomon R. Guggenheim Museum, Dec. 8, 1958, typescript, Frank Lloyd Wright Archives, Frank Lloyd Wright Foundation.

47. Letter from William Short to the trustees of the Guggenheim Museum, Sept. 11, 1959, Solomon R. Guggenheim Museum building archives. It is unclear why Wright or Short did not insist on better formwork, or at least better surface finishing. Common practice of the time was to strike the formwork as early as possible and then to rub down the surface by hand using a cork float or blocks of wood. Water would then be flicked on the surface and the slurry created rubbed into the face of the concrete to seal the pores and present a uniform granular appearance. On contemporary techniques, see J. G. Wilson, *Exposed Concrete Finishes* (London: C. R. Books, 1962), 48. The use of an applied stucco-like finish would have been anathema to Wright's selection and treatment of concrete, and its cosmetic failure was warned by Cohen in his 1958 commentary above.

48. According to the manufacturer's literature, housed in the Solomon R. Guggenheim Museum building archives, Cocoon is a polyvinylchloride–polyvinyl acetate copolymer.

49. The cross sections were examined with a JAOL Series 6500 scanning electron microscope at the Laboratory for Research on the Structure of Matter at the University of Pennsylvania, through support from the National Science Foundation MRL Program under grant DMR91-20668.

50. Cohen, commentary upon the exterior of the Solomon R. Guggenheim Museum.

51. Pfeiffer, 19.

52. Dykstra, 205.