Mies van der Rohe, Crown Hall, Chicago, USA, 1950–1956. Restoration by Krueck + Sexton Architects. © William Zbaren, 2005.

Restoration of Crown Hall

BY MARK SEXTON
WITH THE COLLABORATION OF KATHERINE BAJOR,
BILL KISSINGER AND HEIDI LEE

This essay documents the research of restoration and modifications to Mies van der Rohe's masterwork, Crown Hall, the heart of the Chicago campus of the Illinois Institute of Technology. Restoration was necessitated by 5 decades of use during which the building had fallen into major disrepair. During the restoration, practical and philosophical issues arose from the building's landmark designation by regional and national authorities.
The essay describes the forensic research that preceded design, investigation and selection of alternate materials modifications to the building envelope. This includes a detailed description of modifications balancing original materials and systems with current codes.
The essay concludes by placing the restoration of Crown Hall in the larger context of preservation of modern buildings and the threat to these works which, unlike Crown Hall, are rarely protected by landmark designation.

Introduction

S. R. Crown Hall is widely recognized as one of the supreme achievements of 20th century architect Mies van der Rohe. Housing the College of Architecture on the campus of the Illinois Institute of Technology (IIT), the building was designated a City of Chicago Landmark in 1997 and a National Historic Landmark in 2001. National landmark recognition is very rare for a building fewer than 50 years old. At its dedication in 1956, Mies van der Rohe characterized Crown Hall as "the clearest structure we have done, the best to express our philosophy"[1]. The exposed structural system is central to its design. Whether observed from the interior or exterior, the glass curtain wall reveals a straightforward understanding of the clear-span universal-space structure. As a physical manifestation of Mies van der Rohe philosophy of "almost nothing", it imparts the De Stijl principles of rationalization and universality combined with Frank Lloyd Wright's open plan[2]. After 50 years of continuous use, Crown Hall remained a fully functional school of architecture. Although the structure remained sound, specific components of the building were in a condition of significant deterioration including the south terrace and entry, wood partitions, glazing stops, glazing, and coating[3]. Past renovations intended to address code issues and patchwork/emergency repairs undermined the space's original character. The damaged envelope obscured the aesthetic clarity of the structure and threatened its longevity. This essay focuses on the most substantial structural phase: the curtain wall.

Mies van der Rohe: Germany to USA

Mies van der Rohe was born into a family of stone carvers in Aachen, Germany, in March of 1886[4]. Ambitious to shed his artisanal heritage, he worked at several architecture offices throughout Germany. His work with various leading architects imparted certain influences on form, proportion and detail influencing his architectural perspective. Eventually, his innovative structures on the drawing board and in built form were held in high regard throughout Europe[5]. In 1930, he was chosen to succeed Walter Gropius as director of the Bauhaus, the German school of experimental art and design. Under pressure from the Nazis, Mies van der Rohe closed the school in 1932, after a short two-year tenure[6]. Lacking work, he departed Europe for Chicago in 1938, accepting an offer to head the Department of Architecture the Armour Institute (now IIT)[7].

Mies van der Rohe: IIT, Curriculum, Campus Plan

Upon his arrival, Mies van der Rohe set out to "rationalize" the architecture curriculum. The Institute's Beaux Arts curriculum gave way to Bauhaus principles developed in 1922 by Walter Gropius. Students received a 3-step education[8]. The first stage focused on drawing. Next came mastering the uses and qualities of materials. Finally, students trained in the fundamental principles of design and construction. Building practices were covered in courses while the studio was dedicated to problem solving[9]. Like his buildings, Mies van der Rohe's curriculum was an update on contemporary craft and materials, combining art, craft and technology with an emphasis on aesthetics[10]. As architectural historian, Kevin Harrington explains, "Mies wanted to create a curriculum which would always yield excellent craftsmen and occasionally produce or encourage those with gifts to make expression of technique an act of high art"[11].

Early in his tenure, Mies van der Rohe taught in rooms provided by the Art Institute of Chicago[12]. In 1940, Armour Institute and Lewis Institute merged, forming the Illinois Institute of Technology. This development required a new campus plan which Mies van der Rohe was commissioned to design. A 4-block area laid out on a 24 foot by 24-foot (7.3 m x 7.3 m) grid straddled the 33rd street axis on the south side of Chicago. All buildings were rectangular with variable heights based on 12 foot (3.7 m) modules. The grid imparted a strict order of organization and a fluid sense of flexibility by overlapping placement of buildings. The campus plan reached its peak when Crown Hall opened in 1956, just two years prior to Mies van der Rohe's resignation as Director of the School of Architecture[13].

The Building

Crown Hall has been home to the School of Architecture at IIT since its opening (figure 01). Like its curriculum, it reflected Mies van der Rohe's concept of an open cooperative education. The college classroom building, without the traditional classrooms, alludes to "a modern incarnation of the historic one-room schoolhouse" . Mies van der Rohe sought to create an open space, flexible enough to accommodate changing needs over time. For example, at the time of its opening the building housed approximately 120 students. By 2003, it accommodated more than 400 students, meaning the drafting tables with ample space around each in the late 1950s, were now stacked likes eggs in a crate. Students were no longer just drafting but also working on computers. The natural light flooding into the building was no longer an asset. While the plan lent itself to rearrangement to economize on space, high performing replacement blinds were required to block the glare .

As much as the Chicago School architects and Mies van der Rohe had in common, they had differing perspectives on function and its relationship to form: "What Sullivan said, 'Form follows function', I think that has changed in our time. The function is very short-lived today, and our constructions last much longer. So, it only makes sense to make the plan very flexible" . He referred to this design concept as "universal space"[17]. To create a large clear span structure with 120 x 220 x 18 foot (36.5 m x 67 m x 5.5 m) of unobstructed interior space he moved all structural supports to the building's exterior wall[18].

The exterior structural components allow Crown Hall to be "almost nothing" . Often referred to as "skin and bones" architecture, the exterior skin is comprised of welded steel components, steel glazing stops fastened with countersunk steel screws and glazing divided into three horizontal layers[20]. The main hall has an east-west axis, divided cross-wise into 3 60-foot (18 m) bays. Comprised of two floors, the main floor is elevated so that light come into the lower level through clerestory windows. All joints are held together with field welds ground down to provide a seamless appearance. A steel framed roof is suspended from four externally exposed steel girders. The roof cantilevers longitudinally 20 foot (6.4 m) beyond the last supporting girders. Columns run the full height of the building, supporting each girder. All exposed steel is painted black. As the façade is minimalist, the only exterior features are a steel and travertine terrace that provides access to the raised main floor. Through its "purity of form, perfection of proportions, elegance of detail and dignity of expression", the technologically advanced glass and steel structural system defines the building[21].

The interior of the building features a completely unobstructed main hall. This expansive, open workspace encourages a collaborative exchange of ideas through cooperative learning (figure 02). Free-standing oak partitions barely separate spaces, retaining the expansive feeling of the hall. Two vertical chases placed 80 foot (24 m) apart are the only features that rise from floor to ceiling. Two internal staircases punch through the main floor, descending to the lower level. At the south entry, two partitions frame an exhibition space. The ceiling is set back approximately 1 foot (0.3 m) from the exterior walls and appears as a suspended continuous plane. 1 foot square (0.3 m x 0.3 m) acoustical tiles make up the ceiling finish. To retain the purity of the space in the main hall, Mies van der Rohe created a lower level with standard divisions allowing for building services, restrooms, lecture halls and other operational necessities[22]. 50 years after Mies van der Rohe last taught at IIT, this "temple of architecture" embodies his architectural philosophies more effectively than any textbook. "Form and function unite in Crown Hall - the clear-span, universal-space structure carries out Mies's belief in the value of a collaborative architectural education" to this day[23].

Discovery Process

Analysis and design work began in 2003 and restoration was completed in 2005. Due to the important nature of this project, an interdisciplinary design team led by Krueck + Sexton Architects, was formed, representing architectural, preservation, glazing, sustainability, engineering and construction disciplines. A comprehensive 1998 report by Fujikawa Johnson and Associates and the Secretary of the Interior's Standards for the Treatment of Historic Properties guided the planning process. Joseph Fujikawa had worked on the construction of Crown Hall as one of Mies van der Rohe colleagues[24].

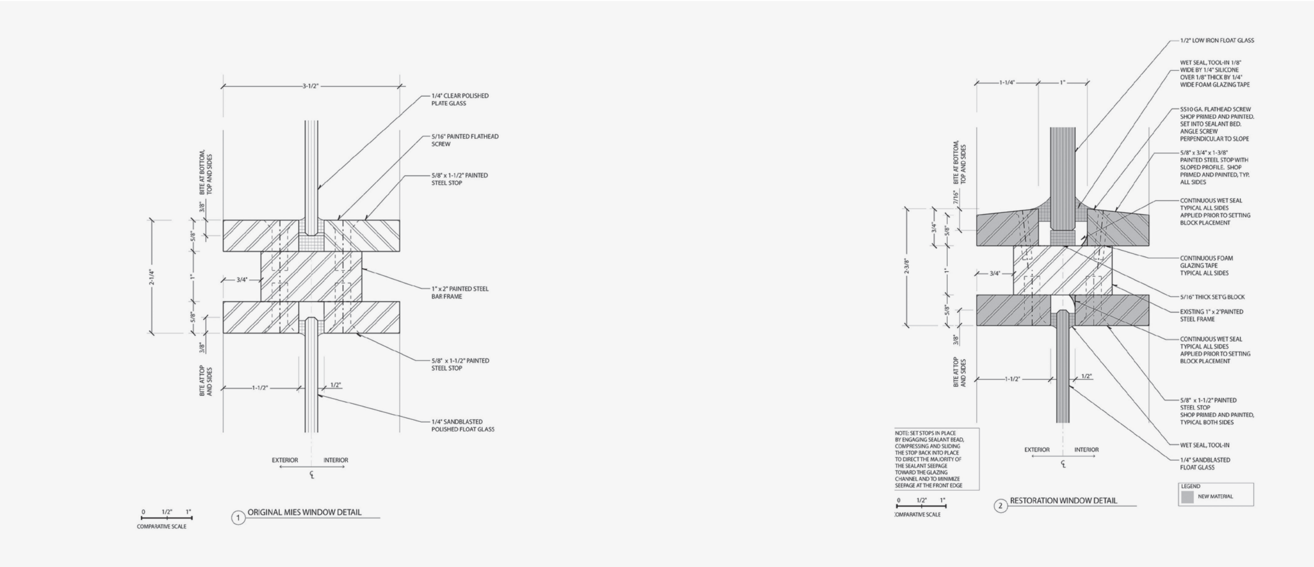
A design review committee of College of Architecture faculty, some of whom occupied the building in its early years, assisted the team's research and decisions while serving as liaison with the University community. A rigorous review process including discussion and presentations to city and state preservation officials provided critical input.

The review process focused on the steel and glass stop details of the façade where all of the building's elements – steel, glass and paint – come together at a critical point. An exemplar of Mies van der Rohe's meticulous approach to construction, this detail required modification to capture and hold the replacement glass. Adherence to the highest level of historic preservation initially seemed to be at odds with the current code and safety requirements. The detail needed to change; but how to most appropriately choose the modification that would have no adverse impact on the historic building? Replacement of the glass presented a similar challenge. Glass and modified aluminum stops installed in 1975 were to be removed because they were not in keeping with the highest standards of historic restoration. The new glass needed to meet the current code requirement. More importantly, it needed to restore the building's

01 Mies van der Rohe, Crown Hall, Chicago, USA, 1950–1956.
© Hedrich Blessing, 1956.

02 Mies van der Rohe, Crown Hall, Chicago, USA, 1950–1956. Interior studio.
© Hedrich Blessing, 1956.

03 Mies van der Rohe, Crown Hall, Chicago, USA, 1950–1956. Detail drawing of original (left) and restored (right) glazing stop condition. © Krueck + Sexton, 2005.

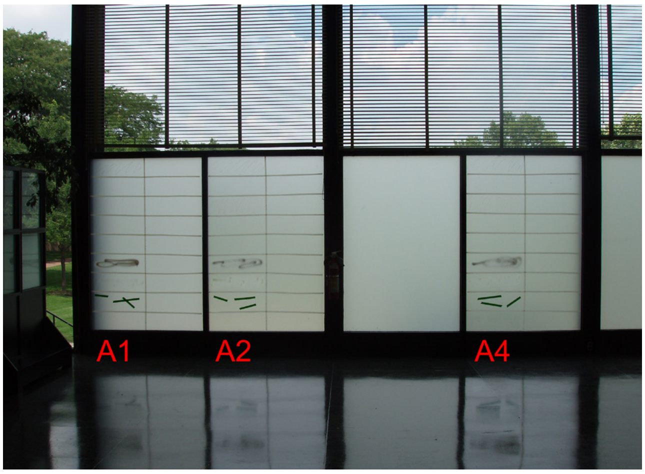


04 Mies van der Rohe, Crown Hall, Chicago, USA, 1950–1956. Restoration works.
© Krueck + Sexton Architects, 2005.

05 Mies van der Rohe, Crown Hall, Chicago, USA, 1950–1956. Restoration works.
© Krueck + Sexton Architects, 2005.

06 Mark Sexton. © Krueck + Sexton Architects.

07 Mies van der Rohe, Crown Hall, Chicago, USA, 1950-1956. Detail view of sill with glazing stop removed. © Krueck + Sexton, 2005.



08 Mies van der Rohe, Crown Hall, Chicago, USA, 1950-1956. Mock-up sample of various materials on glass to test seal. © Krueck + Sexton, 2004.

original subtle play of transparency and translucency. The design team extensively studied potential glass formulation, thickness and finishes, eventually arriving at six strategies. Full size mock ups of the building curtain wall were reviewed by the team and university and city and state preservation authorities. A consensus emerged on the best direction forward, which deployed a thicker float glass in the clear upper lights matching the transparency and color of the original ¼ inches (6 mm) polished plate glass. The team sampled a wide selection of glass for the lower glazing that was more suitable than the laminated glass installed in the 1970s.

The restoration of the exterior steel consisted of removing and replacing steel that had corroded beyond repair, sandblasting the remaining steel frame and a three-coat paint system. The building's entry doors were removed and sent to the original manufacturer, Ellison Bronze Inc., for refurbishment then reinstalled with modern hardware and integrated security devices. Italian travertine for the entry porches was selected to match the texture, color and grain of the original stone.

Metal Stop Design

A predominantly glazed building, Crown Hall consists of a primary steel structure of plate girders and main columns and a secondary steel structure of intermediate columns, mullions and frames. By 2003, years of inadequate maintenance and piecemeal renovation projects left the steel frame and glazing system in a state of severe disrepair. Glass panels on the main floor and lower level were cracked, the steel stops showed signs of advanced corrosion and, due to oxide jacking, window frames were bent out of alignment, exerting pressure on the glass and stops.

Most of the corrosion found on the existing painted steel structure and glazing stops was surface corrosion. The two primary causes of this corrosion were failure of the aged paint coating system and a glazing system unable to repel or weep water. Advanced corrosion due to excess moisture accumulation was found at areas of dense ivy growth and at glazing channels, due to excess condensation and at door sills due to the use of de-icing salt.

The glazing stops on the lower lights appeared to be the original steel bar stock. However, the exterior glazing stops on the upper lights were replacement aluminum pieces installed during the 1975 renovation. The original steel bar stock remained on the interior side and appeared not to have ever been removed. A new stop profile and detailing were investigated to prevent trapped water within the glazing channel and to keep moisture off the glazing assembly.

A careful review of chemical, moisture, galvanic, electrochemical thermal expansion and historic preservation issues led to implementation of steel replacement stops and for the entire glazing system. While higher-performance metals offered apparent advantages, the designers determined that use of these metals may have unintended consequences, such as complicating the glazing system and compromising the future performance of the building.

The question remained as to the cause of the great amount of base glass cracking. Certainly, there was visible oxidation but could the cause of the glass failure be due to water infiltrating the glazing channel and freezing? Removal of the existing steel window stops revealed that in many places the original red iron oxide primer was visible through the top coat. In other locations, the steel stops were found to have only a light coating of primer on concealed surfaces.

Sealant joints around the lower level windows were failing and in disrepair. The sealant, presumably replaced along with all the glass during the 1975 renovation was nearly 30 years old. Large areas of sealant showed signs of material breakdown and adhesion loss, leading to water infiltration of a vulnerable point of the wall system.

The original drawings called for use of a mastic tape product at various locations, which in all likelihood was intended to provide separation and a layer of protection between components of the steel frame. However, this material was not found between the steel stops and frames. This steel-to-steel condition permitted water to infiltrate the glazing assembly where it had access to the open glazing channel and no way to escape.

It was only after removing a dozen steel stops that severe oxide jacking was conclusively identified as the singular cause of the glass breakage. The most significant corrosion was found at the bottom horizontal bar of the window frame (figure 07) and approximately 12-18 inches (300-450 mm) along the vertical jamb members. This caused moderate amounts of pitting of the top surface of the steel frame that was readily apparent after sandblasting. Corrosion build-up and oxide jacking at the glazing setting blocks exerted an upward pressure on the glass. This corrosion build-up, combined with the increased thickness of the glass installed during the 1975 renovation, caused a significant number of the lower level translucent panels to break.

The original 5/8 x 1 ½ inches (16 mm x 38 mm) profile of the steel stops was maintained using all new materials at the lower level lights. This afforded a high degree of shop fabrication and finishing quality control while eliminating the need for costly specialized efforts to repair material or areas of material that had deteriorated through the years.

At the upper stops, current codes required increased thickness of the stop at the glazing channel from the original 5/8 inches (16 mm) bar to 3/4 inches (19 mm) to allow sufficient support of the large upper glass lights. The important design question was whether this could be accomplished within the spirit and letter of preservation. A detailed study determined that a sloped profile at the upper stop would maintain the appearance and proportion of the original 5/8 inches (16 mm) front face of the stops while addressing the increased support requirement at the glass (figure 03). This profile also improved window wall performance by establishing positive drainage away from the glazing channel.

Incorporating a slope into the rectilinear building was considered detrimental to Mies van der Rohe's adherence to right angle relationships. Another objection was that the sloped stop would require custom fabrication. Despite his fondness for artisanal craftsmanship, Mies van der Rohe was committed to utilizing mostly off-the shelf building materials as an expression of universality and industrial era aesthetics. Both tenets were influenced by the De Stijl principles of "transcending the individual in order to evolve towards the universal"[25]. As debate raged among the design review committee members, the design team's response was simple: "you don't see it". Mies van der Rohe was a visual purist above all but he was also practical. For example, at 860 and 880 Lake Shore Drive, another Mies van der Rohe design, the vertical beams at the columns of the apartment towers serve no functional purpose. They are purely aesthetic. According to Mies van der Rohe, the building "just didn't look right" without them[26]. Aesthetics and "spirit" were ahead in the agenda compared to honestly expressed structure.

In the summer of 2004 a full-size mock-up confirmed that the height of the upper window bay completely concealed the bar stop slope. It was almost impossible to perceive, even knowing it was there. The mock-up also proved that thickening the entire face of the stop or replacing the slope with a right angle "just didn't look right". A lengthwise view of a right angled (instead of sloped) lip showed that this stop design would read as another line from a side perspective, disrupting the clean lines. Having proven to be cost effective in pricing exercises, the sloped profile offered a compromise between the original detail and current code while addressing historic, aesthetic, performance and pragmatic concerns.

The original sized fasteners, 5/16 x 1 inches (8 mm x 25 mm) flat head slotted machine screws, were maintained at all of the glazing stops. Thus, existing locations and spacing were maintained on all lower level windows. The spacing was modified slightly at the upper stops to accommodate an angled fastener following the sloped profile of the stop. The original glazing stop fasteners were steel but during forensic exploration, stainless steel screws were discovered in several stops. The team specified stainless screws to resist corrosion. The fasteners were then set in a bed of sealant further isolating materials and protecting against water infiltration.

With the newly fabricated stops sandblasted, and steel frames and new glass components defined, a full-size mock-up was built consisting of one full window bay. This bay served as the benchmark for quality control as well as an in-situ laboratory to test the glazing system for air and water infiltration. Water testing demonstrated that construction methods and techniques would need to be as tight as the architecture itself to achieve system integrity.

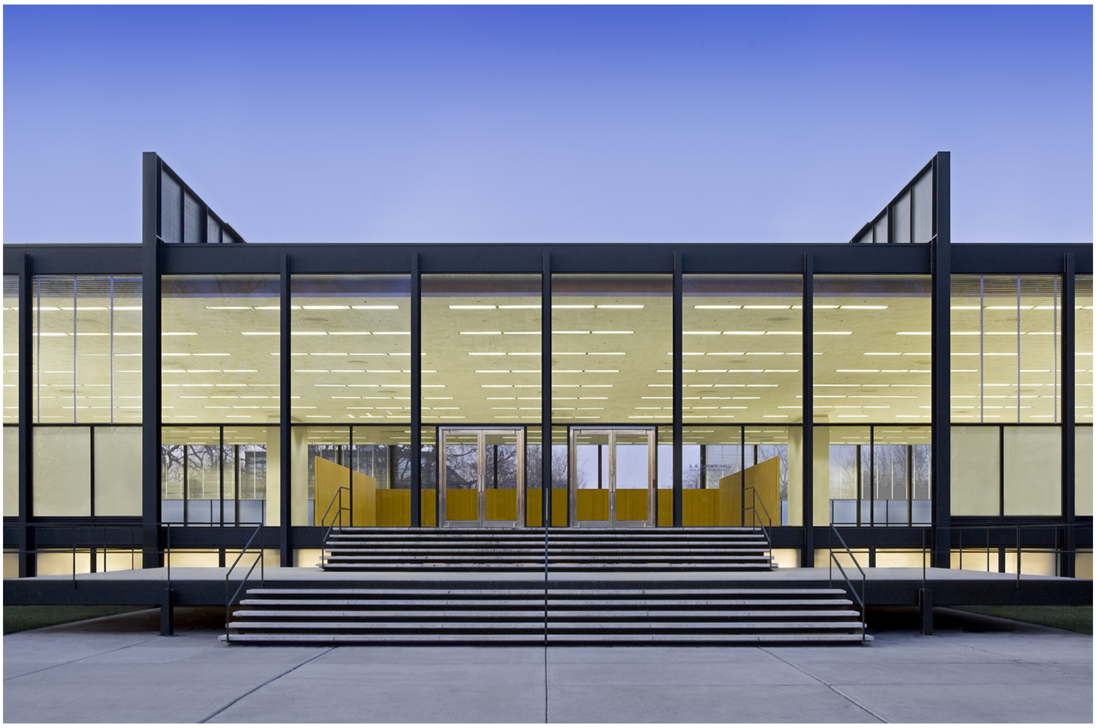
Glazing Design

All of the exterior glazing was replaced during alterations made in 1975. The original ¼ inches (6 mm) polished plate glass in all upper lights was replaced with 3/8 inches (9.5mm) clear float glass. The upper light exterior stops were replaced with a two-component extruded aluminum stop with a ¾ inches (19 mm) leg for the added bite needed to support the thicker replacement glass. This redesigned stop resulted in a subtle outward shift of the glass. The original ¼ inches (6 mm) sandblasted plate glass in the lower lights was replaced with translucent laminated glass.

From the day the building opened the sandblasted surface could be stained with simple fingerprints as well as such ubiquitous products as masking tape, spray paint and markers. While the laminated glass provided both safety and an interior surface that could be easily maintained, it also created two new problems.

Atelier Ten, a London based environmental engineer, discovered that the mylar interlayer absorbed 30% of solar energy compared to less than 5% with sandblasted glass. Having nearly a third of the façade of the building retain solar energy affected user comfort. While easy to maintain, the laminated glass added to the building's summer cooling load. The second problem was that the reflectivity of the laminated glass compromised the quality of light in the interior space. Instead of the soft, almost shoji screen quality of Mies van der Rohe's sandblasted glass, the laminated glass was reflective. The effect was even more dramatic at night when light levels dropped on the exterior and increased on the interior.

In 1975, the original lower light steel bar stops were re-used with the thicker replacement laminated glass. By 2003, glass



09 Mies van der Rohe, Crown Hall, Chicago, USA, 1950-1956. Restoration by Krueck + Sexton Architects. © William Zbaren, 2005.

breakage was primarily in the lower translucent lights. Although oxide jacking was the primary source of glass failure, the modified proportion of the glazing channel was another. Thicker glass combined with the original stops compromised the ability of the system to accommodate thermal movement. Expansion of the original steel stops due to corrosion also contributed to the glass breakage. The combination of stress from thermal expansion of the steel and corrosion expansion were the primary cause of glass breakage.

Upper Clear Glass

Due to more stringent wind load requirements, ½ inches (13 mm) float glass was used for the upper clear lights. Glass of a lesser dimension would require heat strengthening. This tempering process causes roller wave distortion, adversely affecting the visual flatness of the glass. Center-of-glass deflection also increases as the dimension of glass is reduced. Deflection of as much as 1.8 inches (46 mm) is possible with glass less than a ½ inches (13 mm) thick, requiring an increase in the dimension of the glazing stops to prevent pop-out of the glass units. Clear annealed and low iron glass were both considered for the upper lights, with the goal being to closely match the color of the original polished plate glass. The low iron option proved to be the closest match. Using low iron glass offered the chance to double the thickness of the upper glass panels without increasing the amount of iron or color. Because of the large size and color of the upper glass panels, low E coatings were not considered.

Lower Clear Glass

For the lower glass panels adjacent to the entry doors of the north and south elevations, ¼ inches (6 mm) clear tempered glass was used. Tempered glass met the safety requirements for the lower units allowing the use of original thickness and type of glass.

Lower Translucent Glass

For the lower translucent glass, ¼ inches (6 mm) clear tempered glass that was sandblasted, as originally designed by Mies van der Rohe was selected, however, it was coated with a three-part epoxy clear sealer. The sealed sandblasted glass was selected after full-size mock-ups were compared for color, surface texture, translucency and interior reflectance to an adjacent untreated sandblasted panel. No one on the design team, the University committee or city and state preservation officers could detect a difference. When the University requested another mock-up to test the sealer, a sealed panel was divided into sections (figure 08) and a variety of materials from markers, spray paint, spray glue and masking tape were applied and aged for 3 months. With design team direction, University maintenance was able to remove all the markings without affecting the visual character of the sandblasted glass. The quality of the sandblasted glass was retained and completely maintainable.

Coating System

In 1998, Fujikawa Johnson, in collaboration with Krueck + Sexton Architects completed a report that revealed that the original iron oxide lead paint system had remained intact beneath several layers of finish coat material. Various members of the Architectural Committee recounted that subsequent recoating "always faded from dark black to charcoal gray after several years". The report called for abatement of the original lead paint as a prerequisite for future renovations. During the early design stages, a forensic consultant was engaged to determine a color match for the original paint used by Mies van der Rohe: Pre-War Superior Graphite #30 (natural black) manufactured by Detroit Graphite Company[27].

The coating system recommended by the design team was a high-performance system by manufactured by Tnemec Systems. For proper adhesion, prior to application of this product the existing steel frame and structure had to be sandblasted to a minimum surface preparation of SSP-SPC6 Commercial Blast Cleaning. Removing the red iron-oxide lead primer required an extensive environmental control program that included wrapping the building inside and out with a protective plastic layer for proper abatement and control of lead dissipation into the atmosphere.

The first coat of the Tnemec System applied was the Series 90-97 Primer. This coat was spray applied in the field within 4 hours after sandblasting to prevent flash rusting of the newly prepared steel surfaces. The 90-97 Primer is an organic zinc-rich primer that provides maximum protection against surface corrosion of the steel surfaces. The second coat, also field applied in this application, was the Series 66 Hi-Build Epoxyline intermediate coating. The final topcoat product was the Series 175 Endura-Shield Polyurethane Product.

The original steel glazing stops were primed, fastened to the support structure and top coated. The only protection against corrosion at the glazing stops was a thinly applied primer. In the process of renovation, all the steel stops were shop painted with the full three coat paint system and then set into a bed of silicone. The full coating of all the glazing stops provided a superior level of corrosion protection as compared to the original paint system.

The result of the new coating system was an impressive display of the building's clarity and simplicity (figure 09). By removing layers of deteriorated coatings and applying a high-performance coating, the pristine lines of the building's structure were restored to their original elegance.

Conclusion

The significance of this restoration extends far beyond the preservation of one of the world's most important modern buildings. It affirms the cultural legacy of mid-20th century modernism, which left a large and influential footprint on the landscape of North America and the world. Without the landmark status enjoyed by Crown Hall, many of these rapidly aging buildings are at risk. The vast majority of our mid-century buildings face an uncertain future. The strategies employed by Krueck + Sexton Architects and the restoration team at Crown Hall are applicable to buildings of similar vintage. This project demonstrates that structures of the modern era can be successfully restored without loss of historical, design or functional integrity.

Notes

1 McClier, *S.R. Crown Hall Historic Structure Report*, Chicago, McClier, 2000.
2 *Id.*.
3 Fujikawa Johnson and Associates, Inc.; Krueck + Sexton; TT-CBM Engineers; Environmental Systems Design; Pacific Construction Services, *S.R. Crown Hall Restoration Study – 1997*, Chicago, Fujikawa Johnson and Associates, 1997.
4 McClier, *op. cit.*.
5 *Id.*.
6 *Ibid.*.
7 Ginny Pearson, "Historical Significance of the Mies Campus at Illinois Institute of Technology (IIT)", Chicago, IIT Media Relations, 2003; McClier, *op. cit.*.
8 Eric Thompson, "National Historic Landmark Nomination: S.R. Crown Hall", Washington, DC, National Park Service, 2001.
9 Catherine Wetzel, "An Integrated and Collaborative Approach: Integrating Technology in Beginning Design", Proc. of 2008 National Conference on Beginning Design Student, Atlanta, Georgia Institute of Technology, 2008.
10 *Id.*.
11 McClier, *op. cit.*.
12 Eric Thompson, *op. cit.*.
13 McClier, *op. cit.*.
14 Eric Thompson, *op. cit.*.
15 Atelier Ten; Trans Solar, "Illinois Institute of Technology Crown Hall Renovation Environmental Study-Stage I Report", New York, Atelier Ten, 2003.
16 McClier, *op. cit.*.
17 *Id.*.
18 *Ibid.*.
19 *Ibid.*.
20 Eric Thompson, *op. cit.*.
21 *Id.*.
22 *Ibid.*.
23 Eric Thompson, *op. cit.*.
24 *Id.*.
25 Richard Padovan, *Towards Universality: Le Corbusier, Mies, and De Stijl*, Routledge, London, 2002, 4.
26 McClier, *op. cit.*.
27 *Id.*.

References

Atelier Ten; Trans Solar, "Illinois Institute of Technology Crown Hall Renovation Environmental Study-Stage I Report", New York, Atelier Ten, 2003.

Fujikawa Johnson and Associates, Inc.; Krueck + Sexton; TT-CBM Engineers; Environmental Systems Design; Pacific Construction Services, *S.R. Crown Hall Restoration Study – 1997*, Chicago, Fujikawa Johnson and Associates, 1997.

MCCLIER, *S.R. Crown Hall Historic Structure Report*, Chicago, McClier, 2000.

PADOVAN, Richard, *Towards Universality: Le Corbusier, Mies, and De Stijl*, Routledge, London, 2002.

PEARSON, Ginny, "Historical Significance of the Mies Campus at Illinois Institute of Technology (IIT)", Chicago, IIT Media Relations, 2003.

Leach, Neil, *Rethinking Architecture: A Reader in Cultural Theory*. New York, Routledge, 1997.

THOMPSON, Eric, "National Historic Landmark Nomination: S.R. Crown Hall", Washington, DC, National Park Service, 2001.

WETZEL, Catherine, "An Integrated and Collaborative Approach: Integrating Technology in Beginning Design", Proc. of 2008 National Conference on Beginning Design Student, Atlanta, Georgia Institute of Technology, 2008.

Mark Sexton

Founding partner of Krueck + Sexton Architects. Along with Ronald Krueck, he designs and manages all of the firm's work. He is a member of the GSA Design Excellence Program National Registry of Peer Professionals, serves on the Board of Overseers for the IIT College of Architecture, the School of the Art Institute of Chicago Advisory Design Council and is currently on the faculty of Northwestern University teaching an architectural design studio in the School of Engineering. The firm has been recognized with numerous awards including AIA National and Chicago Honor Awards, Divine Detail and Interior Awards, Business Week/Architectural Record – Good Design is Good Business Award, Chicago Athenaeum Architecture Award, AIA COTE Top Ten Green Building, Landmarks Preservation Council of Illinois and Design Build Institute Project of the Year. In 1997, Montacelli Press published the firm's first monograph, *Krueck + Sexton Work in Progress*.