CS07 Curtain Wall Preservation: Technical Considerations

SESSION CHAIR
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CS07a: Assessing and Rehabilitating Historic 20th Century Curtain Walls and Window Walls
Speaker: Matthew Bronski, PE, Simpson Gumpertz & Heger, Waltham, MA USA

ABSTRACT
Perhaps no other visible architectural components embody the rise of the twentieth century American metropolis more than the curtain wall, and its technical sister, the window wall. Along with the steel skeleton frame and the elevator, the development and evolution of the curtain wall/window wall is fundamental to the rapid rise of relatively average-sized mid-19th century American cities New York and Chicago into major world metropolises in the early to mid-twentieth century.

Given their significance in the growth and development of the American metropolis in the “American Century”, as well as their architectural prominence and exterior visibility (as compared with concealed steel skeleton frames, and internal elevators), the preservation of historic early to mid-twentieth century curtain walls and window walls should be a major preservation priority in the urban metropolis, and indeed in many American cities. Sadly, many of the most significant examples have already been lost and replaced with run-of-the mill contemporary aluminum replacements, while many others are threatened by replacement. These threats of replacement often derive from one or more of the following: • well-intended energy conservation improvement initiatives;
• an attendant knee-jerk reaction to replace them without first evaluating their existing condition, performance, and the technical feasibility of rehabilitation; or
• a lack of knowledge of how to undertake such an evaluation and assessment.

In this presentation, the speaker will describe some (of the many) types of construction and assemblage of historic early to mid-twentieth century window walls/curtain walls, some techniques and considerations for their evaluation and assessment, and critical factors in making the assessment and recommendation of rehabilitation or replacement. He will use examples from his personal experience leading the assessment and design (rehabilitation or replacement) of five distinctly different historic window wall/curtain wall projects, each representing different types of construction, different appearances and configurations, and different existing conditions as described below: • A 1965, custom-designed, custom profile steel window wall, in an iconic modernist building designed by Josep Lluis Sert (rehabilitation recommended and outlined in our study which was completed in 2009, rehab. project delayed)
• A 1963, high-end, high-style bronze window wall, in an iconic modernist building designed by Skidmore Owings and Merrill (rehabilitation completed 2005)
• A 1958, custom-designed, custom-profile wood curtain wall, in a university classroom and faculty office building designed by Shepley Bulfinch, Richardson & Abbott (rehabilitation and structural stabilization completed 2012)
• A 1942, standard profile steel window wall, in a landmarked modernist building designed by Philip Johnson (rehabilitation mock-ups currently in progress)

Chicago into major world metropolises in the early to mid-twentieth century.
• A 1914 complex, custom-designed, window wall, consisting of a sheet copper-clad, wood perimeter frame and mullion system, with face-fastened exterior connector hubs, face-fastened copper glazing stops, and with operable rolled steel frame units inset within the window wall as operable sash, in a concrete frame building clad with terra cotta and cast iron, designed by Albert Harkness (rehabilitation was determined to not be feasible – we designed a custom copper-clad wood and rolled steel frame replacement window wall, installation completed in 2004)

OBJECTIVES
Describe some of the common construction types and assemblages of early to mid-twentieth century window wall/curtain walls.
List some techniques for evaluating their condition, performance, and evaluating the feasibility of rehabilitation.
Describe some approaches and techniques for rehabilitating various construction assemblages and types of early to mid-twentieth century window wall/curtain walls.

CS07b: The Hallidie Building: Rehabilitation and Repair of One of America’s First Curtain Walls
Speaker: Annie Lo Associate AIA, Mcginnis Chen Associates, San Francisco, CA USA
Co-presenter: Elisa Hernandez Skaggs, Associate AIA, Page & Turnbull

ABSTRACT
The Hallidie Building, designed by Willis Polk, is one of the first glass curtain wall buildings and is listed on the National Register. The building’s glass facade is hung a foot away from an otherwise conventional reinforced concrete building. The curtain wall was constructed out of a simple kit-of-parts consisting of steel angles, T-sections, and plates. The innovative facade design is juxtaposed with gothic ornamentation consisting of a diverse palette of materials including stamped zinc frieze panels, striated sheet metal pendants, and iron railings with lead brackets. This San Francisco landmark is named for Andrew Hallidie, inventor of the cable car.

The Hallidie Building is seven floors in height. The first three floors have ornamental balconies that span across the facade and are laced with zinc frieze panels. The building features a third balcony along the seventh floor and a decorative gothic cornice. Fire escapes with small balconies at each floor are located at either side of the building and are reminiscent of curtain cords.

The initial project scope was to repair the structural supports of the balconies and ladders at the fire escapes, which had become unsafe due to corrosion of steel outriggers and I-beams. Investigation of the curtain wall began at these locations, where the supports penetrated the facade, and developed into a review that encompassed the condition of all window units and the structural T-mullions that they connect to. The curtain wall assessment determined extensive deterioration of facade components due to oversights in the original design, including no allowance for thermal expansion and the lack of adequate flashing to prevent water intrusion at key locations. The curtain wall was found to be warped, due to the lack proper thermal expansion joints. Some of the cover plates, window frames, and sashes were corroded, affecting the alignment of the curtain wall and the operability of the pivot hinge windows. Extensive corrosion was observed where the structural elements of the balconies were fastened directly to the curtain wall. The alignment and existing supports of the facade structure were evaluated by the Structural Engineer, who recommended additional bearing and wind anchors at the interior of each floor to stabilize the facade. Curtain wall repair included in-kind replacement of the vertical plates, expansion joints, integration of proper flashing within the existing curtain wall, and repair of corroded members.
The ornamental metal of the Hallidie Building hangs from the balconies at the second, third, and seventh floor and also makes up the decorative cornice. The metal includes galvanized sheet metal pendants and zinc frieze panels stamped with alternating floral and bird design. The metals were in poor condition with severe corrosion. Galvanized sheet metal features were repaired or replaced in kind. Frieze panels were initially proposed to include a combination of repairs. Small repairs were to be patched with 1 lb. sheet lead, a malleable material compatible with the zinc. Larger repairs were to be patched with fiberglass. When the existing paint was stripped from the frieze panels, the fragile nature of the zinc was revealed, prompting a change in the repair methodology. Instead, the panels were repaired through a spray-application of fiberglass applied to the backside in order to reinforce them. Fiberglass has a similar coefficient of thermal expansion to that of zinc, and the repair method allowed a higher percentage of the original zinc to be salvaged.

All repairs and replacement elements were mocked up and reviewed by the local preservation commission. In addition to the structural and material repairs, an extensive color analysis was conducted to determine the original blue and gold colors of the facade.

OBJECTIVES
Participants will examine sensitive and compatible structural upgrades employed to stabilize and correct deficiencies in the original design of a curtain wall using the Hallidie Building (1918) as a case study. * Participants will assess lessons learned in the evolution of the approaches used to repair deteriorated decorative elements of the Hallidie Building curtain wall facade. * Participants will compare various decisions for repair as well as the pros and cons of selected treatments for the facade of the Hallidie Building.

CS07cs: Determining the Fate of the Houston Skyline: Studying Change in Mid-Century Modern High-Rises
Student: Urmila Srinivasan, University of Texas at Austin, Austin, TX USA

ABSTRACT
This study focuses on mapping the improvements made during rehabilitation and renovation of mid-century modern high-rises in Houston, Texas. Often known as the energy capital of the world, Houston boasts of the fourth largest skyline in the United States with over 400 high-rises, which are buildings taller than 35m (114 feet also approximately 12 stories). Notorious for tearing down mid-century high-rises like the Shamrock Hotel, Prudential Building, and the Houston Savings Building, downtown Houston currently has around forty high-rises that were built during the 1950s and 1960s. While some of them stand abandoned waiting for a sympathetic developer to change their fate and save them from demolition, several of them are still being used and have undergone successful rehabilitation.

Of the several building types and structures, high-rises are an important and integral part of most metropolises. Significant amounts of energy are invested in their construction, and it is extremely important for any city to ensure that they are retained, protected and continuously used from both a preservation and sustainability perspective. Some common problems faced while rehabilitating modern buildings are the significantly high amounts of toxic materials present in them. With their low levels of thermal mass and dependence on mechanical ventilation, they are less environmentally friendly. The most common issue that make developers shy away from them are their low floor to floor heights and narrow floor plates, which do not make them a potential case for a retrofit.
The first modern high-rise was the Melrose building designed by Lloyd and Morgan in 1958. The turquoise glazed ceramic tiled spandrels were replaced by bronze colored anodized aluminum panels, and the windows were tinted in 1969. Today the building stands vandalized and abandoned for more than a decade. The Texas National Bank building designed by Kenneth Franzheim in 1955 was considerably altered in 1998 when Kirksey re-skinned the first five floors with glass curtain walls. Contrastingly, the Southwestern Bell Telephone Company, designed by George and Abel Pierce in 1965, was adapted by Gensler in the 2000s for the Houston Community College. In this case the rehabilitation was performed in a more sensitive manner that recognized the integrity of the structure. Unlike many other cities, all the mid-century modern high-rises of Houston are not merely flat surfaces of glass curtain walls. Some of them have brise-soleils with deep set windows that protect the interiors from the harsh Texas sun. Therefore, these are not only a character defining feature, but are important as they improve the energy performance of the building, and would be an important element to preserve.

Preservationists often face the dilemma of retaining character defining features against making modifications that make the building more sustainable. This paper intends to study the alterations made to mid-century high-rise buildings in Houston, and outline the overriding factors for these changes. Have they been driven by preservation, sustainability, or just economics? It will also attempt to understand where they fall short from contemporary standards of preservation, sustainability, and building codes.

OBJECTIVES
Attendees can describe the common problems developers face while rehabilitating mid-century modern high-rises. * Outline the current trends in rehabilitating mid-century modern high-rises. * Elaborate with concrete examples the dilemma professionals face while trying to uphold preservation principles, and make the building more sustainable.

CS07d: Should the Single-Glazed Aluminum Curtain-Wall be Saved?

Speaker: Angel Ayón AIA, LEED AP, Israel Berger & Associates, New York, NY USA
Co-presenter: Pamela Jerome, AIA, LEED AP, WASA/Studio A,

ABSTRACT

60 Broad Street is a 41-story commercial structure in the Wall Street district designed by Emery Roth & Sons in 1960 and completed in 1961. Its aluminum curtain-wall skin is single glazed, originally featuring operable windows, which were subsequently secured shut. The curtain wall is the source of ongoing leaks. WASA/Studio A was retained to investigate the condition of the curtain wall and recommend options. In addition to archival research, probes at the 27thfloor and main roof provided hands-on information. Further probes confirmed that the weeps are ineffective and that the internal gutters have no end dams.

Can the performance of single-glazed curtain walls that leak heat, water and air be improved? Is there a reason to save single-glazed curtain walls? Why is it that we often consider glazed curtain wall a disposable item, when as preservationists, we are mandated to save original fabric? Should we not be considering these the way we would preserve a single-glazed historic window? Or are single-glazed operable curtain-walls an experimental but failed technology beyond repair?
Most clients would choose to replace an aging curtain wall with a more energy-efficient double-glazed skin. However, our client elected not to, and instead tasked WASA/Studio A to design repairs to improve its performance. This was additionally necessary as the Seventh Cycle Facade Inspection Safety Program (FISP) and report had identified SWARMP (Safe with a Repair and Maintenance Program) conditions. FISP is the New York City facade ordinance in which all buildings over six stories are required to undergo a critical examination by a licensed architect or engineer on a five-year cycle, resulting in a report that gets filed with the Department of Buildings. Any SWARMP conditions identified must be cured before the following cycle or they automatically become classified as Unsafe.

We designed the repairs to the existing single-glazed curtain wall for the first phase, which includes the 17th through 41st floors. The goal was to perform discreet interventions that enhance the performance of the curtain wall and prolong its service life. These include installation of silicone tape and wet seals, mechanical securing and sealing of loose spandrels, replacement of aluminum copings, and interventions to base flashing and counter-flashing at the main roof. To water-test our concept, a pilot project was performed at the 19th-floor setback. This resulted in some fine-tuning of the repair design. The client has now decided to implement the repairs throughout the building.

The paper will present the designs developed to implement a progressive replacement of the existing curtain wall, as well as the details of the repair option finally implemented. It will discuss the pros and cons of both and will suggest general recommendations for approaching similar tasks while in early-construction aluminum-and-glass single-glazed curtain-wall high-rises.

**OBJECTIVES**