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Restoring 20th Century Skyscrapers in New York: Woolworth Building, Chrysler Building, Lever House

The preservation of 20th century architecture presents many new challenges, unexplored opportunities and some inherent historic ironies. Where preservation is about saving significant historic buildings for the future, modern architecture is often about breaking with the past. Where the new architecture did not seek to be based on historic precedent but rather to be reflective of a new aesthetic, advancement of the machine and the social needs of a society, this new architecture has now become historic precedent and deserves to be saved. It is therefore not surprising that this new architecture requires a preservation philosophy that reflects the innovative aspects of its own original ideals. The answer for preservation must be found in the very origins of this modern architecture, not unlike earlier preservation philosophies found their basis in the appreciation of pre-industrial design and craftsmanship.

To rely for the preservation of modern architecture on current preservation principles and philosophies presents a fundamental dilemma. Developed during an era concerned with saving the art and craft of building in the face of the onslaught of the Industrial Revolution, these principles are not suited for safeguarding contemporary buildings designed to celebrate the very advancements of that revolution. The emphasis on traditional technologies, the intimate relationship between the architect and the artisan – whether expressed or implied – as opposed to the use of machine made materials, more economic substitutes or labor saving techniques are likely to be irreconcilable.

A new and appropriate preservation philosophy has to be based therefore on the very ideals that have given these buildings their meaning and form. That is to say that the significance will not be in the intricacy of its stone carvings or the mastery of its repousse copper but in the principles of the new design, the sleekness of the forms and the transparency of its architecture. Therefore the authenticity of the original design ideas has taken on an additional significance. If preserving historic architecture thus far was about saving the intrinsic value of the design and the craftsmanship, then for the architecture of the Modern Movement in particular it must be first and foremost about safeguarding the intrinsic value of the original design. In other words, the preservation of the design intent must be one of the central tenets for any new preservation philosophy.

Making the design intent an important aspect of the new preservation philosophy offers also new and intriguing opportunities for the design of adaptive and continued uses. Here is also a unique chance to reconcile the antagonism and separation between design and preservation. Design for and in historic buildings and districts, certainly in American practice, can be characterized, for decades now, by a contextual temerity. The very desire not to offend the historical context – or the preservation community for that matter – will detract from the strength of the original design. These stylistic adaptations or re-interpretations result in the very sort of eclecticism to which the modern movement objected. Design therefore must be a true partner in the preservation of the modern monument and working together to enhance the design intent is the true opportunity for architects and preservationists. This new cooperation could lead to "creative restorations". These "creative restorations" are not in the sense of Viollet-le-Duc by adding historically correct elements that should have been there but never were or in the fanciful manner of Disney but truly creative solutions that enhance the qualities and strengths of the original design and its intent.

Aside from the theoretical and philosophical challenges that lie ahead, there are a series of pressing practical and economical problems. The quintessential American building type, the skyscraper, chosen here, is emblematic. The sheer number and size of these high-rises, the new and often untested technologies used in their construction and their enormous commercial potential represent a synopsis of the significant and complex issues affecting the preservation of modern architecture. The three most significant and most frequently recurring issues seem to be:

1. Functional or economic obsolescence

Many 20th century structures were designed for a specific purpose and function. Once these functions in our rapidly evolving society become less desirable or disappear altogether these 'custom' buildings become functionally obsolete and are economically no longer viable. The increase in technological requirements have further aggravated this process and, for instance, office facilities designed before the 1970's are considered less desirable (Class B as opposed to Class A) and are under considerable pressure to change. While the upgrade may be physically possible it is likely to be costly and to generate considerable sentiment to alter the building architecturally to reflect its new technology externally. Unfortunately the more customized the building type is, the less flexible it is likely to be and the greater the possibility that the structure will become obsolete prematurely. This has sometimes resulted in the claim that these buildings were not designed to last.

2. Transparency

A unique architectural dilemma presented by modern architecture is the critical desire to express architecturally

Ill. 1
New York, Statue of Liberty by Auguste Bartholdi and Gustave Eiffel, completed in 1886

and visually the organization and structure of the building and its use. As a result the relationship between the inside and the outside is expressed in a largely transparent exterior wall making the interior an integral visual element. This has made it impossible to list or landmark the exterior without reaching some consensus or control over what the interior will look like in the future.

Related and important considerations are interior lighting and exterior glazing. The lighting makes the interior visible at night expressing that clarity of purpose, a feature very much in evidence in the architectural photography of that time. Where the complexity of the window mullions or the presence of interior window treatments like blinds or curtains reduce the transparency, the overall uniformity of the exterior appearance does remain critical.

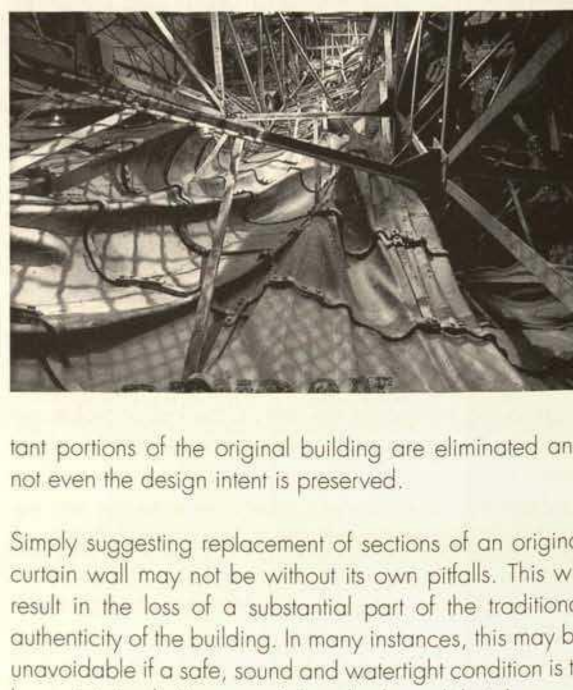
The glazing may also affect the overall transparency. Early curtain walls will most likely have single glazing with the actual glass not entirely perfect. Where retrofits are necessary the installation of not just dual or insulated glazing but also slight tinting or E-glass coating of the glass may become an issue. All this will affect the reflectivity, color and transparency of the outer wall and therefore the overall external appearance of the building not just during the day but also at night.

Besides the expense of necessary retrofits, the need to establish some degree of visual control over the interior architecture and how it affects the external appearance will continue to generate considerable discussion. In some instances this has been used as an argument to demonstrate early obsolescence (thereby advocating change) and leading to unnecessary expense, in other instances it has been used to establish the uniqueness and quality of the building.

3. Experimental technologies

With the advancement in building technology has always come the use of new and often experimental technologies and materials. Because of a lack of understanding of and experience with a particular material or system, today they may have performed unsatisfactory or may have failed altogether. This raises a series of important philosophical and technical questions that in scope go well beyond our earlier experiences. Is the entire assembly to be replaced because of the integral nature of the system? Is this still preservation? In-kind replacement, the goal of earlier philosophies, is not feasible or desirable if the earlier system has failed? Does this mean that the use of substitute materials is a given, particularly, if the primary interest is in the preservation and enhancement of the design intent?

Although these issues have important philosophical and financial implications, there is one significant and undesirable side effect. Wholesale refurbishment or replacement provides the opportunity to "modernize" the appearance of the building and a re-positioning of the real estate asset in the market place. In the process significant and important portions of the original building are eliminated and not even the design intent is preserved.



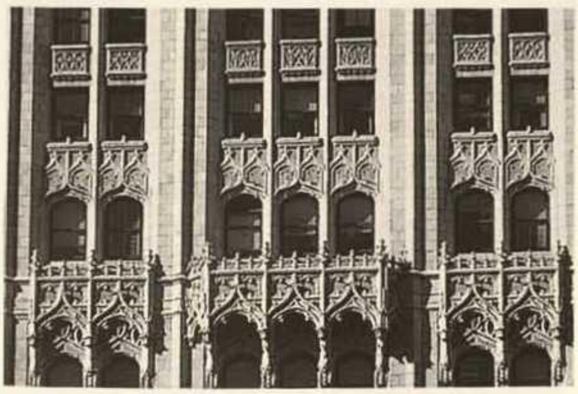
Ill. 2
New York, Statue of Liberty: The external copper skin is supported by forged bars, made originally out of carbon steel but now replaced with stainless steel members, that follow the different contours closely. Where originally felt was utilized to separate the dissimilar metals, now Teflon tape is found. The bars are connected to the structural frame and function not unlike the springs on a wagon. The movement is absorbed in the spring allowing the outer skin to move freely without being restraint by the more rigid structural steel frame.

Simply suggesting replacement of sections of an original curtain wall may not be without its own pitfalls. This will result in the loss of a substantial part of the traditional authenticity of the building. In many instances, this may be unavoidable if a safe, sound and watertight condition is to be maintained. However, it is to be hoped that the argument can be made that maintaining the overall visual intent is, after securing safe and sound conditions, the primary goal to be accomplished in the preservation and conservation of important modern architecture.

While the above considerations may apply also to the preservation of any modern building, not just high rises, several other issues, mostly peculiar to the US, that affect preservation need to be considered at this time. Building in America grew considerably during the period 1880-1930 both in the number of buildings erected as well as the scale and size of the individual structures. The economic growth and expansion that fostered the development of the skyscraper, also saw the growth of another American institution: the corporation. As a result many buildings that deserve conservation are historically identified with (and formerly owned by) American corporate giants. These buildings therefore express as much the talents of their architects as the prowess and power of its owners.

However, the economic climate and corporate thinking have changed. Changed fortunes, lack of willingness or ability to spend the appropriate funds has begun to affect and potentially endanger the survival of these often unique and idiosyncratic buildings. The lack of any government funding, subsidy or significant tax considerations requires frequently a combination of public pressure, innovative financing and unique public and private partnerships to enable any preservation. This may present a model for saving other significant monuments and particularly those of the Modern Movement. The very forces that made the construction of these buildings possible are to be harnessed for their preservation.

Aside from the lack of public funding there are also little or no statutory or regulatory powers to enforce designation or listing. The deeply engrained principle of (more or less absolute) property rights makes any regulatory intervention



difficult because of challenges to their constitutionality. The limited controls that do exist, are under considerable pressure because of the changed political climate and rise-emergence of the so-called property rights movement.

Having reviewed the challenges facing the preservation modern architecture and taking into account the peculiarities of the American system, it is worthwhile to look at aspects of the conservation of particularly three high rise buildings in New York City. The three buildings selected represent three different decades of the 20th century and three distinctly different stylistic periods: the Woolworth Building, the Chrysler Building and Lever House.

While the early American high rise saw many technological advancements, including the eventual total separation of the exterior envelop and load bearing frame, the architectural form and detail remained eclectic and reminiscent of an earlier period. Conversely a new aesthetic is introduced suggesting a new technology but one that still largely relies on earlier building practices. The Statue of Liberty unintentionally illustrates that dichotomy excellently: The conventional sculptural copper cladding (designed by the Alsatian sculptor Auguste Bartholdi) was attached to a unique structural frame (designed by Gustave Eiffel) using iron bars and straps. The copper skin and the wrought iron straps, separated by felt to prevent galvanic action, absorb the movement caused by either the wind or the temperature fluctuations. This structure which reflects technological innovation and which could be considered an early example of a curtain wall, appears to be traditional on the outside. Many high rises and buildings created subsequently represent this very same dichotomy. A large and diverse number of buildings, which, in a short period of time, went from 4 and 8 stories to 20 and 40 floors. Most downtown areas in the United States, especially New York, show this wide variety and the odd, but interesting, juxtaposition of size, style and shape.

The *Woolworth Building* is a good example of that divergence of style and technology. It was once the tallest structure in the world and probably still ranks as the highest (high) gothic building. Designed by the architect Cass Gilbert and completed in 1913 for the F.W.Woolworth Company at a cost of 13 million dollars, the structure consists of a riveted structural steel portal frame clad with a gothic exterior made of architectural terra cotta. The terra cotta masonry is carried directly on the structural steel. This type of construction, which is essentially load bearing masonry inserted into a structural frame, was widely used at the time. The use of terra cotta allowed a great deal of (repetitive) ornament to be applied.
In the restoration of the exterior terra cotta substantial sections of broken or stressed terra cotta were removed. The fracturing of the terra cotta did occur not only because of the corrosion of the structural steel anchoring and support systems but also because of excessive compressive stresses in the material. When tested with strain relief gauges, stresses from 1,500 to 4,000 psi were recorded,

Ill. 3

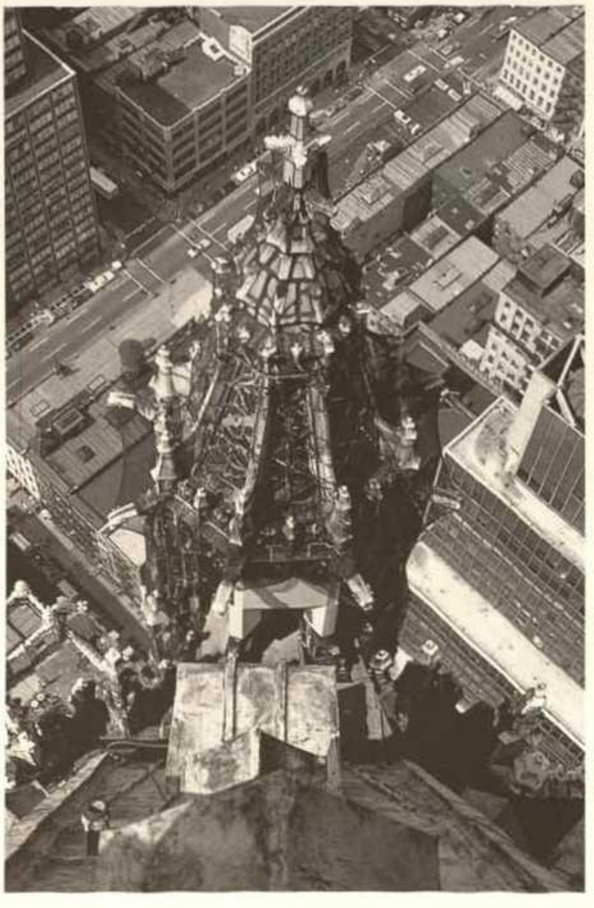
New York, Woolworth Building, detail of the façade: Substantial sections of the original ornamental masonry were replaced using cast stone units. In some instances the design was simplified while the overall detail and character was maintained. Where the masonry protruded significantly from the wall the overhang was reduced. Because of its height above the ground, the end result was hardly distinguishable from the original design.

Ill. 4

New York, Woolworth Building, c. 1913: Today the visual impact and significance of the Woolworth Building is not easily appreciated because the twin towers of the World Trade Center overshadow this 54-story building. When completed in 1913 after the designs of the architect Cass Gilbert, the building was the tallest structure in the world for 17 years. The steel structural frame is clad in its entirety with architectural terra cotta, which is backed with brick to form a wall that is some 12 to 18 inches thick (30 to 45 centimeters). This masonry is supported on the steel frame but has no relieving joints or shelf angles.

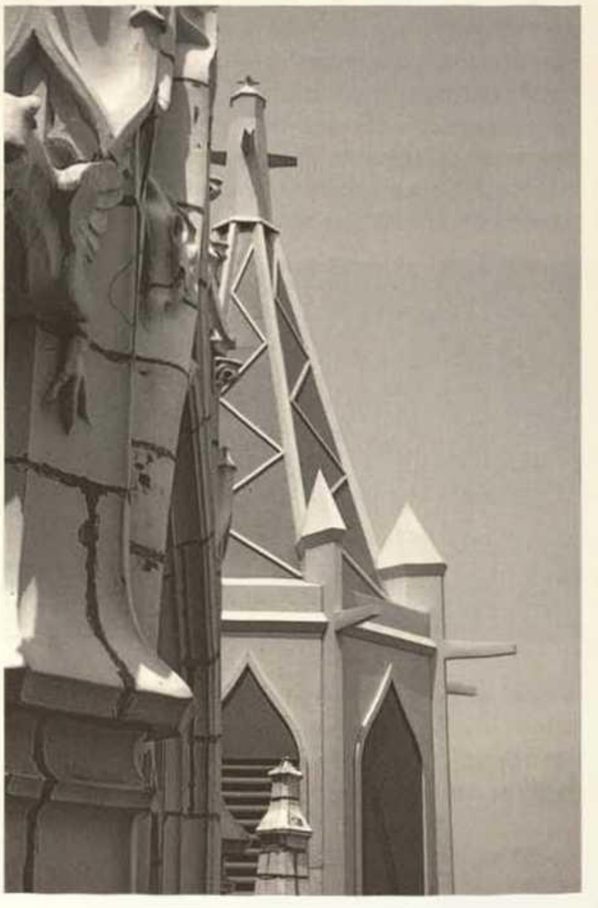
well in excess of acceptable safety standards. The volumetric expansion of the terra cotta, which was caused by moisture and re-hydration of the fired clay was tightly restrained by the existing wall construction and caused pressure to build up. This is another example where the combination of technologies led to some unforeseen interface problems. Cutting every other horizontal joint to the full depth of the terra cotta block, some 4 inches, was found to be the best method to bring the pressure down to acceptable levels and minimize damage to the masonry. Where replacement units were necessary, high quality cast stone blocks which simulated the original color and detail closely, were used.

The decision to choose cast stone as replacement material rather than terra cotta is the type of decision that will



Ill. 5

New York, Woolworth Building, secondary tower: At the very top of the building, the main tower is flanked on its four corners by small secondary towers, which Cass Gilbert named "tourelles". While exceedingly important in the silhouette of the building, the tourelles themselves have no particular purpose with the exception of the one on the northeast corner, which is a chimney for a boiler room that once existed in the basement of the building. Because of their severe exposure and inaccessible location, all tourelles were in poor condition and required substantial work.



Ill. 6

New York, Woolworth Building, restored secondary tower: While replacing the tourelles was considered, the complexity, long term durability and the overall cost of such an effort was determined to be prohibitive. However, it was recognized that these tourelles played an important role in the overall appearance of the building. The decision was made to stabilize the original terra cotta where possible and to create a new aluminum cladding that would resemble but not mimic the original detail. When viewed from close, the new detail appears oversimplified. The intent, however, was to maintain the overall appearance when observed from some distance (right side).

become more frequent in the restoration of a modern building where economic obsolescence of a material is likely to be as critical as its physical condition. Cast stone was selected for economic, technical and logistical reasons. With no large production facility for terra cotta available at the time (thousands of replacement units were required) quality, turnaround and delivery time became critical. While obtaining a replacement unit in terra cotta was expected to take as much as 6 months, a cast stone block could be delivered in two weeks and at a lesser cost.

The repair of the tourelles (a French term used on the drawings of Cass Gilbert) or small towers, which extend along the four corners of the main tower from the 47th to the 52nd floor, are examples of "creative restoration". While one tourelle was a chimney at one time, the other three were decorative. With separate steel frames attached to the main structure and clad in terra cotta, the tourelles were in poor condition because of severe exposure and their inaccessibility for maintenance.

After considerable study of various alternatives which ranged from complete elimination to complete rebuilding in-kind, a modified replacement system that evoked the original design was selected. After repairing the structural steel and filling the masonry voids where necessary, a new aluminum panel system was designed to enclose the entire tourelle. Because the metal fabrication process allowed only for bending shapes and applying minimal detail, all original architectural detail had to be simplified and compressed to its visual essentials in such a manner that the overall architectural articulation and appearance was maintained. Colors for the baked finishes of the aluminum were not just used to match the original detail but, like the original design, enhanced the articulation of design with its profiles and moldings. On close observation the differences between the new and the old is very apparent but when moving further away the distinction becomes less and less obvious. When seen from the ground or when compared with a photograph taken directly after completion of the original construction, the change is hardly noticeable. A concern that the new surfaces would become more noticeable over time because of their smoother finish has proven to be unwarranted.
While the uniqueness of the original architectural composition and detail was recognized, it could hardly be observed from the ground, some 54 stories below, or from further away. Once it was determined that the primary sig-

nificance of these tourelles was in the overall silhouette of the building, a solution or a "creative restoration" was found. The simplification of form supported the overall appearance and silhouette or in other words the design intent of the original architecture.

The 75-story *Chrysler Building*, another early skyscraper icon, was completed in 1930 after the designs of the architect William van Alen. While built for Walter P. Chrysler (not his company), the architecture of the building and its decorative detail recalls the automobile background of its owner. A riveted structural steel frame carries an exterior cladding made of black, gray and white brick backed by structural clay block. The entire assembly, some 12 to 16 inches in thickness, has no provisions for shelf angles or expansion joints.

One of the critical elements that need to be understood prior to any restoration of an early skyscraper is the interaction between the steel frame and the exterior cladding or curtain wall. Hybrid technology, earlier construction methods or code requirements get mingled in the various solutions. In the early masonry clad high rises load bearing masonry technology and detailing was rather indiscriminately transferred to steel framed construction. Little or no accommodation or adaptation for different behavior or performance characteristics was made. For instance, it is not entirely clear when the first expansion joint was introduced but it was probably not much before the end of the 1920's. Similarly early metal and glass walls use masonry technology to provide the necessary fire resistance.

Masonry cladding of the Chrysler Building, like other buildings of that period, has no provisions for thermal expansion and contraction. This becomes particularly critical at the corners, where combined with other internal pressures; long vertical cracks are likely to develop. The resulting water infiltration causes structural steel columns to corrode, thereby further aggravating the cracking and the subsequent water entry. The masonry separated and lost lateral restraint, a potentially unsafe but rather typical condition for this type of construction. Removing the existing corner masonry, repairing the structural steel and rebuilding the masonry with proper expansion provisions was a major but necessary undertaking. By introducing the corner expansion joints and by separating but reattaching and anchoring the masonry, better thermal movement can occur. Visually the intervention can be minimal if detailing is carefully worked out and new and old materials are not indiscriminately mixed together.
With the increase in the size of buildings and the more frequent and wider use of non-traditional materials, the interaction of dissimilar materials and technologies, particularly under severe conditions will cause serious problems. For instance, stainless steel, particularly chrome nickel alloys, became widely used in the 1930's in the USA. The distinctive ornamental sheet metal on the Chrysler Building was made from an early German stainless steel alloy marketed in the United States under the name 'Nirosta' and is similar to our type 300 series. The metal itself has remained quite unaffected by the aggressive atmospheric conditions but the connections between the metal sheets and with the masonry were clearly affected. Most problematically were the areas of the spire where the metal directly abutted the masonry or the parapet walls. The differentials in expansion and contraction caused the metal to rip the masonry apart resulting in water infiltration. Reinstallation of the metal sections, providing expansion and sliding joints for the metal combined in some instances with a secondary water proofing membrane proved effective. With simply buffing the metal a "shiny" appearance was restored.
Because the large majority of pre-World War II high rise buildings use traditional masonry supported on a structural steel frame, repair and replacement can follow mostly traditional methods. After the war with the changes in construction methodologies are more pronounced and the predominant use of metal and glass and the elimination of the so-called wet trades (that is the masonry trades) the problems change and overall performance of the building system becomes more critical. Much of the experience and understanding is gained over a shorter period of time with little opportunity in between different projects to improve the performance.

Ill. 7

New York, Woolworth Building after restoration: When the top of the tower is observed from some distance away, the distinction between the new and the old begins to disappear. The new tourelles with their new aluminum cladding resemble the original design sufficiently to support the overall appearance as intended by the original architect Cass Gilbert without having duplicated his design exactly. The design intent has been maintained.

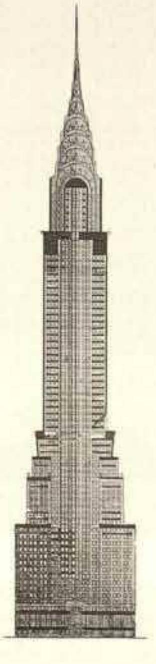
While *Lever House* is generally seen as one of the first curtain wall buildings, some experience was acquired during the construction of the UN Secretariat Building between 1947 and 1950. The wall sections were partially modified during construction. The excessive wind and water pressures generated during a hurricane exposed several inadequacies in the original design and led to the addition of gaskets and weep holes. To achieve sufficient rigidity carbon steel channels were incorporated

Ill. 8

New York, Chrysler Building: Completed in 1930 after the designs of architect William van Alen, it was for a very short moment the tallest building in the world. The structural steel frame of the building has been clad with a glazed brick, either white or black in color, which has a structural clay block backing. No proper shelf angles or relieving joints exist in the entire exterior wall. All parapet walls have been covered with stainless steel called 'Nirosta' not dissimilar to our contemporary 300 series.

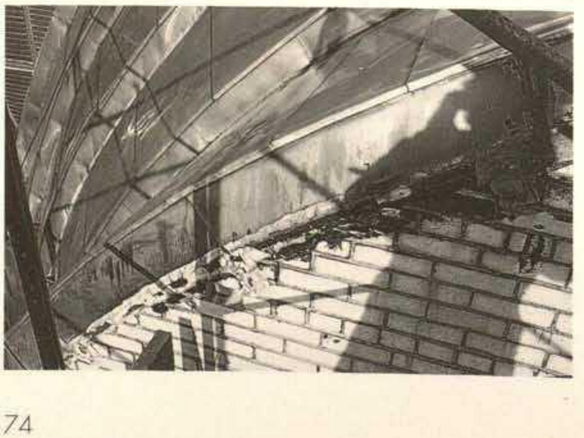
Ill. 9

New York, Chrysler Building, detail of the façade: The sheet metal ornaments that adorn the different corners. These distinctive ornaments, which recall the automobile past of the first owner, Walter P. Chrysler, were generally in good condition.



Ill. 10

New York, Chrysler Building, detail of the roofing: The lack of proper provisions for movement is also found in the interface between the sheet metal and the masonry. Where the stainless steel spire meets the masonry, the differential thermal movement of the dissimilar materials causes havoc. The sheet metal tears at the masonry making this joint difficult to keep watertight.



into the early curtain walls. While this became a standard solution for the first decade, it also resulted into a fundamental problem because of corrosion caused by water infiltration or condensation. The corrosion forces sections apart allowing additional water to enter and the process accelerates.

The visual impact of these early skyscrapers is not easily appreciated today because the surroundings have so drastically changed. For example, the Woolworth Building was once the tallest building in the world but now seems dwarfed by the twin towers of the World Trade Center. Lever House is now surrounded by many curtain walled office buildings but, when constructed, Park Avenue was lined with large residential buildings dating from the beginning of the 20th century. These Beaux-Arts style masonry buildings stood in sharp and dramatic contrast to the gleaming and shiny glass box of a soap company.

Designed by Gordon Bunshaft of Skidmore Owings and Merrill and built between 1950 and 1952 the building is an example of the corporate architecture of post World War II. The structural steel framing and floor system was separated completely from the glass and metal curtain wall, in essence establishing the concept of core and shell. The separation went as far as moving all structural supports out of the outer wall and eliminating any distinction between primary and secondary mullions. To stiffen the wall vertical structural steel U-channels were attached to the horizontal spandrel beams. Horizontal glazing

angles were attached to the sides of the verticals. The glazing was placed in the rabbits and secured against the horizontals and verticals with carbon steel glazing stops. The assemblies were covered with stainless steel covers. The wall had no operable sections – one of the first of its kind – and was wet glazed. A system of flashing and weep holes allowed water that may have entered to drain out.

While remarkable in its simplicity the stick build curtain wall of the Lever House is still a hybrid technology and very reminiscent of the earlier masonry walls with its system of flashing and weep holes. Where the Woolworth Building may be described as an assembly of eighteenth-century brick houses in a steel frame, the curtain wall of Lever House can be characterized as a series of early storefronts in the air.

At the location of the spandrel a concrete block wall was maintained as a fire stop, as required by the building code at the time. A small section of block was more or less suspended below the slab while the remainder was placed on top of the slab. The front of the block wall was parged and painted and served as a 'shadow box' for the tinted and wired vision glass that was used at the spandrel level.

Very quickly after completion the wall began to show problems. The limited life span of the early caulking and sealant compounds had undoubtedly something to do with the need to reseal. By the 1960's apparently the corrosion of the carbon steel glass stops and rabbits as well as the wire embedded in the spandrel glass was sufficiently advanced that glass breakage became a common occurrence. The corrosion also forced the screw-mounted stainless steel covers to open further, allowing even more water to enter. While an on-going program of glass replacement was instituted, it was not easy to match the original glass consistently resulting in the wide variety of colors existing in the spandrels today.

The on-going and progressively worsening conditions recently led to a re-examination of the curtain wall and the development of a repair and replacement strategy. The underlying philosophical approach essentially accepted the need to maintain the overall visual appearance and design intent of the curtain wall but identified the necessity to use contemporary technology and materials to achieve a better performing solution.

Over a period of time all ferrous glass stops and rabbits will be replaced with non-ferrous sections. The main vertical structural steel channels, which were found to be in a reasonable condition, will remain but will have to be cleaned and painted. For different reasons, all vision glass, spandrel glass and stainless steel covers will be replaced. While the wire glass will be replaced because of its unsatisfactory performance, the vision glass will not be salvaged because it would require extraordinary effort to minimize breakage. Because the existing stainless steel covers have been severely damaged and bent a new cover will be installed to restore the machine like precision that is such an integral part of the design intent of the original building.

The result of this curtain wall repair and replacement project, once completed, will be an elevation that closely resembles the original appearance. However, the amount of original material that remains in the exterior wall will be minimal. In the context of traditional preservation philosophy the authenticity of the wall could be questioned and most likely would have to be described as a reconstruction.

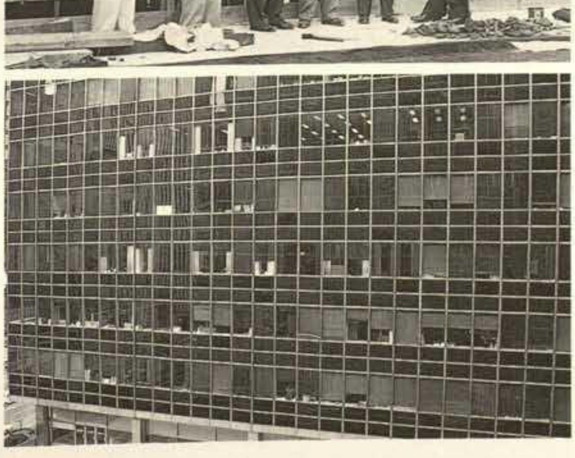
The principles to guide and, to some extent, the language to describe the safeguarding of the architecture of the more recent past can not be the same as for earlier and more traditional architecture. New attitudes and concepts that reflect our economic realities as much as the ideology of the original architecture must be established. The architecture of the Modern Movement and many of its precursors broke the rules of eclecticism to forge a new aesthetic. The new preservation philosophy must also break with earlier precedent to be able to save for the future the architecture of the 20th century.

Ill. 11

New York, Lever House: Designed by Gordon Bunshaft of Skidmore Owings and Merrill at the end of the 1950's and located on Park Avenue, the building with its gleaming glass and stainless steel curtain must have been very striking among the masonry Beaux-Arts-style buildings that lined Park Avenue at the time. Now surrounded by glass and metal curtain wall buildings of a later vintage, the significance of the building as a pioneer and icon of modern architecture is much harder to appreciate.

Ill. 12

New York, Lever House: The curtain wall was installed piece by piece. Because of code requirements at the time the sections of spandrel glass were to be backed with masonry. The back of the masonry was treated as a "shadow box" for the glass, which was vision glass with wire mesh embedded. The overall design and technology of the curtain wall was simple.



Ill. 13

New York, Lever House: The gradual replacement of spandrel glass necessitated by the breakage has led to a wide diversity of colors. In the proposed restoration all glass will be replaced and match the original color as much as possible. Although virtually all exterior materials will be replaced in their entirety, the overall detail and dimensions of the original curtain wall will be maintained.