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Innovation for Preservation

Conserving Newer Built Heritage in the United States

RMHF Final Report

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The Richard Morris Hunt Prize is not simplya travel grant. It is an unparalleled opportunity to deepen one's knowledge of architectural heritage and to make decisive contacts.

At the beginning, my research subject was focused on the ways recent architectural heritage was preserved in the United States. As an instructor in the graduate program in Twentieth-Century Architecture and Preservation at ENSA Paris-Belleville since 2006 and newly appointed as assistant professor at ENSA Toulouse – all the while pursuing doctoral studies and working as a consultant with architects commissioned with the restoration of 20th-century architectural works – this research theme appeared especially promising to me. During a preliminary phase, my approach was rather technical, in continuity with the doctoral research I had begun at the CNAM. That research concerned the restoration of lightweight building façades from the 1930-1960 period, an illustration of the contradiction existing between architectural conservation and conformity with new standards of comfort and energy consumption.

However, by the time my trip to America began in July 2010, I had to face other evidence before me: I would have to broaden my subject and convey the way preservation functions in the United States in its ensemble. I was particularly inspired to learn about systems for establishing preservation criteria, establishing categories for the types of renovation choices made by Americans, documentation such as HABS drawings and NPS technical briefs. I also ended up learning much about the way architecture firms present preliminary studies (or "Historic Structure Reports") as a tool for efficient communication with a range of different institutions.

The investigational methods of my research came in place little by little. Adding complexity to my original enquiry – "Do technical innovations lead to better preservation of recent built heritage?" –, I was curious about the role played by historic preservation organizations, about the instruction given in historic preservation masters programs, the practices of specialized architects, etc. Benefitting from my numerous visits and meetings, I also gained a perception of the widely varying real situations englobed by the notion of "20th-century built heritage." I was able to hone my critical perspective on subjects such as interpretation and the contrast or compatibility of contemporary interventions within existing structures.

During my extraordinarily dense phases of research travel – three two-month trips, around fifty cities and 300 buildings visited in twenty different states, multiple weeks spent in New York, Chicago, Los Angeles, and San Francisco – I benefitted enormously from logistics and networking provided by the American Architectural Foundation, as well as the hospitality and generosity of past American Fellows. These travels encourage the creation of lasting personal and professional bonds within the RMHF community. These friendships are regularly renewed through biannual seminars and reunions organized by Michèle le Menestrel Ullrich, RMHF founder, who is able to gather together her "petits" with so much warmth.

Eight years after my first departure for Washington, D.C., I take stock of the benefits of the Richard Morris Hunt Fellowship Prize. First of all, in my teaching. The knowledge I acquired and the perspective I gained on the conservation and restoration of recent built heritage allow me to share with tomorrow's young professionals a more profound sense of how to work creatively. My American experience, both academic and reality-based, has inspired me to follow a similar approach to the large-scale restoration projects on which I am consulted professionally. My involvement in international research networks has also greatly benefitted from my experience in the United States. Today, some stimulating new perspectives are opening up. It is essential to continually renew ties between the recognized professionals who make up the Richard Morris Hunt Fellowship and the network of research instructors in the preservation field in France, always with the goal of bringing more students and architects to consider and appreciate their heritage, whether older or more recent.

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English translation by Joseph Warner

ACKNOWLEDGEMENTS

The Richard Morris Hunt Prize was created in 1990 through the will and tenacity of Michèle le Menestrel Ullrich and the American Architectural Foundation, an entity emanating from the American Institute of Architects. It carries the name of the first American who came to France to study architecture at the École des Beaux-Arts de Paris, initiating a long tradition of mutual exchange and inspiration between the two countries. For 24 years, a jury of recognized peers has attributed this prize alternatively to French and American architects working in the conservation of architectural heritage. Laureates are selected equally for the excellence of their competence levels and the potential offered by their research proposals. They complete a six-month voyage in the partner country, encountering professionals from the conservation/restoration fields (architects, curators, entrepreneurs), directors of institutions, researchers, and a variety of other personalities. New laureates are welcomed and advised by former laureates who fulfill important roles during the travel period. The program is about creating professional ties, sometimes even bonds of friendship. It is the durability of these links that ensures the future vitality of the RMHF. The laureate is financially supported by the Lafarge group, whose major support – 25,000 dollars – meets the program's high standards. Finally, the laureate receives logistical support from the managing teams of the Richard Morris Hunt Fellowship in planning a very dense agenda. These exceptional circumstances create a unique opportunity in a career, whether as a way to further develop one's ongoing education and training, or in the context of a professional sabbatical. It offers a chance to encounter the finest experts in the preservation field, to visit the most magical places in the company of property owners or curators, but also, and most importantly, to open up to different practices, philosophies and viewpoints. Two laureates have written that the RMHF is a moment of inspiration for future professional leaders in preservation. This inspiration far surpassed my initial expectations, and it will surely take many years to truly measure the depth of all the information and observations amassed during these six months. Echoing experiences shared with me by yet another laureate, I indeed believe that the RMHF not only changed my career, but my life.

I must therefore express my gratitude to the members of the France Managing Team of the Richard Morris Hunt Prize. This group is coordinated by Michèle le Menestrel Ullrich, whom I thank for her unfailing support and crucial advice, and Florence Jeanjean, whose energy deserves to be saluted. In the United States, I particularly thank Ron Bogle, President and CEO of the American Architectural Foundation, and Liz Blazevitch, AAF Program Manager, who accompanied me daily by supplying ideas, advice, and contacts. I owe my gratitude to the members of the jury for the confidence they placed in me, choosing me from a pool of five high-level candidates. Finally, I must thank Léopold Lombard of the Lafarge group. I am grateful to all the individuals whose names are mentioned in an annexed list which I hope is complete, who exchanged with me over these six months, sharing their time, knowledge, and attention. I equally salute the many I met "on the road" and who have since become friends. This research would not have been quite so driven without my conversations with American laureates. I am particularly indebted to them for the generosity they demonstrated as they received me in their offices, showed me their

jobsites, put me in contact with other experts, offered me lodging and other invitations, and gave me the opportunity to present my research during lunch seminars, leading to work on an article for *Architectural Preservation Technology Bulletin* in July 2011. I also thank Nicole Roux-Loupine, Director of the École nationale supérieure d'architecture de Toulouse, as well as my colleagues, for the enthusiasm they demonstrated in regard to this prize, and the freedom they allowed me to organize and prepare for this extraordinary voyage [Figure 1].

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GLOSSARY OF TERMS

Adaptive Reuse: conversion of a building by changing its purpose and bringing it into compliance with standards

Advocacy: activity of defending architectural heritage with the public, among decision-makers, etc.

Authenticity: refers to original materials and features

Conservation: activity aimed at maintaining and repairing original materials and features

Designation: act of recognizing and protecting a building by registering it on a national or local inventory

Fifty-Year Rule: belief that a building is worthy of consideration for protection measures only once it has attained 50 years of age

Historic Preservation or Preservation: practice of safeguarding buildings with architectural or historical interest (from protection through restoration)

Incentives: advantages (mainly financial) to facilitate financing the safeguarding of protected buildings

Integrity: attribute of an edifice whose original materials and systems are still in place

Fundraising: raising monies and calling for donations, one of the principal means of financing architectural preservation

MIMO: or "mid-modern", refers to architecture or design from the 1950s and 1960s

Mitigation measures: interventions intended to compensate for the modification of parts of protected buildings

Modern Architecture: 20th-century architecture, often exhibiting a purity of style in rejection of conventional classical ornamentation

Preservationist: an individual, usually a specialist, involved in the protection of built heritage

Protection: action undertaken by a national or local institution to acknowledge the particular qualities of a building

Recent Past: refers to more recent architecture, particularly buildings erected in the 1950-1970 period

Reconstruction: recreation of previously demolished parts of a property for interpretive reasons

Rehabilitation: alteration or enlargement of an historic structure to ensure its continued existence

Resource: refers to a building registered and inventoried as a protected edifice

Restoration: returning to a state of existence at a given period by removing traces of other periods

Retrofitting: can also be expressed as "standards compliance"

Secretary of the Interior's Standards: best practices rules for protected buildings as set forth by the Department of the Interior, of which the National Park Service is a part

Significance: degree of historical or architectural importance of an edifice

Survey: survey drawing and diagnostic report on a building

Tax credit: tax deduction to help finance the safeguarding of protected buildings

RESEARCH SUBJECT

From a French perspective, the United States does not always appear to be a paragon of heritage preservation. Its rather short history in comparison to our own, its pioneer attitude resolutely turned toward the future, the visceral attachment to private property and liberty which seemingly defines its citizens might seem to contradict the very idea of architectural and urban conservation.

The notion of heritage is ordinarily associated with a history and a collective memory which one seeks to preserve and transmit. The architectural quality of an edifice, its exceptional or innovative character, or still yet the fame of its architect can equally give a building a form of recognition among specialists, thus protecting it from demolition or alteration. For the last couple of decades, we have witnessed increasing interest taken in more recent buildings or urban ensembles – that is to say, those built in the second half of the 20th century – whose historical value or exceptional quality does not always draw consensus. A disconnect from the notion that heritage only concerns historic buildings strictly speaking and an accompanying trivialization of objects of remembrance call into question established doctrines and, along with them, traditional practices and techniques of conservation-restoration.

The research presented in this report was carried out in the United States between July 2010 and September 2011 in the scope of the Richard Morris Hunt Fellowship. It focuses on a few questions posed by the notion of "recent past." As I became familiar with the workings of historic monument protection, with issues related to conservation, with the training and practices of professionals, etc., my initial range of observation of recent heritage was broadened to include more ordinary buildings. Through my meetings and visits, it became apparent to me that the conservation of innovations in construction – my initial subject –, while certainly fascinating, represented only one aspect of the vast issues surrounding recent heritage. This document attempts to render the full scope of these questions in summary form.

After reflection, it appeared to me that the best method for sharing the extraordinary knowledge acquired on modern American architecture and its conservation-restoration would be two-fold. First, I created a travel journal of photos and texts documenting the 180 buildings I visited over the course of 6 months. Most date from the 20th century; the preservation questions they pose are presented here. Stretching beyond iconic buildings by great masters, whose current state sometimes still remains unappreciated, my interest was then directed toward non-monumental, everyday architecture. From office buildings to residential subdivisions, from campuses to public spaces, from roadside attractions to "Googie" constructions, it became clear to me that Americans are more attached to their past than I had once thought.

ORGANIZATION OF THIS REPORT

To manage the vast amounts of information gathered during the research period, topics are treated on three levels corresponding to issues related to protection, followed by typical examples, and finally technical responses for preservation.

In the first part entitled "The Organization of Heritage Protection in the United States," the research presents information about how preservation institutions function in the United States. In France, American historic preservation is largely unknown: its associated organizations, financing systems, the practice of safeguarding on a day-to-day basis. Without attempting an exhaustive treatment of a subject already often addressed by RMHF Fellows in their reports, this first section sheds some additional light on how preservation is organized. After a brief history of the events leading to the legislation passed in 1966 in spite of an American culture little inclined to consider its past, we mention the tools used for protection: preliminary studies and surveys, classification methods, and the standards and guidelines established by the Secretary of the Interior. The research then outlines the types of training giving architects access to the historic preservation field, as well as the system for acquiring AIA qualification and its entailed continuing education. A succinct presentation of a few architecture firms gives an idea of the lessons which can be learned from this experience. Finally, the research lays out the problem of adapting buildings to current regulations regarding accessibility, security, and, above all, temperature and energy consumption.

The second part of this study, "Issues and Problems with Recent-Past Preservation in the United States: Case Studies" is briefer. Its thematic approach is intended to highlight current issues of 20th-century heritage conservation. By laying out the range of questions elicited through our study of both iconic buildings and more minor structures, we attempt to demonstrate problems specific to the conservation of buildings from the recent past and thus offer some directions for future research.

The third part of the report, "Innovate to Preserve," explains techniques of conservation and restoration. Ongoing technical progress in countries such as the United States leads to perfecting state-of-the-art tools for the conservation and restoration of 20th-century heritage. Through several detailed case studies, we demonstrate that the safeguarding of recent architecture is possible by combining historical and scientific research, materials produced through industrial innovation, and the sophisticated execution skills of professional companies. It must be kept in mind that constituting a knowledge base on the conservation-restoration of modern architecture is ongoing. This chapter therefore seeks to bring some of this information together as a contribution to this domain of understanding. As a way to conclude, we observe that state-of-the-art tools and materials are often useless without the corresponding manual know-how: this, no technology will ever be able to replicate.

PART 1: ORGANIZATION OF HERITAGE PROTECTION IN THE UNITED STATES

Introduction

This chapter concerns the institutional organization of preservation in the United States. More generally, it examines the protection of heritage from the recent past in relation to older built heritage.

I. LEVELS OF MONUMENT PROTECTION IN THE UNITED STATES AND THEIR EVALUATION CRITERIA

Brief summary of the background of historic protection in the United States

In the United States, the consideration of historical patrimony is closely linked to the specificity of American culture. We review here the different stages according to which historical and architectural heritage is recognized.[1] For the sake of clarity, we also provide a table summarizing the main dates [Figure 3]. The recognition of monuments and sites had a difficult time getting underway; it is taking place gradually. The first examples of safeguarding demonstrate patriotic attachment to buildings with symbolic weight in the history of this young nation. Popular mobilization led by historical societies against the demolition of Independence Hall[2] in Philadelphia in 1816, the rescue of George Washington's home, Mount Vernon, by the "Ladies" around 1853 (see Appendix for more information of these two cases), or the protection of Civil War battlefields through the efforts of veterans, such as Gettysburg, protected as a National Military Park in 1895[3] – only 32 years after the famous battle –, demonstrate this affection. From the end of the 19th century up to 1906, it was the breathtaking landscapes discovered by pioneers or sites that relating to recent history that were protected, as evidenced by the creation of the Yellowstone Nature Reserve in 1872.

In 1906, the Antiquities Act was passed in the United States under the Theodore Roosevelt administration. [4] It institutes the National Monuments, which complement the national parks. Certain prehistoric, pre-Columbian and Indian sites, geological or botanical curiosities, as well as forts owned by the federal government – or sometimes by private landowners – began to be protected.[5] Unauthorized excava-

[1] This historical summary placing the important dates relating heritage protection in France and the United States in parallel is primarily drawn from one of the most complete American works on the subject: N. Tyler, *Historic Preservation: An Introduction to its History, Principles, and Practice* (New York and London, W.W. Norton, 2000; 2nd ed., 2009), as well as F. Choay, *L'Allégorie du Patrimoine* (Paris: Éditions du Seuil, 1992). Other sources were used for the writing of this article. Among them, we cite: R.A. Young, *Historic Preservation Technology* (Hoboken: John Wiley & Sons, 2008); E. Connally, "Philosophie de la conservation et politique de restauration" (in *Les monuments historiques de la France,* pp. 2-8); and J. Rogers, "National Park Service" (in *Les monuments historiques de la France*, nº 173, March-April 1991, pp. 9-15).

[2] The Pennsylvania State House, formerly the state capital, is the site of the signing of the Declaration of Independence on July 4, 1776, and the ratification of the United States Constitution on September 17, 1787. Built in the 1750s to house the colonial assembly, it is one of the country's oldest and most significant historic structures.

[3] War veterans saw to it that Congress took measures to preserve the major battlefields, which led to the acquisition of thousands of hectares between 1890 and 1899 to create the first five National Military Parks.

[4] This date also corresponds with the date of the France's legislation of 21 April 1906 which organized the protection of natural sites and monuments of an artistic character. This legislation was passed thanks to the initiative of the Ministry of Public Education, Fine Arts, and Religion, which instigated the creation of a Departmental Commission in charge of establishing a list of "natural sites and monuments of an artistic character" whose "conservation presents an interest for the common good."

[5] Thanks to the creation of the National Monuments to protect "historic and prehistoric structures, and other objects of historic or scientific interest" Designations are made in response to proposals by the President or Congress. They number 117 at the present time. The oldest National Monument is Devil's Tower in Wyoming, designated by President Theodore Roosevelt in 1906. Among recently protected sites, we point out the African Burial Ground in New York, 2006 [https://en.wikipedia.org/wiki/List_of_National_Monuments_of_the_United_States consulted 5 September 2015].

tions of sites with the purpose of looting for objects or vestiges they contain, as well as degradation and destruction became punishable by law.

In 1916, the U.S. National Park Service (NPS), an offshoot of the Secretary of the Interior, was created for "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."[6] Its scope extends only to federal properties. The NPS exists primarily to manage the oversight and maintenance of National Parks and National Monuments, including the buildings they include. Beginning 1933, one of the missions of the NPS is to document historic sites, buildings, and machines by means of surveys – drawings, photographs, descriptions[7] – as a response to the rapid deterioration of the patrimony as a result of the economic crisis. This census work, now largely available online from the Library of Congress, has provided the basis for an inventory of historic buildings that took shape in the 1960s.

As early as the 1930s, historic districts were created in the United States under the impetus of cities. In 1935, F.D. Roosevelt submitted the Historic Sites Act for Congress's approval, which was to establish as "*politique nationale la préservation pour l'usage public, des sites historiques, des bâtiments, des objets d'importance nationale pour l'inspiration et le bénéfice du peuple des États-Unis*".[8] The 1935 Act established the basis for the protection of sites, buildings, and objects of national importance for public use and created National Historic Sites, the scale of which is smaller in comparison to National Monuments. The first example is the Jefferson National Expansion Memorial in St. Louis, Missouri, designated in 1935, where E. Saarinen erected the famous Gateway Arch in 1965.

The National Trust for Historic Preservation was created by Congress in 1949. It is intended to promote the active and financial participation of the public in the preservation of sites, buildings, and protected objects. It provided the United States with a powerful organization that would become a true institutional partner.[9]

In the early 1960s, the NPS established the National Historic Landmark designation (NHL), a substitution for National Historic Sites, for which the government recognizes outstanding historical importance. [10] This recognition is intended to encourage property owners to preserve their property, serving thus as an alternative to the purchase of historic sites by the federal government in order to preserve them. The Mission 66 campaign, organized on the occasion of the 50th anniversary of the NPS, authorized the construction of dozens of interpretative centers – or visitor centers – to attract the public to protected sites and parks.

The protection of individual buildings is the most recent of these implementations in the United States, a paradox from the French point of view, but which is rather logical in view of the importance of private property in America. It was not until 1966 that the U.S. National

[6] Declaration by President Woodrow Wilson, 25 August 1916.
[7] *Historic American Buildings Survey* and *Historic American Engineering Record* (HABS and HAER).
[8] Historic Sites Act, 1935, Article 1.

[9] Inspired by the England's National Trust, the NTFHP identifies sites and works for their protection at the national level, supports and strengthens local organizations, communicates with all involved parties (especially institutions), and extends private and public financing for preservation. Recently, the NTFHP purchased two houses from the modern period in order to save them: Philip Johnson's Glass House, following the death of the architect; and Ludwig Mies van der Rohe's Farnsworth House which was under threat of being moved by a potential buyer after having been partially damaged by floods.
[10] "Outstanding degree of historical significance." This historical importance is then defined according to several different categories: sites where historic events took place, where individuals of the highest importance lived, iconic places related to the ideals which built the nation, exceptional examples of design or construction, places which exemplify a way of life, archeological sites with a value as sources of information. They number approximately 2550 today, including around 100 shipwrecks. Source:
http://en.wikipedia.org/wiki/National_Historic_Landmark consulted 5 September 2015.

Historic Preservation Act was promulgated. This is more than a half-century after the corresponding French text, and two years after the drafting of the Venice Charter. This law creates the national list indicating the historical importance of buildings – the National Register of Historic Places (NRHP) – to which we will return later. It encompasses the National Historic Landmark designation, created in 1960, the equivalent of the French *monument historique classé*. The law also includes Section 106 and the state historic preservation offices, which will also be discussed below.

A major trauma accelerated consciousness and led to the adoption of the 1966 law: the demolition of Pennsylvania Station in New York, a grandiose hall in metal on par with the Grand Palais in Paris. The resulting civic awareness would make it possible to thwart plans to demolish Grand Central Station, built in 1903 in the Beaux-Arts style, thanks to the creation of the New York City Landmark Commission under the influence of New York associations opposed to the project, with support from Albert S. Bard and the pen of Ada Louise Huxtable.[11] The owner sued the municipal commission for violation of the right of ownership without compensation, a breach of the Fifth Amendment of the Constitution. The case was brought before the Supreme Court, which ruled in favor of the preservationists in 1978, seemingly thanks to the involvement of Jacqueline Kennedy Onassis in the campaign.

In France just as in the United States, the 1960s saw many renovation projects with particularly destructive effects urban centers, leading to a heightened awareness of the need to protect urban and ordinary patrimony. At the same time, however, this preoccupation was accompanied by a certain rejection of modernity, a view which today is prejudicial to the recognition of recent heritage.

The Americans began protecting nature reserves in the second half of the 19th century, whereas it was not until the 1930s that this notion made its appeared in French law. It is interesting to note that the buildings related to the story of independence and Civil War battlefields were protected so early in the United States. Remarkable in a similar way in France is the rapidity with which World War I battlefields were protected – only 2 years after the end of the conflict.

Different levels of protection

We will mainly focus here on the protection of monuments at the national (federal) level. Indeed, inventory registers and building classification criteria also exist at the state and local levels, but we will not detail these here because they are all different. As a preamble, it must be made clear that the recognition of the historic character of a building does not guarantee its protection against demolition or major transformations. There are two levels of protection for buildings. It should be noted that protected buildings do not engender a protected spatial perimeter.

National Historic Landmarks

Approximately 2,500 sites are recognized with NHL status, the equivalent of French *monuments historiques classes*; they are representative of important events for the history of the United States. They are also listed in the National Register of Historic Places.

They can include the Model-T Ford for its engineering qualities as well as SLAC, the first particle accelerator, located at Stanford University in California, or the Statue of Liberty, or George Washington's home of Mount Vernon. National Historic Landmarks represent "historic sites, buildings, and objects of

[11] Ada Louise Huxtable (1921-2013), architecture critic, author of around ten books on the subject, journalist at *The New York Times*, she received the first Pulitzer Prize attributed to a critic. Her articles largely contributed to introducing conservation as a subject for debate in society.

national significance for the inspiration and benefit of the people of the United States." The evolution of NHL protections since the 1960s and the most notable protected buildings from the 20th century can be consulted in appendix [Figure 11].

The National Register of Historic Places and qualifying criteria

This is a list of buildings recognized for their historical importance. Inscription on the NRHP does not guarantee any protection but simply gives official recognition, making work proposed on designated a subject for organized debate. This is roughly the equivalent of French *monuments inscrits*, which are simply reported on the national inventory of historic monuments.

The most important of the criteria is historical significance, which combines historical importance with architectural value. There are four criteria[12]: A. Association with an historical event, B. Association with the life of a famous person, C. Showing characteristics particular to an era or remarkable artistic qualities or which represent remarkable techniques, or more generally architectural quality, D. Relationship to important information about history or prehistory, as in the case of archaeological sites, for example.[13] We observe that for buildings from the second half of the 20th century, the third criterion prevails; tends to favor exceptional buildings, unless one can demonstrate a characteristic quality of a precise period, which is difficult due to the lack of full historical objectivity regarding more recent periods.

The second criterion is the degree of **integrity** of the original elements of the building, which has more weight than age or style. This **authenticity of elements** is recognized as having the capacity to convey the historical meaning of the **period of significance**, or period of historical interest, which must be determined. This includes the site, the design, the environment, the materials, the type of execution. We can see that using this criterion, recent architecture can have a relative advantage, if its material qualities have not yet been totally modified.

The third criterion is the **Fifty-Year Rule** requiring that monuments must have this age in order to be registered as an historical monument. This rule is commonly accepted and supported by the government. However, it can be circumvented in cases of a building's exceptional character. It should be noted that no such rule exists in France, where the registration of a building is common practice following the death of its architect, with the exception of Le Corbusier, whose dwelling unit in Marseille was listed as a *Monument historique* in 1964, a year before the architect's death. It must be emphasized that inclusion on the NRHP does not convey an automatic right to protection, but simply recognition. The owner's consent is not obligatory for listing but is strongly desired. In some states, it is practically impossible to obtain the owner's consent, so strong is the notion of the inalienability of private property. The main advantage of the NRHP is that it opens the way to apply for tax credits[14] for renovation work.

Origin of the notion of protecting the Recent Past

In the United States, consideration of 20th century patrimony emerged through two conferences organized in 1995 and 2000[15] as part of the Recent Past Initiative launched by the NPS.

[12] They are described here briefly. For more details, see the document "National Register's Criteria for Evaluation."

[13] For example, among the places I visited: (A) a house at the Klondike Gold Rush interpretation center in Seattle; (B) the home of George Washington at Mount Vernon; (C) the TWA Terminal at JFK Airport in New York, and Lever House, also in New York; (D) the Burial Ground Canal Street, New York.

[14] On this subject, see p. 19.

[15] *Preserving the Recent Past,* 1 and 2, coordinated by Tom Jester and organized by the NPS. Anne Sullivan (interviewed in Chicago 2 September 2010) co-organized these conferences.

Doctrines and techniques were discussed. These conferences did little to follow the recommendations of the Council of Europe (1989),[16] which in part stemmed from the Tourette conference in France (1987),[17] which led the French Ministry of Culture to create the "Twentieth-Century Heritage" designation in the early 2000s.

In the United States, the interest in recent built heritage has focused on the roadside architecture of restaurants, gas stations, motels, and neon signs, often framed with a nostalgic attitude towards the 1960s[18] as a golden age of youth, Recently, it has been reinforced and extended to many other objects, as evidenced by the "Modern Matters" program set up by the National Trust for Historic Preservation in 2006,[19] "Modernism at Risk" from the World Monuments Fund,[20] or GSA Modern[21] which has led to the recognition of the architectural qualities of modern federal buildings since 2007. Also notable is the recent program of the Getty Conservation Institute, "Conserving Modern Architecture Initiative" which studies recent texts, such as the scope of action defined by ICOMOS ISC20, a committee specializing in the heritage of the 20th century.

II. THE NATIONAL PARK SERVICE

Roles of the National Park Service

The NPS is an agency of the United States Department of the Interior. It is the rough equivalent of France's Ministry of Culture, except that the NPS also manages national parks. The NPS:

- stimulates protection policies at the federal level,
- locally controls the application of protection measures through the State Historic Preservation Officer (SHiPO),
- establishes selection criteria,
- publishes recommendations,
- updates the inventory of the National Register,
- manages certain historic monuments and natural or archaeological sites,
- maintains the buildings existing on these sites,
- commissions survey drawings for the HABS-HAER,[22] and
- oversees the application of tax credits.

Sites managed by the NPS

NPS properties range from prehistoric caves to the Statue of Liberty and include both cultural and natural resources. Among these, we can

[16] *Stratégies de conservation et mise en valeur*, proceedings of the conference organized by the Council of Europe with the Austrian Federal Ministry of Science and Research and the Bundesdenkmalakt, Vienna, 11-13 Dec. 1989, in *Patrimoine culturel,* no. 29 (Strasbourg: Council of Europe Publishing, 1994).

[17] *Les enjeux du patrimoine architectural du* XX*e siècle*, conference proceedings, Direction du Patrimoine, Couvent de la Tourette, Éveux, June 1987 (Paris: Ministère de la Culture et de la Communication, Direction du Patrimoine, 1988).

[18] In any event, this is what can be learned by consulting a work from the City of Phoenix Historic Preservation Office and Ryden Architects, Inc., *Midcentury Marvels: Commercial Architecture of Phoenix, 1945-1975 (*Phoenix, Arizona: City of Phoenix, 2010).

[19] Since 1988, the NTFHP has published a list of the eleven most threatened buildings, and works to promote protection by citizen activism, with the initiative "This Place Matters" being one example. Several modern buildings have recently been saved: the D. & G. Wright House in 2012 and the L.A. Century Plaza Hotel in 2010 (http://blog.preservationnation.org/2010/02/11/how-to-save-a-modern-landmark/#.VesnA3CBQ4M, consulted 5 September 2012).

[20] The World Monuments Fund is a private international organization devoted to conservation. Its mission is to bring together the financial, technical, and human resources to conserve threatened works of art and architecture of international importance. Its program for modern architecture was put in place in 2006 with sponsorship from Knoll. Every two years, it issues alerts on threatened modern buildings and gives awards to particularly successful renovation projects (http://www.wmf.org/advocacy/modernism, consulted 5 September 2012). At the current time, 23 modern edifices have been saved thanks to the WMF in Europe and the United States.

[21] The General Services Administration manages all federal buildings in the United States. For a number of years, they promote heritage protection through exemplary renovations, for example by giving older buildings the capacity to offer levels of performance similar to those of recent constructions. A list is available at the site http://gsablogs.gsa.gov/gsablog/2015/05/21/national-preservation-month-2015-preserving-the-present/ (consulted 5 September 2012).

[22] See the survey drawings, p. 26.

cite *cultural landscapes*, vernacular environments where ethnic groups maintain their way of life and agricultural subsistence methods.[23] The parks and sites represent an area of 8 million acres and have a budget of 2.6 billion dollars per year. There are approximately 23,000 employees.[24] Today the NPS manages about 80,000 entries at the National Register of Historic Places, 2,400 National Historic Landmarks and about fifty Heritage Areas or Corridors in addition to national parks. For a comparison, in France there are 28,336 *Monuments incrits*, 14,308 *Monuments incrits classés*, and 2,086 protected parks and gardens.[25]

NPS properties are places where buildings are usually treated with great care. In my opinion, this attention makes it possible to demonstrate examples of the application of doctrines for preservation and interventions. The construction of buildings on NPS-managed sites occurred in two main phases. The first, from 1860 through World War II, concerned tourist facilities built in the National Parks using a rustic style inspired by local traditions. The second extends to 1966, when the NPS reached its fiftieth anniversary (Mission 66 program). Interpretation spaces, or "visitor centers," were built at that time for a total budget totally 4 to 5 billion dollars in today's terms, some of them by impressive names in modern architecture, such as Richard Neutra for Gettysburg. Today, visitor centers present conservation issues because they are 40 years old or more. A typological study was conducted about ten years ago,[26] but the problems are the same as those recurrently observed in recent past situations. The panoramic building at Gettysburg is a good example. A few years ago, the NPS decided to demolish it in order to restore the battlefield to its original state. Attacked by conservation associations, the NPS had to review its decision.[27] Other visitor centers, such as the Dinosaur Valley Museum in Denver, have serious stability problems, having been built on sand; additionally, they are too small to house their collections. This is a reminder that the innovative techniques and building materials used in the 1960s were often planned for a shorter period of time than traditional materials.

The NPS also manages the National Heritage Areas, which are organized on the English model. The federal government does not own the land but gives grants or subsidies. On the other hand, for hiking trails, lands on the National Trail System are treated as federal property.

Attribution and oversight of tax credits

The NPS is also involved in the tax incentives process through the issuance of tax credits. These credits apply to properties generating commercial income – not for individuals living in their homes, for example. The standards are different in this case, but individuals can qualify for local subsidies or easements. In general, it is recommended to maintain as much of the original materials as possible and to replace them only when **repair is impossible**.[28] It must be verified that the property is eligible for listing on the National Register of Historic Places if not already listed, or it must be situated within the perimeter of a historic district and

[23] R. Longstreth, *Cultural Landscapes: Balancing Nature and Heritage in Preservation Practice* (Minneapolis: University of Minnesota Press, 2008).
[24] This information and that which follows were provided to me by Randy Biallas, a director at the NPS, during and interview and visit to the NPS in Washington, D.C., on 15 July 2010.
[25] Source: http://www.lessourcesdelinfo.info/Patrimoine-42-644-monuments-historiques-proteges_a2123.html (consulted 14 September 2012).
[26] See also E. Carr, *Mission 66: Modernism and the National Parks Dilemma* (Boston: University of Massachusetts Press, 2007).
[27] The Cyclorama Building by Richard Neutra at Gettysburg was built in 1962. In 1995, the NPS and the ShiPO for Pennsylvania issued an opinion in favor of demolition which U.S. Commission of Fine Arts opposed in 1999. Registration of the building on the NRHP was rejected, but a subsequent court ruling in response to action from the Recent Past Preservation Network authorized an additional study by the NPS, which concluded that destruction of the edifice was necessary; this was carried out in March 2013 (source: Wikipedia).
[28] It is more difficult to base an argument on this criteria in the case of edifices from the second half of the 20th century, whose materials and application methods are short-lived, and whose original elements have already been replaced once or twice.

correspond to the period of historical importance ("period of significance") and thus contribute to the historical character of the district.

- Part 1: The National Register defines criteria to be met, such as date of construction (more than 50 years required), historical events, integrity, etc.
- Part 2: after 2 to 5 years, the standard is confirmed. The Internal Revenue Service confirms the tax credit for an investment that is often very significant. Credit cannot be applied for outdoor facilities, garages, or additions, nor can art works or furniture. For individuals who do not pay taxes or who own a structure that does not generate annual income, a partnership must be established with an investor who then transfers the funds to the owner, for an amount corresponding to approximately 80% of the tax. The tax credit covers 20% of work expenses, and can include finish work (windows, doors, etc.) as long it is carried out for the purpose of standards compliance.
- Part 3: Photographs of the completed restoration must be provided.

Three thousand applications are received each year. These are reviewed by 15- or 16-member state committees who select those projects which can continue in the process up to the federal level.

Saving the original materiality from the recent past is a real challenge. Even at the NPS, a lack of theoretical tools (preservation philosophy) and experience it is avowed. There is no guarantee that the interventions will be reliable or sustainable. Legal implications are becoming increasingly important, since companies no longer want to assume the risk of repairing and prefer to replace. Besides, owners do not want to keep original materials, which they consider too expensive to maintain and often look degraded. However, it happens that tax credits are granted despite replacement of original materials. Such is the case of the Lever House building in New York, where the curtain wall was completely replaced,[29] and a tax credit issued all the same.

For older buildings, obtaining tax credits is sometimes difficult if significant alterations are made. For example, on the San Francisco Ferry Building,[30] only one façade was preserved, and floors were partially demolished to allow light to penetrate into lower levels. The other façade was been completely redone to integrate earthquake-proofing systems. Finally, the rear façade was extended after the proof was submitted showing that it had been reworked several times in the past. These essential changes for the conversion of the old passenger terminal – and therefore the safeguarding – were considered too significant to benefit from the tax credit according to the commission on attributions.

It should be remembered that in the United States, tax credits represent one of the principal means of public financing for the renovation of historic monuments.

Other means of financing the restoration of architectural heritage

The NPS is not involved in these other private financing methods for the maintenance and renewal of built heritage. However, we chose to mention them here to offer more clarity on the subject. The other means of public financing of renovation in the United States include, on the one hand, grants offering one-time assistance for which a file must be prepared. On the other hand, the ballot or bond vote can be used. Here, citizens vote to authorize exceptional fundraising for a specific project. This was the case, for example, for financing the

[29] We will revisit this case in Part 2 of this research report.
[30] This project led by the firm of Page & Turnbull (Ruth Todd, Principal, RMH Fellow 1994), included evaluation tasks on behalf of the city, rehabilitation of the building envelope, and procedures for obtaining tax credits.

construction of fire stations in San Francisco in the 1960s.[31] There are also special funds created for very specific projects, such as the Presidio in San Francisco.[32]

With regard to private financing, several types exist (this list is indicative, reflecting only the cases I actually observed, with no claim of exhaustivity):

- Trusts, supported by boards of trustees.[33] These may be non-profit foundations that conduct fundraising for the maintenance or renovation of a building.
- Grants. For example, the First Church of Christ, Scientist, built in 1910 by B. Maybeck in Berkeley,[34] received assistance by the Getty Center. The National Trust has also set up a project with American Express to finance renovations for a total of 10 million dollars, the allocation of which is decided by a regional public referendum. This project benefited from the fund for seismic upgrade in 2006.
- Endowments or easements. For example, for Hanna House,[35] Nissan loaned Stanford University an initial fund of 500,000 dollars, which yields 40,000 dollars each year for maintenance and public education projects, which thus cost nothing to university.
- Sponsorship or fundraising.

Survey drawings

The NPS is responsible for creating and archiving records on buildings in the NRHP register, and more broadly, for documenting all historical elements, including landscapes. In recent years, these surveys are no longer done by hand but with 3D laser scans[36] and with the GPS system. The NPS also draws explanatory drawings of machines termed "interpretative drawings," for equipment such as coal boilers. All of this data is then posted on the Library of Congress website[37]. This service employs 23 people plus 16 other contributors. Additionally, the NPS organizes an annual student contest, awarding prizes for measurement drawings and documentation.

The NPS has managed the Historic American Buildings Survey (HABS) since 1933, which today gathers some 300,000 records and photos, as well as the Historic American Engineering Record (HAER), the Cultural Resources Geographic Information System (CRGIS), and the Historic American Landscape Sur-vey (HALS) [Figure 2].

Technical information

The NPS provides abundant documentation on conservation and restoration topics, based on subject or materials, with recommendations. The *Preservation Briefs* are published with professionals in mind but are totally accessible to individuals. They deal with all topics of conservation and restoration of historic buildings, with emphasis on older single-family houses. They are available in paper format by request and many of them have been digitized and can be consulted online.[38] They deal with various topics ranging from the repair of traditional masonry to concrete, from the maintenance of wood windows to the treatment of wall cladding in shingles, from the restoration of interior plaster decor to the conservation of ceramic floor tiles. They also address the issue of im-

[31] This case was brought to my attention by Ruth Todd. It was the historical study produced by the Page & Turnbull firm which revealed this interesting particularity. During the period I spent in the Page & Turnbull offices in San Francisco, the possibility of a ballot vote for financing the renovation of the communal dwelling at Glen Canyon Park in San Francisco was being discussed.
[32] See page 61.
[33] Picard, R., *Financement du patrimoine architectural: Politiques et pratiques* (Strasbourg: Éditions du Conseil d'Europe, 2010)
[34] Visited on 18 March 2011.
[35] Visited on 22 March 2011.
[36] For more information on this technique, see the work from English Heritage *3D Laser Scanning for Heritage: Advice and Guidance to Users on Laser Scanning in Archaeology and Architecture* (available online at http://fr.scribd.com/doc/13868921/3D-Laser-Scanning-for-Heritage, consulted 15 September 2012).
[37] Website address: http://memory.loc.gov/ammem/collections/habs_haer/hhmap.html.
[38] To consult the Technical Preservation Briefs online: http://www.nps.gov/how-to-preserve/briefs.htm.

proving energy performance, humidity control, etc.

I was particularly interested in the document dealing with heating, ventilation, and cooling (HVAC) issues in historic buildings.[39] I have observed how often these recommendations are generally ignored. The document reminds readers that the installation of an air-conditioning system must be the subject of a precise study attesting to the certainty that it is necessary; simple improvements to ventilation can often suffice. An air conditioning system entails the loss of 10% of space and an expenditure of about 30% of a renovation budget. In addition, there are problems with the weight of equipment on old floors, moisture in historic materials, such as masonry, insulation that causes the removal of siding, the installation of false ceilings, not to mention the updating of systems every 15 or 30 years, etc. Nevertheless, I often saw air-conditioning installations in old buildings while no preliminary study was conducted.

Perfecting techniques and products

Due to the difficulty of replacing traditional windows, the NPS has worked with manufacturers to develop alternative models in aluminum, insisting that they replicate historic profiles, and these models are regularly improved. These are not made-to-measure windows but are manufactured industrially and therefore less expensive. The other alternative proposed by the NPS in the case of historic windows is the possibility of creating fixed double windows on the interior (storm windows) as a way of keeping older, less efficient windows [Figure 13].

The NPS also promotes good practices for substitution materials. This is particularly the case of terracotta elements, which are now replicated in fiberglass, or cast-iron ornaments replaced by panels in aluminum or polyester resin.

III. DOCUMENTATION AND METHODS OF ANALYSIS

Standards and Guidelines

The Secretary of Interior's *Standards and Guidelines for Historic Preservation*[40] were developed to support conservation and restoration projects. This is a set of recommendations for the treatment of historic buildings based on intervention types – additions, for example, or materials or systems. For each one, they recommend or discourage interventions for identifying, maintaining, preserving or protecting, keeping or replacing, altering or redesigning replacement elements and propose new uses. These guides are very useful and very well done, giving architects the tools to describe their projects precisely and thus facilitate their evaluation.

What particularly interested me was the clarification of the intervention types and the vocabulary presented in these documents.

- **Preservation:** repair, stabilization and maintenance of existing structures. For example, work to strengthen the structure of the Kauffman House, "Fallingwater," by Frank Lloyd Wright.
- **Restoration**: restoration of a property to its state at a certain period in time, removing traces of other periods. For example, the renovation of the lobby of the Empire State Building in New York by Beyer Blinder Belle.
- **Reconstruction**: recreation of the destroyed parts of a property for reasons of interpretation. This was done particularly at

[39] NPS *Preservation Briefs,* no. 24, "Heating, ventilating and cooling historic buildings: Problems and recommended approaches."

[40] The *Guidelines* can be consulted at the site http://www.nps.gov/history/hps/tps/standguide/index.htm (consulted 31 August 2012).

Mount Vernon, where altered or destroyed elements like the mill were reconstructed to demonstrate the ingenuity of George Washington.

- **Rehabilitation**: acknowledges the need to alter or enlarge an historic structure so that it can continue to be useful; or accepts a change of use while maintaining historical character. For example, the refurbishment and extension of the TWA Terminal at JFK Airport in New York by E. Saarinen.

It is rehabilitation or adaptive reuse that raise the most questions about the approach to be adopted in the context of protecting built heritage.[41] The standards of rehabilitation involve:

- Maintaining of the original **use** or a use compatible with the building;
- Maintain **historic character** and **original materials** when these are in good condition;
- A building is a physical relic of its time. If **consolidation** is necessary, it must be done in a legible, compatible manner and be carefully documented;
- **Modifications** made to a building are also historic; they must be maintained (otherwise we shift into the field of restoration);
- Original materials and finishes characterize the **knowledge and skills** of an era;
- Historical elements are to be **repaired** rather than replaced. When replacement is necessary, materials and appearance must be as close as possible to the original.
- Physical or chemical treatments that damage original materials are not to be used.
- If original elements are removed, compensation measures must be taken, such as conservation and documentation.

These "best practices" rules are generally respected in projects subject to tax credit and for buildings belonging to the NPS.

The *Guidelines* published by the NPS are also very interesting. I particularly focused on the recommendations published for window joinery, because it represents one of the least durable elements of construction and original windows are very often at odds with the issue of energy saving. However, these windows play an important role in defining the character and cannot be replaced without a significant loss of material appropriateness and original appearance. In the recommendations on metal windows [Figure 12], one learns that it is possible to renovate or replace them without compromising their character, improve the thermal insulating efficiency of the glass panes with solar or low-emission films. As regards profiles, it seems difficult to maintain their character through replacement because their dimensions cannot be replicated. In fact, windows must generally be adapted to current dimensional standards for reasons of durability and strength. In addition, it is often recommended to take advantage of the modification to implement profiles that incorporate thermal breaks or improved air- and watertightness, not to mention double-glazing. However, introducing elements such as storm windows can allow one to keep existing window joineries.

Historic Structure Reports (HSR)

The basic document used to guide the restoration of a building listed on the NRHP or eligible for registration is the Historic Structure Report (HSR). Architecture firms specialized in historic preservation are responsible for creating these files.

The HSR usually consists of a brief historical report, followed by recommendations for the treatment and use of the structure. Joined to

[41] Restoration and reconstruction call for more advanced historical and technical research to address the notions of integrity and authenticity mentioned here previously. Both approaches elicit interesting questions, but rehabilitation is perhaps the most stimulating in regard to theoretical debates on contemporary interventions in existing constructions.

report is the knowledge base on which the project will be judged, in terms of integrity and respect for the historical and cultural significance of the building. Additional information (bibliography, references, survey drawings, site data, reports from surveys and tests, copies of historical documents, and photos are annexed with the methodology used to exploit the data).[42] The HSR is also the place to define the scope of work and to propose cost estimates.

This document is based on the complete diagnostic report on the building ("existing conditions assessment report", or CAR) established prior to the study and on the historical report that must highlight key dates ("developmental history" or "historic resource study"). It is of course necessary to determine the historical significance of the building and the period of its historical importance, to suggest themes for the inventory process, and to follow the recommended *Standards and Guidelines*[43] for ease of evaluation by the State Historic Preservation Office (SHiPO) and by the commissions.

For example, in the HSR I consulted at the Page & Turnbull offices concerning the Desert View Watchtower, a 1932 structure by the architect M.J.E. Colter, I found that the analysis had been very carefully done. After an historical summary, beautifully handwritten records are rigorously annotated. They constitute the "diagrams of historical significance," which are analytical drawings used to determine and report the valuable aspects specific to the building [Figure 5]. Tables indicating materials seen from the exterior indicate the state of conservation of the building, and suggest interventions for protection, maintenance, and further investigation. There is also a form completed on each significant element describing its historical importance if it contributes to defining the building's character of the state, indicating its condition and including comments and recommendations [Figure 6]. Then the building is described space by space according to the materials for flooring, walls, decoration, and coatings. Annexed to the HSR is a structural condition assessment, a mechanical and electrical systems evaluation, a copy of the building's registration in the NRHP inventory, and the general diagnostic report (building condition assessment report).

Architectural firms also handle inventories when there are multiple buildings to investigate, such as the campus of scientific facilities at the Stanford Linear Accelerator Center at Menlo Park, or the fire stations built in San Francisco in the 1960s.[44] In the first case, the study was commissioned by SLAC, aware that the permits to demolish some of its 280 buildings could be blocked because of their historical importance and the fact that they were more than 50 years old. All participants in a building's protection must reach consensus on the HSR, with modifications made to satisfy the different parties. In the end, the document adopted by the SHiPO is considered authoritative; it is the involvement of federal money through the tax credit allocation that makes the process so long. What blocked the adoption of the document in this case was that the whole complex was being considered a historic district (as another office had done for NASA facilities), instead of looking at each building and considering it individually. The inventory is rather succinct, but with the historical report, it was judged sufficient to decide that the period of significance lasted from 1962 to 1970, when the essential experimental discoveries were made. The method adopted by the Page & Turnbull firm consists in isolating three particularly significant buildings from among the

[42] For more information, see NPS *Preservation Brief* no. 43, "Preparation and Use of Historic Structure Reports".

[43]

[44] These two projects were handled by the Page & Turnbull firm in San Francisco where I remained from 10-25 March 2011, thanks to assistance and hosting by Ruth Todd, RMH Fellow 1994.

280. In one of these the researcher who received the 1976 Nobel Prize in Physics had worked (Burton Richter). The construction technique is also important because the engineers had dimensioned the structure with 2- to 5-foot thick concrete walls to withstand radiation and sliding panels on the ground floor to allow the particle accelerator machines to pass through.

In the case of the San Francisco fire stations built in the 1960s, the question is whether a building is ascribed with certain qualities because of its place among a collection of similar buildings or, rather, for its individual architectural value. Here, architects and historians determined that the ensemble is significant because all the facilities have the same characteristics. Their history is of particular interest since they resulted from a major financial effort on the part of the community in the form of a bond proposal.

I was very impressed by the quality, thoroughness and completeness of these preliminary studies, but also by their formalization according to criteria in order to facilitate their evaluation.

Historic Resource Evaluations (HRE)

The Historic Resource Evaluation (HRE) is another type of report that can be requested from an architectural firm specializing in historic preservation. For example, the modification project for the Kaiser Center built by the architects Wuderman & Beckett Associates in Oakland was evaluated by Page & Turnbull. The file includes a brief historical sketch and a summary of the criteria on which judgements about building's historical significance are based. It contains an analysis according to the NRHP criteria,[45] reiterates the importance of the integrity of the characteristics retained for registration, such as the fact that it is the last of the company's buildings remaining today. It is therefore the testimony on the history of the building and the H.J. Kaiser Company[46], a pioneer in the area of social protection for construction workers which built major works such as the Hoover Dam. The file also includes graphic diagrams, a California Environmental Quality Act (CEQA) document detailing the environmental impact of the project; it examines whether the project meets the requirements of Secretary of the Interior standards and proposes mitigations measures to compensate, such as survey drawings of the building prior to the intervention to be given to the HABS database and various local historical societies,[47] as well as a financial contribution to the city's façade improvement program. The architects who evaluate the project make few recommendations and simply offer analysis in terms of the standards to judge whether or not the project corresponds to the points examined.

In preparing these evaluation files, the firms prepare the work of the SHiPO, whose role is similar to that of an *Architecte des bâtiments de France* or the *Centre de recherche sur les monuments historiques* in France. The established criteria indicate very specific conditions to be met, thus giving an objective basis to decisions about the conservation of built heritage. In them, we see that the tools used to evaluate work proposed on an historic property are the same whether it dates from the 20th century or an earlier period. The architecture of the recent past is different from that of other period only in that it calls for an interpretation of the criteria and a relaxation of the Fifty-year Rule, but

[45] There are seventeen criteria distributed among four categories: visual quality; design and history; association with an historic event, continuity, and integrity; and reversibility. Buildings are classed from "A" (highest importance) through "E." Buildings of no notable interest or less than 45 years old are classed "F."

[46] Henry J. Kaiser (1882-1967) was an industrial magnate at the head of shipyards and a construction company which completed major public works projects. He also created the Kaiser Family Foundation, a charitable institution.

[47] Oakland History Room at the Oakland Public Library, Oakland Heritage Alliance.

it does not require any documents or a particular approach. The existing tools are therefore suitable for all periods and all types of buildings.

The scope of protections: interior and exterior

In the United States, it should be noted that only the exterior of buildings is protected. When a building is listed, the four walls delineating the construction must be retained. Public interiors such as hotel lobbies, banks, etc., can sometimes be preserved, but there is no set rule unless changes would alter the façade or the view from the exterior.

The example of the Manufacture Trust Company in New York, built by Gordon Bunschaft and SOM, is an interesting example. After protecting the exterior in 1997, the Landmarks Preservation Commission recently decided to also protect the interior to prevent destructive alterations. Indeed, the interior design is immediately recognizable. It has a role in defining the architectural intent as seen from the exterior since the building is of low height and entirely in glass [Figure 16].

IV. SOME COMMISSIONS

During my six months of study, I had the opportunity to attend a few commission meetings in different cities. One thing that surprised me is the public, open character of these hearings which anyone can attend and in which they can even participate. At the same time, I was surprised by their formality somewhat reminiscent of a courtroom session. I also met with commission members for interviews outside the hearings as well as with members of various institutions. They were thus able to explain to me the workings of historic protections at their respective level. Without attempting an exhaustive treatment of the many existing commissions and institutions, I present below a certain number of those which particularly interested me.[48]

Commission of Fine Arts (CFA), Washington, D.C.

Created in 1910, this commission advises Congress and the President on aesthetics and design for the capital region. Its scope includes the area of the National Mall and Georgetown. This commission gives its opinion on new buildings, such as a museum of Latin American culture planned by the Smithsonian Institution, the Martin Luther King Memorial,[49] as well as projects to renovate existing buildings. Hearing are held, but there is no debate. Applicants for permits present their project, the committee members[50] vote, and then move on to the next file. The commission is able influence decisions in the planning phase of a project. For example, the programming phase for the Latin American Culture museum is underway, and various sites around the Mall are being considered, including the conversion of existing buildings currently unused or that could become available in the future, such as the Department of Agriculture, for example. This option, while supported by the commission, is not suitable for the design team who wishes to create a building that expresses of the Latin culture, as was the case of the Amerindians.[51]

Changing the appearance of the National Mall is very complicated. Although it was totally created in the 20th century, and despite all the attention devoted by the commission, I noticed

[48] The full list of my meetings is included in annex [Figure 18].
[49] I attended the commission meeting held on 15 July 2010. I was invited by John Lindstrom, commission secretary, who was contacted by Tina Roach (RMHF 2009). Perhaps due to delays resulting from CFA demands, the Memorial was not ready in time for its dedication in September 2011.
[50] Earl A. Powell, III, Chairman; Pamela Nelson, Vice Chairman; Diana Balmori, landscape architect; John Belle, Elizabeth Plater-Zyberk, Michael McKinnel, and Witold Rybczynski, architects.
[51] A reference to the National Museum of the American Indian built in 2004 by the Canadian architect D.J. Cardinal.

that some recent buildings are not architectural successes.[52]

The Advisory Council for Historic Preservation (ACHP)

The ACHP is an independent federal agency that advises the President and Congress on heritage conservation issues. It is also consulted when federal funds are involved in renovation work, particularly when Section 106 is applied.[53] In my meeting at the agency, committee members[54] said they were very concerned about conservation of the recent past. Many questions are directed to them because of the great pressure to renovate many obsolete facilities such as hospitals connected to the Department of Veterans Affairs. The military is one of the largest owners of historic buildings in the United States (together with the General Services Administration), especially buildings constructed after World War II.

They often ask themselves how to advocate for safeguarding when no obligation exists to follow the agency's advice. The President's Executive Order on Sustainability from November 2009 calls for a rethinking of the energy performance of existing buildings, whether they are recognized or not. The federal government has a responsibility to set an example and the council must give its opinion on the policy to be followed in public buildings. They are in charge of judging what conflicts might arise between the conservation of historic buildings, the purpose of the agency, and the national policy for sustainable development, for example.

[52] I refer, for example, to the United States Institute of Peace headquarters built in 2011 by the architect Moshe Safdie which appears to me as unsatisfying hodgepodge which attempts to blend into its neoclassical surroundings through the use of stone and domes [Figure 19].
[53] Section 106 of the National Historic Preservation Act (NHPA) of 1996, requiring federal agencies to take into consideration the effects on historic properties of development projects they conduct, approve, or finance. Decisions reached in scope of Section 106 encourage preservation but are not obligatory. See, for example, http://achp.gov/docs/CitizenGuide.pdf.
[54] I met John Fowler and Catherine Dewley of the Advisory Council on Historic Preservation during an interview on 16 July 2010.

National Register Commission, Washington, D.C.

The commission seated in Washington, D.C., is composed of seven members[55] who render decisions on applications for listing on the National Register of Historic Places, for other designations such as National Historic Landmark (NHL), and projects in the Historic Districts (HD) of the capital. The public can attend and intervene just as in a consultation meeting. I had the opportunity to attend a hearing about the protection of a house inhabited by a Black American pastor, built in 1906. The story of this man and his contribution to the life of the neighborhood, the friendship between communities he has inspired, counts more than the building, which is also remarkable architecturally. At the same time, it is also the last unaltered relic of a district that has completely disappeared under the blows of urban renewal. The owner of the house, the electricity group Pepco, neither approves nor disapproves of the initiative which is led by the members of the community. Due to its historical significance and because there are no other examples of architecture of this period in the area, the NRHP registration was accepted unanimously by the members of the commission.

Then there is the case of a project to create an extension at the rear of a house built on Capitol Hill. It is a very interesting historic district and has retained a high level of authenticity. The request was rejected to protect the particular character of this neighborhood. It must be said that the houses in this district are narrow and small, but they have gardens giving onto alleys running through the center of the blocks, which is quite exceptional. The permit to change the windows of the same house is also refused because it would alter the appearance too greatly and create a negative precedent for

[55] As of 21 July 2010, the commission was composed by Catherine Buell, Maria Macsarella, Elinor Bacon, Pamela Scott, Christopher Landis, Joseph Taylor, and James S. Kane.

the preservation of the neighborhood's historic character.

New York City Landmarks Preservation Commission

Public hearings quickly follow one after the other in this commission.[56] These are mostly cases of single-family homes that owners or preservation associations offer for protection and listing on the local register. Each of the five boroughs of New York is represented. The board also issues certificates of appropriateness and makes recommendations for the work. This commission is said to be extremely powerful and demanding, but I found that the muddled atmosphere of the hearings, especially when compared to the rigorous formality of the Washington, D.C., hearings, does not help to create the impression of serious work. Project presentation panels pile up in the corridors, most of the listeners are standing, and there is so much noise that the members' comments are barely audible. This commission issues permits for work to be done at the local level.

New York City Planning Commission[57] and the zoning code

Presentation of projects before the CPC is done in public by the architects[58] supported by residents' associations. Modifications of what could be likened to the zoning of the French *plan local d'urbanisme* are discussed. The atmosphere is a mixture of a consultation meeting and a public inquiry. The commission must arbitrate between divergent points of view on the densification of residential areas. Some residents are worried about their property values should neighbors build multiple-storey houses on their lots and if the neighborhoods being subjected to development by small real estate operations. Small homes have been demolished to make way for two-family dwellings. For the owners of these newer houses, on the contrary, it is the small houses, old and poorly maintained, that degrade the neighborhood. They think they contribute more fully to city revenue by paying taxes on a larger surface area. The speakers take turns expressing their points of view before the commission. Parking, public transport, schools, and garbage collection are cited as reasons by both parties for reducing or maintaining building density in the neighborhood. I was impressed by the magnitude of the debate. Many speakers followed one after another, they were able to express themselves without being interrupted except by the bell signalling the end of their speaking time, and they were listened to. I do not know, however, whether these debates are really taken into account in decisions on urban planning.

The New York City Planning Commission is also responsible for the transfer of rights to build in height, known as "air rights." This is a real heritage protection tool. A tower development can buy the rights of its lower-height neighbors in order to add a few additional floors. This action is final, and it therefore becomes useless to demolish old buildings in the interest of land profitability once their air rights have already been sold. This is the way the theaters in the Times Square district were preserved.

Sometimes, however, air rights can result in very harsh architecture, and precisely neighborhoods relatively preserved from urban development so far. Near 42nd Street in New York, Yves Deflandre[59] showed me that instead of erecting buildings on a north-south oriented lot, as has usually been the case in New York, developers tend today to acquire several ad-

[56] I attended the commission meeting held on 10 August 2010.
[57] Commission meeting held on August 11, 2010, New York.
[58] The jury is composed of ten members and presided over by Amanda H. Burdenla.
[59] RMH Fellow 1997, Yves is an architect working independently. He spends time working with an organization for sustainable development in his Rose Hill neighborhood in New York.

joining lots in the same street to build buildings that block the view towards the southern tip of Manhattan. Some are very high, exceeding 80 floors, and one of them, located at the end of Park Avenue, bought all the air rights down to the tip of Manhattan to ensure that no other building will be built in its cone of vision.

The right to build additional floors is conferred when a school is included in a building program; such is the case of F. Gehry's 75-story Beekman Tower, the tallest residential building in the United States. A public space of arcades on the ground floor gives an 20% surface area allowance beyond what is normally allowed by the zoning code. For this reason, many tower lobbies on 5th Avenue are open to the public during business hours, for example. Again, it is the City Planning Commission that issues these authorizations.

The process of approving a building permit generally takes six months. After one month, objections are raised by the examiner followed by other agencies such as the sanitation department. However, objections based on the zoning code may be arbitrated or interpreted in order to preserve existing buildings in their original dispositions.[60]

V. EXAMPLES OF ASSOCIATIONS

It is useful to recall here that, in the United States, historic conservation is essentially a grassroots citizen movement. I was struck to discover how many associations for historic protection exist, both well-established and newer ones. From the National Trust for Historic Preservation, a true partner of federal agencies, to simple individuals who fight for the recognition of buildings precious to them, as well as local associations working to create links between SHiPO-represented agencies[61] and residents, there is a huge variety of associations. Here again, an exhaustive treatment of all the associations defending built heritage would be impossible here. I would like nonetheless to illustrate certain examples of those with whom I directly interacted.[62]

Preservation Alliance for Greater Philadelphia

John Gallery, president of this association, tells me that there are only ten historic districts in the city of Philadelphia, a very low number, while a hundred buildings of the 19th and 20th centuries deserve to be protection, including the Philadelphia Life Insurance Company Building,[63] the Naval Hospital, Mill Creek Public Housing, etc. The association is a nonprofit organization with activities consisting mainly of tours to inform and educate the public about the history of architecture. To this end, association members have published a guide to the city's remarkable architecture.[64] They also work at local and state levels of by partnering on projects for the renovation or transformation of historic buildings, ensuring the participation of state institutions locally. Since there is no system set in stone for historic protection in the United States, it falls on associations to mobilize residents and invigorate interest. The role of this association is therefore to promote preservation through advocacy work. It also represents the public's point of view in conservation debates and in NRHP registration requests.

[60] Raymond Plumey, RMHF 2001, is today Deputy Borough Commission of the New York City Deparment of Buildings. He makes decisions on appeals on construction permits concerning the application of historic building codes.

[61] State Historic Preservation Officer, who works at the state level and makes decisions on applications for building permits. Somewhat similar to the French *Architecte des Bâtiments de France* (ABF) or *Centre de recherche sur les Monuments historiques* (CRMH).

[62] The complete list of these associations is provided in annex [Figure 21].

[63] Penn Mutual Tower was built in 1972 by the architects Mitchell and Giugula just behind Independence Hall, one of the country's most historic buildings. This somber glass skyscraper thus rises in the perspective of the Mall. Yet, due to its architectural quality, it is one of city's greatest 20th-century buildings.

[64] J. Galley, general editor, *Philadelphia Architecture: A Guide to the City* (Philadelphia: The Foundation for Architecture, 1994).

Preservation Chicago

Since 2001, Chicago has been ahead of other cities in protecting its historic buildings. There are 51 historical landmark districts, 300 protected structures out of 700 catalogued landmark buildings, and a demolition delay ordinance is in place to allow time for opposition to be voiced regarding the demolition of a building. Historic buildings were identified in the 1980s, and public demonstrations held in the late 1990s led to the cancellation or postponement of the demolition of 90 buildings.

There is a good deal of litigation in historic districts, mainly regarding opposition to projects by developers. According to association members, it is difficult to create a landmark district in Chicago. Normally, owner consent is not obligatory; it is nonetheless politically expedient to have the agreement of at least half of the owners and public enquiries take place in the form of public meetings. City commissions do not engage in proactive work but rather oversee projects. Field work in the interest of protection thus falls on associations. Property owners often ask for assistance from the association to build case files and organize defensive action concerning projects on neighboring properties. The members of the association (historians, architects, trained historic preservation specialists, etc.) take part in public meetings, and educate residents. The government provides is no financial support for this activity, nor for the protection of buildings in historic districts; it therefore depends on grants and fundraising. Preservation Chicago works in collaboration with other heritage preservation association, such as the Frank Lloyd Wright Preservation Trust, for example, which works on the restoration of Wright's home and studio.

With regard to hospitals and universities, I am told that it is very difficult to promote the protection of their built heritage because they have money and lawyers. Managers generally choose not to bother with existing buildings if they deem them obsolete or unsuitable, despite their possible historical interest. Universities do not need the consent of local commissions for their demolition and construction projects because they are state agencies. This question is very important in my opinion, because American universities hold much of the interesting architecture of the recent past and this heritage is potentially threatened by decisions taken without consultation and with a vision of short-term profitability.

Documentation and Communication of the Modern Movement (DOCOMOMO)

Since the 1990s, the international preservation community has been interested in recent-past heritage. DOCOMOMO[67] has been a pioneer in this field. The role of the association is to bring together specialists, to collect and disseminate information on outstanding or endangered buildings, to contribute to the international debate on the technical and institutional means of safeguarding modern patrimony, and to promote education in this field.

I met several members of the association DOCOMOMO during my six months of study. Eugenia Woo[68] advocates for both Preservation Seattle and DOCOMOMO Northwest, which cuts across regions in Canada and the United States. It was explained to me that very few property owners agree to have their buildings protected in the United States, with the state of Washington being a rare exception, perhaps due to the influence of neighboring Canada.

I also met Susan McDonald[69] at the Getty Institute in Los Angeles. She specializes in the conservation of concrete and has participated in

[67] The DOCOMOMO organization was creation in the Netherlands in 1988. It mission is to identify and catalogue built heritage from the years 1930-1970, to advocate for its conservation, to alert public agencies, and to disseminate knowledge.
[68] Interview on 22 March 2011.
[69] Interview on 15 March 2011.

the preservation plan for the Sydney Opera House in Australia and in many publications on modern concrete for England's National Trust. She currently participates in preservation programs in Egypt for the Getty Institute.

In New York, I met the architect and preservationist Kyle Normandin[70] who works for the architecture and engineering firm WJE[71] specializing in restoration projects. Theo Prudon[72] is a teacher in the Master of Historic Preservation program at Columbia University. He is a recognized theorist of the conservation and restoration of modern architecture in Europe and the United States and the author of an important book on the subject.[73] Through the interviews I conducted with them, I better understood the importance of case studies and their dissemination as a reference for good practices in the restoration of modern architecture. Sharing this knowledge is essential; both men dedicate themselves to promoting appropriate techniques and interesting solutions through their participation in conferences and by writing articles and books.

National Trust for Historic Preservation

The NTFHP was created in 1949. It is inspired by the English National Trust, it identifies and acts for protection at the federal level, supports and strengthens local associations, communicates with all interested parties, especially institutions, and extends private and public funding for preservation. It also owns and manages certain sites including Philip Johnson's Glass House and Mies van der Rohe's Villa Farnsworth. In the first case, after the death of Philip Johnson in 2005, the NTFHP built a visitor center and opened the site to the public in 2007. It is possible that P. Johnson desired that his property join the villa Farnsworth, his source of inspiration in 1949, which was bought by the National Trust in 2003. Former owner P. Palumbo auctioned it off for 5.7 million dollars. The major effort by NTFHP donors to acquire this icon of modernity can be explained by the fact that the potential buyer had supposedly planned to move the house to keep it out of the Fox River flood zone. Indeed, the villa was severely damaged during the episodes of 1956, 1996 and 2007.

In San Francisco, I met the manager of the Modern Matters program, Christine Madrid French.[74] She was quite pessimistic about the issue of modern heritage conservation, arguing, for example, that none of John Lautner's homes[75] are registered on the NRHP and that they are potentially threatened with alteration by their owners. Some states do better than others depending on the personalities involved and the quality of buildings that are there. She mentions Miami and Seattle as cities which care for their modern heritage. In visiting these two cities, I could indeed see that modern heritage was important and relatively well preserved. In the case of Seattle, I was first struck by the site of the 1962 World's Fair, also nicknamed "Century 21." Although some buildings are closed, the site is well maintained and quite busy. The fact that it is connected to the city center by a monorail ("airtrain") and that there are many public buildings such as an ice rink and a museum built by Frank Gehry can explain this success. In addition, I was also impressed by the quality of creations by the Seattle School, to which Eugenia Woo of Docomomo Northwest had directed my attention and to which I shall return in Part 2 of this study. As far as Miami is concerned, it is evident that the restoration of the Art Deco district of South Beach is a success, as proven by the crowds it attracts.

[70] Interviews on 23 August 2010 and 21 July 2011.
[71] Discussed later in this document.
[72] Interview on 17 August 2010.
[73] T. Prudon, *Preservation of Modern Architecture* (Hoboken: John Wiley & Sons, 2006).
[74] Interview on 17 March 2011.
[75] These houses, primarily built in Los Angeles, are quite unique and spectacular. They have served as locations for many famous films.

World Monuments Fund

The WMF's campaign to monitor monuments existed before UNESCO's. Each year, projects are selected for support. Sustainable development and aid to poor countries are particularly important in the choice of buildings. For example, the condition of New Gourna, Hassan Fathy's earthen project built in Egypt, is problematic and is receiving aid for the transformation and preservation of the site. I met with Erica Avrami, who explained to me the WMF's actions to protect of modern heritage. Twenty-three 20th-century buildings in twelve countries have benefited from WMF restoration assistance. Examples include Schindler's Kings Road house and studio and R. Neutra's VDL research house, both in Los Angeles.

In 2009, the World Monuments Fund mounted an exhibition entitled "Modernism at Risk: Modern Solutions for Saving Modern Landmarks," on the heels of the establishment of a prize with the Knoll company recognizing restorations of modern works.[76] A catalogue was published[77] and an internet site created to accompany the exhibition. A list of five outstanding structures in danger In the United States was compiled: the A. Conger Goodyear House by architect Edward Durell Stone, Grosse Pointe Library by Marcel Breuer, Riverview High School by Paul Rudolph, and Kent Memorial Library by Joseph Warren Platner. And these risks are very real: because Riverview High School was demolished in 2008, despite the mobilization of the preservation community.

Other associations

The network of architectural foundations has an important role in the promotion of architectural quality and knowledge about built heritage in the cities where they have offices. In Seattle and Chicago, for example, numerous architectural tours are organized for the general public. In Chicago, excellent educational materials are published to introducing children in primary schools to architecture.

VI. ARCHITECTURE FIRMS WORKING IN PRESERVATION AND THEIR PRACTICE

During these six months, I had the opportunity to visit numerous firms specializing in historic preservation.[78] Again, without attempting exhaustivity, I tried to understand the specificity of these firms and their particular qualifications for addressing 20th-century architecture. Below, I briefly describe the work of some of the firms where I was able to spend several days.

Quinn Evans Architects

I was able to visit this firm thanks to Tina Roach (RMHF 2009).[79] Located in Georgetown in Washington, D.C., the agency has about 30 employees. Their projects focus exclusively on renovations and extensions – "retrofitting" old or historic buildings.[80] In recent years, they have specialized in energy renovations. For example, the renovation project at the AIA headquarters built by the Architect Collaborative (W. Gropius) will lead to its becoming the first zero-carbon building in the capital. Also worth mentioning, the National Academy of Science building, where the installation of solar panels and glass roofs should improve its performances.

[76] This prize is given biannually. In 2008, it recognized the restoration of the ADCB Union Trade School in Bernau, Germany, led by W. Brenne and F. Jaschke; in 2010, to B. Henket and W. de Jonge for the restoration of the Zonnestraal Sanatorium at Hilversum in the Netherlands. In 2002, the prize went to the consortium of the Hizuchi Elementary School on the Japanese island of Shikoku.

[77] *Five Case Studie: Modernism at Risk* (exhibition catalogue, World Monuments Fund and Knoll, 2008).

[78] The complete list of firms is provided in annex [Figure 22].

[79] On 19-20 July 2010 and 25-26 August 2011.

[80] That said, one of the most interesting projects being developed when I visited the firm concerned a building whose historical quality poses questions: the renovation of the home of Benjamin Franklin in Philadelphia, for whom the NPS is commissioning client. See further below.

The renovation of Eastern Market is one of their best-known and most successful projects. Although it is not a 20th-century building, I was interested in its renovation because of the ingenuity of its indoor comfort control system for the summertime heat. Tina led the renovation. The market hall has a high ceiling. Powerful ventilators located under the skylights make it possible to completely renew the air volume with fresh outdoor air in the morning. In the afternoon, air conditioning placed down low and slower-moving fans just above the stalls guarantee a good comfort level for a minimum of energy consumption [Figure 23]. For me, this is an excellent example of integrating advanced technology into a historic building.

Ann Beha Architects

This Boston-based agency[81] develops mainly contemporary projects in historic buildings and neighborhoods. For the project of a townhouse in the Back Bay district of Boston, I was particularly interested in the method of translating elements of traditional architecture into features used today. For projects involving additions to free-standing houses, it is the compatibility of interventions with the existing building which is interesting. Further in this report, we will look at an example of a contemporary project in an old building completed by this agency (Portland Museum). We point out that architect Ann Beha is a member of the Richard Morris Hunt Fellowship jury.

Holabird and Root

This Chicago agency[82] has been in existence for a century. Most projects are for new buildings, but there is also a historic preservation department with between 5 and 10 employees headed by Mary Brush (RMHF 2005). The projects discussed here are mainly renovations and upgrades to buildings erected by the firm in the past. However, their skills are also solicited by building cooperative boards, city halls, and universities. The approach developed is that of conservation. One of the most important projects in recent years has been the restoration of stained glass in the Chicago Library cupola by Tiffany.

Page & Turnbull

I was fortunate to be able to spend two weeks in this San Francisco firm of about thirty employees, from March 5th to 20th, 2011. Thanks to Ruth Todd (RMHF 1994), I have gained a better understanding of how the world of preservation functions, its codified documents and how to present them presentation, which I covered in the preceding pages. Ruth also detailed for me the ways in which historical preservation firms diversify their activities and maintain their regular clients in order to have regular access to private or public commissions. It is not uncommon for architects who have previously worked in the public or semi-public sector (such as a university) to be hired by private firms with the assurance that they will bring in their former employer as future client. The firm carries out a wide variety of projects. Generally, they are only concerned with the building "envelope," the interior being handled by offices specialized in space planning, as in the case of the San Francisco Ferry Building. The adaptation of historical buildings to seismic retrofitting, which has been compulsory since the 1994 earthquake, is one of their main tasks. This is what the agency carried out in the transformation of the former Presidio military site into a residential area.[83] Their projects have included the restoration of M.J.E. Colter's Desert View Watch Tower built in the Grand Canyon and the former Hallidie warehouse building by W. Polk, which boasts the first curtain wall façade in the

[81] Visit on 3 August 2010.
[82] Visit on 1-3 August 2011.
[83] See further below.

history of architecture. Most of the firm's clients are public bodies or real estate groups rather than individuals.

Multidisciplinary skills

In firms of a certain size like Quinn Evans, Holabird & Root, or Page & Turnbull, I noticed that it was common to combine several types of skillsets internally when building the teams in charge of developing restoration projects. Thus, such firms employ not only architects – be they AIA-accredited or not – and city planners, but also engineers, economists, historians, curators, landscaper designers ...

Standard architectural education

Architectural studies are carried out in public or private universities on two levels: the undergraduate (Bachelor's degree or B.Arch.) and graduate (Master's or M.Arch.), Although the practice is tending to become rarer, it is common for undergraduates to already have a two-year university education equivalent to a French *classe préparatoire.* The Bachelor's degree is sufficient to qualify for work in an architecture firm. It is also common for American students to take a pause in their studies at this level and return to school to complete their master's a few years later. With a degree in art history, for example, one can also enroll in a Master of Architecture program. I also think that the possibility of studying multiple disciplines at the same time as a minor or major is an additional asset. Ultimately, it is quite apparent that the value of an architecture degree in the employment market depends on the reputation of the university where one has studied. Prestigious private universities with annual tuition of tens of thousands of dollars frequently have scholarship funds for less fortunate but very bright students. This class of universities is the most well respected, architecture programs included (Harvard, MIT, Penn, etc.).

To be an AIA-certified architect, i.e., to be able to practice under one's own name as an independent professional, project manager, or head of a firm, one must have two years' professional experience after the master's degree. Then it is necessary to pass a series of exams on design and regulations. Difficulty varies from state to state, the most challenging being the New York and California tests.

Masters programs in historic preservation

I mention here briefly the content of the masters in historic preservation.[84] The information I provide comes from interviews and from the National Council for Preservation Education website.[85] Although undergraduate programs exist, that is to say, the possibility of studying historic preservation at the bachelor's level, this discipline is usually studied in graduate school. Such training is offered in about thirty universities throughout the country. At the University of Pennsylvania,[86] for example, one trains in four distinct skill areas within a single master's program: architectural design, urban planning to train managers for institutions and cities, conservation, and advocacy. This last skill is of particular interest. Students are trained to become promoters of preservation in communities, with organizations, in lobbying groups who interact with politicians, and so on.

I looked over the curriculum of the University of Maryland's master's program in historic preservation. Fundamental training during the first year includes the history of architecture, historical research methods, preservation law and economics, social and ethical issues, case studies, preservation policy and planning, as

[84] I had the opportunity of meeting master's program instructors at Boston Architectural College, the Art Institute of Chicago, Cornell University, Columbia University, the University of Florida, and the University of Pennsylvania. For a complete list of these meetings, please refer to the annexes [Figure 24].
[85] www.ncpe.us
[86] I met with Randy Mason, director of this master's program, in Philadelphia on 5 September 2011.

well as a research seminar, for a total of 24 credits (3 credits per subject). Summer is devoted to an internship in the field of historic preservation. The second year is devoted to design studio (6 credits), a seminar (3 credits), and 3 electives (3 credits each). Electives are subjects chosen in order to deepen knowledge in fields as diverse as American studies (essentially based on ethnology to train for curatorial or museum work), anthropology (archeology training), architecture (all subjects related to the history of architecture) and history (historical research). This university trains specialists in historic preservation who will practice in academic and scholarly fields.

Continuing education

The level of professional competence I observed in architecture firms is maintained and stimulated by the accreditation system put in place by the American Institute of Architects (AIA). Once professional accreditation has been obtained, architects must complete a hundred hours of continuing education each year in order to maintain it. These courses can take the form of a lunch seminar, consisting of the presentation of a product or an application method during lunchtime. These presentations are followed by a short test to obtain the corresponding credits. It is also possible to follow conferences or even read articles followed by a questionnaire, such those in the journal *Architectural Record*, for example. This system allows professionals to keep their knowledge and professional competence up to pace, but it is also certain that the system creates a big market for the business of continuing education. I also noticed that the system allows companies to promote their products by claiming to offer "training" (along with lunch). Nonetheless, the fact remains that the architects with whom I met take extremely seriously the upkeep of their accreditation through continuing education.

Specialized training

Many architects choose to acquire additional skills through qualification programs. The most popular at the moment is the LEED AP credential (Leadership in Energy and Environmental Design). It is awarded by the U.S. Green Buildings Council following an exam on a certain type of construction (public facilities, residential sector, mechanical systems). One must then complete 30 hours of continuing education every two years to maintain accreditation. The LEED rating system has been in existence since 1998. It makes it possible to promote architectural design approaches with a goal of reducing a building's ecological footprint by taking into account not only its non-renewable energy consumption but also its consumption of natural resources such as water. This approach in fact significantly reduces buildings' operating costs.

Equally worth mentioning, the American Institute of City Planners (AICP) offers certification in the field of urban planning.

There is also a higher certification issued by the AIA to recognize professionals for their "significant contributions to the profession and society and who exemplify architectural excellence."[87] They become, after a fashion, model architects on a national scale. The title is awarded through a competitive selection process.

Accessibility of projects in the historic preservation field

Generally speaking, American architects are entrusted with what are referred to in France as *missions completes*, running from diagnostics all the way through project completion, including job sequencing, constitution of the project team and consultants, etc. As mentioned previously, some firms specialized in historic

[87] http://www.aia.org/practicing/awards/AIAS075320, website accessed 4 July 2013.

preservation and having diversified expertise may be directly assigned historical studies, surveys, historical resource inventories, HRE assessments, or tax credit application procedures. Some offices such as Quinn Evans Architects or Page & Turnbull have the National Park Service or State Historic Preservation Officer as privileged partners. I imagine that it is crucial for a firm to ensure its access to this clientele. For this reason, former NPS employees who "go back" to the private sector are particularly sought after by these firms.

Up to a certain level of professional fees, contracts are passed by mutual agreement.[88] The awarding of larger contracts by municipal governments or the NPS is done through a Request for Proposals procedure. The contents of the proposal file are very similar to what is normally asked for in France. For example, for the renovation of the needle crowning the Marin County Civic Center [89] built by F.L. Wright's disciples of the Taliesin workshop near San Francisco, the following documents were requested:

- Summary
- Project approach (a methodology note)
- Firm and team qualifications (references of the applying entity and co-contractors)
- Fee proposal (cost estimate)
- Table of tasks and corresponding prices
- Scope of work and schedule of deliveries

Typically, selected firms already have established connections with the commissioning client, or are highly recommended, such as BOLA Architects in Seattle which is recognized as an approved consultant by the SHiPO of Washington state. This status serves as a reference and leads to the firm being contacted by commissioning clients for private contracts.

It is important to note that historic preservation competence is strongly desired but not required to work on buildings listed on the National Register of Historic Places, especially when they were built in the 20th century. Again, practices change from place to place. On the other hand, for National Historic Landmarks, it is certain that for campaigns of restoration or maintenance of public edifices such as the White House or the Senate, the greatest specialists are called upon, such as Vittetta Architects,[90] Quinn Evans Architects, or Beyer Blinder Belle who takes care of public spaces in the Empire State Building.[91]

Sometimes talented architects having no particular qualifications in historic preservation are solicited and develop very interesting projects on well-known existing buildings. We can cite the example of Mark Cavagnero[92] for the extension of the Oakland Museum built by Kevin Roche, or Ana Escalante[93] for the restoration of the Albert Frey's Yacht Club on Salton Sea.

Project phases and corresponding documents required

Projects are broken down into four phases:

- Preliminary design: Corresponding to the French étude de faisabilité, this is comprised by sketches and preliminary drafts;

- Preliminary plan review: As we will see later, the building permit application is only submitted once the file is complete. It is therefore advisable to have a preliminary discussion with the administration on the basis of initial drawings;

[88] Unfortunately, I was not able to get access to information on the way professional fees are calculated for architects and contracting teams. Apparently, documents do not exist in the same way that they do in France, published by the *Ordre des architects* and which give a table indicating fee amounts in relation to a percentage of total job cost according to the project type and its complexity.

[89] Contract awarded to the Page & Turnbull firm of San Francisco.

[90] Meeting in Philadelphia on 17 July 2010.

[91] Jobsite visit with the architect on 3 August 2010.

[92] Interview in San Francisco on 3 March 2011.

[93] Interview at Palm Springs on 15 February 2011.

- Design development and construction documents: The file progresses to a stage corresponding to the PRO or Dossier de consultation des entreprises. It is quite detailed, describing very precisely all aspects of the proposed work. This file is referred to as the "H sheets." A price estimate is annexed. When the file is 80 to 90% compliete, building permit application is submitted;

- As-built drawings: These correspond to the French *dossier d'ouvrages exécutés*.

We have seen that decisions by some commissions, such as the New York City Landmark Commission, are issued during the planning phase before the building permit application is submitted, and that others, such as the Fine Arts Commission of Washington, D.C., are associated at the earliest design phase, even when project goals are being determined. Finally, it should be noted that the tax credit application which involves experts specialized in the field of built heritage can lead to projects being called into significant doubt or even abandoned.

Design tools

In firms using the Microsoft operating system (QEA, Ann Beha Architects, Page & Turnbull, for example), I found that the preliminary designs were run with SketchUp drafting software. It is a simple program to use, flexible, and allows monitoring the appearance of what one is drawing, but it lacks precision, however. Design development is then done with Revit software. This program is not yet widely used in France because it is new, quite expensive, and very complex. It is in fact a database in which each component is associated with a multitude of characteristics such as its dimensions, composition, weight, and thermal or structural capacities. This software helps to simplify the relationship with the design offices once they master its functionalities. Architects have all shared with me the difficulty they have in moving from a drawing-based thought system to one of assembled components. Since Revit is was developed for new construction, they also have difficulty using it to represent existing buildings that are imprecise, contorted, ornate. In addition, architects point out the lack of a plug-in for timber framing, for which the demand is significant in the case of historic buildings. Without dwelling on the advantages and disadvantages of Building Information Modeling systems (BIM), and keeping to my objective of addressing how technological innovations can help improve the preservation of historic buildings, I simply wanted to emphasize that these tools, while particularly high-performing for new construction of complex buildings and integrating all construction data in a single file (appearance, surfaces, structure, HVAC and utilities, quantity measurements, etc.), they seem to pose more problems in the case of existing buildings. Software developers should focus more attention on this issue, given the size of the market for the renovation of existing structures.

VII. OBSERVANCE OF REGULATIONS

Architects' liability

In the United States, the concept of liability insurance for architects seemed rather vague to me. Confronted with the question, most of the architects I interviewed were perplexed, and instead directed me to the guarantees provided by construction companies. It seems that construction companies carry an extension of guarantee for the amount of the contract, known as a "performance bond," while the architect has insurance to cover his own design errors; the duration of this insurance depends on the contract.

This may partially explain why more original materials can be kept in an existing, renovated

building in the United States. In France, the ten-year liability of architects and the obligation of companies to offer work in compliance with building codes are major obstacles to the maintenance of historical materials. I find that this point, which I have only touched on here, deserves receiving further attention in future research, because it is certain that the rigidity of ten-year liability requirements, when applied to older structures, often leads to very heavy work.

Handicapped accessibility

I found that America is far ahead of France when it comes to standards of accessibility for disabled persons. Providing accessibility is obligatory when work exceeding 30% of a building's estimated real estate value is undertaken. Many buildings and sites have recently been or will soon be subject to implementing accessibility standards for the disabled. This is the result of Ordinance 88 ("88 Improvement"),[94] which bears evidence to the significant efforts that have been made in the interest of persons with reduced mobility in the United States. This very often includes the installation of an exterior access ramp, not always easy in the case of an historic building. Among the more interesting projects, I find the Baker House building in Cambridge, Massachusetts, built by Alvar Aalto and renovated by the EYP architecture and engineering firm, to be one of the most successful [Figure 25]. The small structure uses the same vocabulary and materials as the original building with its very colorful bricks. In another example, the creation of a handicapped ramp at the Oakland Museum by Mark Cavagnero's firm became an opportunity to completely redesign the entrance.[95]

In France, the law requiring facilities open to the public (ERP) to be made accessible to disabled persons dates from 2006, 11 years after the United States. The deadline for compliance is January 1, 2015.

Fire safety

In Washington, D.C., I was confronted with an interesting case.[96] At the National Gallery of Art (NGA) custom solutions were proposed by the National Fire Protection Association's Committee for Cultural Property and Historic Buildings. The Dutch painting gallery, with its oak-paneled walls, posed a particular problem. The architects of the National Gallery of Art wanted to keep these panels in order to maintain as much of the original materials as possible, and the curators wanted to avoid sprinklers at all costs. The system ultimately installed consists of high-pressure sprinklers. Using very little water, they create a mist of micro droplets that penetrate fire, blocking radiant heat and quickly cooling the space without damaging the artworks. Oxygen is also removed from the air.[97] Since installing the system was extremely sensitive due to several factors, it had to be verified through test-runs. Similar firefighting systems are in place at the Louvre, for example. Smoke extractors were discretely placed in the NGA skylights and are not noticeable. Indeed, the architectural quality of the building could have been ruined by poorly-integrated security equipment. As an interesting detail in this example, it was necessary in 1997 to determine the combustible mass of artworks in order to properly adjust the fire-ratings.

[94] In the United States, the legislation recognizing the rights of handicapped (Americans with Disabilities Act) was first debated in 1988. Signed into law in 1990, it was elaborated on the model of the Civil Rights Act of 1964. It first concerned the access to public transportation (ADAPT). Access to public facilities was made mandatory by a 1995 law.

[95] For these two projects, see travel journal.

[96] This example was explained by John Robbins, RMH Fellow 1991 and NGA Deputy Administrator, and Susan Wertheim, managing architect at the NGA, during our meetings on 13 and 14 July 2010.

[97] This is likely the HI-FOG system from Marioff (water mist high protection) or a similar one.

In New York, building codes apply as soon as more than 75 individuals or more than three families are gathered in a structure. This standard has been in force since 1938. Fire regulations are particularly restrictive, necessitating the installation of sprinklers and emergency lights as soon as these very low thresholds are reached. As seen in the case of the Twin Towers tragedy, the American system tending to favor detection and sprinklers over evacuation may need to be re-evaluated. Still, one must consider the relatively rare occurrence of such events, and clearly recognize the cost of safety installations (emergency staircases corresponding to the number of personnel can consume precious surface area, particularly in skyscrapers, and firebreaks between floor-levels can require adding significant amounts of expensive, heavy materials). I did not have the opportunity to delve into the possible consequences of subjecting older buildings to fire-standard norms. My impression was that the installation of a sprinkler system seemed sufficient.

Seismic retrofitting

In Los Angeles, I was struck by the number of old buildings that do not comply with seismic retrofitting standards and need to have remedial work done. For example, F.L. Wright's houses constructed in textile blocks were damaged by the Northridge Earthquake in 1994. Some of them, such as the Ennis and Freeman houses, are currently abandoned while awaiting significant repair work. In San Francisco, on the other hand, earthquake readiness is more clearly visible. X-shaped bracing is seen the windows of many older buildings, and I saw a very interesting seismic retrofitting worksite in progress at one of the buildings of the Presidio. Masonry walls are peripherally girded by carbon-fiber strips to create diaphragm walls. These walls are in turn linked to a horizontal spandrel course of L-shaped metal members belting each floor level [Figure 26].

Requirement to improve buildings' thermal performance

In the United States, meeting energy performance standards is obligatory for new constructions. One particularity of the American system is that objectives are defined in terms of cost rather than consumption, thus favoring low-cost energy sources without necessarily promoting architectural design based on energy economics. It must be remembered that the LEED credit system is distinct from respecting building thermal standards; it takes other aspects into account, such as the proximity of public transportation and so on. LEED accreditation is a voluntary step, desirable but not obligatory. It is popular for large office developments because the lower maintenance costs are attractive for buyers and tenants. Cities are responsible for verifying LEED qualifications. The highest grade (platinum) is very difficult to obtain, because it requires two additional points relative to the next-highest grade (gold). These two additional points are particularly delicate to achieve, requiring, for example, a non-smoking designation for an entire building. It is worth noting that obtention of the LEED platinum level results in the reimbursement of all costs incurred by the certification application.[98]

As a general rule, thermal performance criteria are not mandatory for older buildings. In New York City, however, protected buildings on the

[98] Among the LEED-certified buildings I visited in the course of the six months of study, I will mention the example of the Friends Center, a community building in Philadelphia. The members of the Religious Society of Friends are more commonly known as the Quakers. I observed that design quality criteria for harmonization with the historic character of the building were not considered in the LEED certification. A very recent building of a very contemporary architectural design is annexed to the historic one; it is responsible for the majority of the energy performance of the complex as a whole. The tools used are geothermal heating and cooling, rooftop solar panels to generate electricity, stocking of rainwater, a "green roof" with plantings, and the use of natural light. Source: http://www.friendscentercorp.org/ (website accessed 4 July 2013).

city registry (Landmarks) must meet to the energy code. On the other hand, buildings on the NRHP or the state registry are not subject to this requirement.

Comfort, air conditioning, energy economization

Every European who travels to the United States is struck by the omnipresence of air conditioning.[99] From the point of view of comfort and energy economics, this excess of icy air very often seems incomprehensible. Why not open the windows when it is nice outside? Why wear sweaters and jackets to the office in the summertime? Americans' indifference to these questions intrigued me a great deal. Looking more closely, I found that on the West Coast, air conditioning was used less frequently. Everywhere else, windows in offices usually do not usually open in order to avoid high-altitude drafts of air altitude, or the Venturi effect, etc. Sometimes I even found relatively low-tech systems interesting, such as the one at the National Gallery of Art in Washington, D.C. Originally, the deep water of the Tidal Pond (a pond created by infill on the banks of the Potomac River) was directly pumped in to supply the cooling system. [100] Additionally, outside air was cooled by pasing through a curtain of droplets from the municipal water supply. Since 2008, the water of the basin no longer being deep enough, and with a small worm posing maintenance problems, the NGA building was connected to the city system, as was the case for the heating.

Innovative examples of more energy-efficient climate control systems[101] are not lacking. One of the most famous is the Equitable Building, built in 1948 by P. Belluschi in Portland, Oregon. It has been on the NRHP since 1976 and the American Society of Mechanical Engineers (ASME) recognized it as a National Mechanical Engineering Historic Landmark in 1980 for its innovative groundwater heat-pump system for heating and cooling[102] several decades ahead of its time.

Among more recent examples, I had the opportunity for a discussion with the managing architect for the construction of the Bank of America tower at One Bryant Park in New York City, built from 2004-2008 by the architectural firm of Cock and Fox. The cooling system is based on a high-pressure gas cogeneration plant. This power plant supplies the building as well as some of its neighbors with electricity. At night, this energy is used to freeze basins located in the basement. The ice is used to operate the air conditioning during the hot hours of the day. Such systems are regularly used in power plants for hospitals, airports, etc. This plant is less powerful (60 KW instead of 5 MW). The extra investment is supposed to be profitable after five years.

So why is it that Americans do not care about reducing the energy consumption linked to air-conditioning use? I believe, without going into the details, that there is more to blame than the warm climate of the continent and that a radical transformation of habits and lifestyles would be needed. This question surpasses the scope of this study, but it is likely to become a crucial one in years to come.

Recognition of environmental constraints

In July 2010, I had the opportunity to attend a conference where the topic of discussion was the implementation of government policies

[99] A system controlling not only the temperature of the air but also its hygrometry, dust particles, etc.
[100] This system is similar to one I had previously seen at Nestlé headquarters in Vevey, J. Tschumi, architect, 1961.
[101] Generally, cooling systems use electricity or gas, and the fluids they use are pollutants.

[102] Today the building is known as the Commonwealth Building. It was a pioneering example of the architecture of office towers entirely in glass and totally air-conditioned, of which the United Nations headquarters and Lever House in New York are the most famous examples. The Equitable Savings and Loan Association Building in Portland first used tinted dual-pane glass and aluminum panels, a material widely produced in the region (by Kaiser Aluminum Company, for example) for the aeronautics industry, due to its low energy cost.

regarding the protection of National Parks[103] by the historic preservation community. Among the issues raised was that of tools common to both the preservation of buildings and of National Parks.[104] Initial findings were severe: landscapes were deteriorating because of the decreasing volume of visitors to the parks. In fact, young Americans are two times less engaged in outdoor activity than were their parents at the same age and with this, obesity has increased and poses a major public health problem. This conference was an opportunity for me to realize that environmental concerns do not intersect with those concerning the impact of lifestyles on global warming, on pollution, and on health in general. One is concerned with having efficient and economical buildings, cars, etc., but not with behavioral changes – using public transportation instead of cars, opening windows instead turning on air-conditioning, reducing urban sprawl by opting for collective housing – as a way of caring for the environment. A short film shown during this meeting organized to alert the public of the urgent need of returning to the National Parks, a crucial piece of United States heritage, made a quick reference to climate change with a splendid image of a part of an iceberg breaking away and sliding into the water. However, this portrait should be tempered with two examples. Some cities like Portland, Oregon, for example, are leaders in taking the quality of the environment in and out of the city seriously. New York City is putting plans in place to save energy, rethinking public spaces through the use of vegetation, and so on. Nevertheless, it could be pointed out that the opportunity to expand and rethink the Port Authority station hub located under the World Trade Center has been missed. Only the size of the World Trade Center Memorial was discussed. Yet, this is a strategic point for the development of connections with the suburbs, New Jersey, and elsewhere. In other matters, the case of cities with shrinking populations like Detroit or New Orleans is also problematic. Should public service levels be maintained despite lowering density? Should populations be concentrated in certain neighborhoods? The issues are vast.

Finally, few municipalities are conducting research on the possibility of rising waters as a consequence of global warming. A department at Columbia University is doing this kind of research on New York. This has led to the city withholding its support for an NPS project to renovate a historic site that may be threatened by rising waters.

Is an ecological approach possible in the United States?

I encountered few people in the United States who have a truly ecological approach, outside of those I met at Arcosanti.[105] This is a community in Arizona promoting a lifestyle with little need for fossil fuels, generating little environmental pollution, based on local organic agriculture, etc., and which prides itself on being a kind of prefiguration of what the post-petroleum-era lifestyle should be. Buildings constructed by the community are very futuristic. This city, originally planned for several thousand inhabitants but built for only a hundred so far, assumes the most economical form in terms of space and resources, according to its creator Paolo Soleri. Here, we are not talking about LEED targets applied to devices while ignoring behaviors. The inhabitants are engaged. They welcome the public to the site

[103] Listening session on historic preservation, 26 July 2010.

[104] We have previously explained that in NPS reasoning, these two notions, while having no apparent relationship in French thinking, are indeed linked in the United States.

[105] Arcosanti is a community built by the Italian architect and former resident of Taliesin West, Paolo Soleri, during the 1960-1970 period. Located about 60 kilometers north of Phoenix, it currently has around fifty members who support the community and receive volunteers, among them many young architects from all over the world, who participate in organic farming, building and maintaining structures, and making bells from clay or bronze. The site also offers lodging for tourists and an archival center where spectacular drawings by Paolo Soleri and an architecture studio are housed. The buildings contain offices, housing, workshops, and amphitheater, and community rooms.

to explain aspects of the ecological life, offering them lodging in guestrooms and food from their organic harvests. Proceeds from the sale of clay or bronze bells and catalogues of Paolo Soleri's drawings contribute to the community's income. They also welcome architecture students who come for six-month residencies to learn about the construction and renovation of buildings. By the time I visited Arcosanti, they were installing a solar heating system, a necessity in my opinion, given the rigor of winter nights in the guest rooms.

The significance of this architectural production is in its expression of the idea of the energy-saving city, and it is beginning to take on historical importance today. However, preservation of the work itself is not what seems to be crucial. According to the inhabitants, the idea is more important to preserve than its material form. Paolo Soleri's drawings are therefore carefully preserved and exhibited from time to time. This community striving for self-sufficiency in the Arizona desert reminds us that Americans were the pioneers of 1960s counter-culture[106] and among the first to develop and promote solar architecture after the first petroleum crisis in 1973.[107] I am very intrigued by the lack of this knowledge in everyday life in the United States, even as environmental and energy issues become increasingly acute. I was hoping to get the perspective of the last of the surviving pioneers on the issue of preserving existing cities, and I must say I was disappointed. I had the feeling that their conception of the ecological approach was based only on individual or communitarian initiatives, a sort of generalized "every man for himself" idea. However, in my opinion, these issues can only be dealt with effectively on a large scale and through public policies regarding the city, transportation, consumption, etc.

I am even more intrigued since reading in Lewis Mumford's[108] book an interesting parallel between the peculiarities of American architecture and climatic solutions necessary for adaptation to different environments. For Mumford, the roots of American architecture are deeply rooted in the independence of the United States and the rejection of copied colonial styles. True creativity free of any European influence begins, according to the author, with the architects Meade, McKim & White or Louis Sullivan at the end of the 19th century.

In addition, the influences of American architecture exceed those of Europe, drawing inspirations from a larger culture ranging from the Indian bungalow to the Japanese house. These two references are also important because their adaptation to a warm climate explains the particularities not only of California houses and traditional tropical architecture, but also the houses of the Greene brothers, Keck and Keck, and Frank Lloyd Wright, among others. This demonstrates great inventiveness in the interrelationship between climate and architecture.[109]

I discovered with regret that the subject of the specificity of modern architecture's relation to climate, a precursor of the bioclimatic architecture of today, is not more greatly appreciated as an asset and a patrimonial value to preserve. Our current focus on eco-friendly solutions for comfort that reduce energy costs

[106] C. Maniaque, *Les architectes européens et la contre-culture américaine* (doctoral dissertation under the direction of J.-L. Cohen, Université de Paris 8, 2006).

[107] M. Zardini, editor, *1973: Désolé, plus d'essence : L'innovation architecturale en réponse à la crise pétrolière* (exhibition catalogue, Montreal: CCA, 2007).

[108] L. Mumford, *Roots of Contemporary American Architecture: A Series of Thirty-seven Essays dating from the Mid-nineteenth Century to the Present,* introduction (New York: Grove Press, 1959). Lewis Mumford, a famous architecture critic, notably maintained an ample personal correspondence with F.L.Wright.

[109] One of the contentions of this study is that the relationship between architecture and climate is one of the pillars of American architectural inventiveness and considers America to be the pioneer of current bioclimatic architecture, thanks to its capacity to seek out examples in widely differing regions and bring them together. See, for example, J.E. Aronin, *Climate and Architecture: A Progressive Architecture Book* (New York: Reinhold Publishing Corp., 1953), or V. Olgyay, *Design with Climate: Bioclimatic Approach to Architectural Regionalism* (Princeton: Princeton University Press, 1963).

should help us bridge the gap between preservation and improved energy performance more often.

VIII. CONCLUDING REMARKS

Does protecting heritage from the Recent Past have its own specificities?

The initial questions which guided the first part of this report were directed toward understanding whether any specific approaches characterize the preservation of modern heritage in the United States. The different institutions, associations, means and tools in place for the protection of older heritage in the United States are the same as those applied to the recent past. Only the number and quality of edifices vary, not the rules or criteria used to address them. They are also submitted to the same regulations concerning **energy performance**, accessibility, and fire safety codes. As we have seen, the Fifty-Year Rule seems to disadvantage recent buildings. Nonetheless, thanks to the existence of local registries, there are ways around this rule.

An explanation exists for this lack of a special approach to architecture from the recent-past as distinguished from older periods. One of the first ambiguities to point out is modern architecture's relationship to history and the notion of heritage. We should remember that modern architects from the avant-garde artistic period between the two World Wars attempted a break with the architectural tradition of drawing inspiration drawn from old monuments, as had been the practice until the beginning of the 20th century. The movement for heritage protection which developed so vigorousy in Western countries around the 1960s was both a citizens' and an institutional response to the massive destruction of neighborhoods carried out in the name of modernism.[110] In New York, the opposition between two leading figures of urban planning, Robert Moses and Jane Jacobs, clearly illustrates this antagonism.[111] In such a context, it is not surprising that many of those who defend architectural and urban heritage, whether French or American, find it contradictory that neighborhoods and buildings constructed to replace older sectors are today attaining the status of resources worth protecting. They sometimes cite the ephemeral nature of some structures, built in response to urgent demands, but only planned to last a few years, as an argument against their protection.

Essential aspects of the American system of protections

An interest in everyday objects serves to remind us that monument protection in the United States is a grassroots movement based on citizen initiatives, even if knowledgeable experts such as historians, architects, and specialized commissions give their active support them. In principle, institutions and administrative bodies do not take a proactive role and they are unable to make propositions for protections. It falls upon individuals in a given area to bring attention to buildings of interest which are threatened.

We have also underlined the seriousness and rigor of preliminary studies conducted prior to beginning work on historic structures in the United States, with rules on how applications are presented and strict evaluation criteria. Further, we were impressed by the efforts of the National Park Service to document, survey,

[110] Certain founding texts date from this period, a foremost example being the Charter of Venice (1964).

[111] Robert Moses (1888-1981) was the author of the urban-planning renovation of New York between 1930 and 1970. He is sometimes compared to the Baron Haussmann for the great scope projects aimed at facilitating automobile circulation, to the disadvantage of local populations (creation of highways, etc.). Jane Jacobs (1916-2006) was a writer, urban-planning philosopher, and activist. Her ideas perceptibly influenced American urban planning. In her work *The Death and Life of Great American Cities* first published in 1961 in New York, she criticized the excessive urban renovation and modernization of cities.

and archive historic buildings, making this information available to the public via its Library of Congress database. We have also found the circulation of "best practices" rules intended for private individuals and professionals found in the Technical Preservation Briefs to be remarkable.

We have also pointed out the fact that the Americans were pioneers in mid-century **bioclimatic architecture**, a movement largely abandoned despite the interesting structures and valuable knowledge it produced. In a general way, the degree to which modern edifices take into account the environment in which they are built, and the comfort of their occupants often goes unrecognized. Assuredly, this aspect of 20th-century architecture ought to be taken into greater consideration by the preservation world, still characterized by its reluctance to consider architectural design based on climate-control and energy data as worthy of preservation.

PART 2 : ISSUES AND PROBLEMS WITH RECENT-PAST PROTECTIONS IN THE UNITED STATES: CASE STUDIES

Introduction

In this second chapter, I wanted to give a perspective on the richness and attention from which America's recent past heritage benefits. I have already mentioned the fact that, over the course of my six months of research, I discovered aspects of the protection of modern architecture which I had not suspected. This chapter aims to offer a view of the main themes I addressed, and the principal issues they entail.

I. THE VALUE OF INDUSTRIAL DESIGN: SAFEGUARDING SINGLE-FAMILY HOMES

Just as in France, the greater part of construction taking place in the United States during the second half of the 20th century was for housing. American choices are quite different from French ones, with the emphasis placed more on single-family dwellings than apartment buildings. Here I will cite some examples which particularly drew my interest.

Palm Springs

The residents' associations with which I became acquainted are generally composed of a very limited number of members. Their activity mostly involves the creation of a blog or internet page used to promote their activities or the neighborhood they support.[112] One Palm Springs organization for the preservation of modern architecture is different. Its members organize "Modernist Week" in February of each year as well as the Alexander Tour. During these events, one can tour private residences, villas, or tract homes, attend lectures, exhibitions, etc. While this is a worthy initiative, it deviates a bit, in my opinion, from its initial objective – the research-based historical conservation of a structure or a built ensemble of recognized quality. Some of the property owners with whom I exchanged admit that authenticity is not a primary preoccupation; one is more concerned with "spirit and creativity". Such an approach is at odds with NPS best practices rules for historic conservation, for it encourages a more "romantic" conservation style subject to personal whim. One seeks not only to preserve a home's charm but also the different elements that increase its market value.

Attending this event brought my awareness to the density of voluntary association work in neighborhoods to whom the name of a famous architect or builder is attached. The Palm Springs event attracts numerous amateur visitors from the region and beyond who are interested in architecture and design, but few professionals. The houses are considered as architectural works in a state of conservation as close as possible to their original look, yet with all the modern comforts to give them higher real-estate value.

In the process, I visited the Edris House, built in 1954 by the architect E. Stewart Williams. The current owner, an architect, embarked on an extensive renovation of the house, while maintaining as closely as possible its 1950s appearance as evidenced in vintage architecture magazines. The wooden ceiling was completely replaced during the installation of air conditioning and exhaust fans in the kitchen

[112] One could mention such organizations as Tulsa Modern or the one in Hollin Hills, for example.

[Figure 27]. Air conditioning installation also led to insulation of the exterior walls whose cladding was replaced with the same material used for the ceilings. The interior and exterior appearance are thus significantly different from the original, but this is the price to pay to meet current standards of comfort and protect the house from depreciating in value. Yet, in my view, the loss of authenticity and material integrity could be said to take away just as much value from the property.

This observation leads me to another. For whom does authenticity represent the greatest value? For the historian? The architect? The property owner? For owners, the goal is to leave their heirs a property with profit-earning potential. The freedom of life choices offered by increased value is an important factor to take into consideration. It is essential to find ways to reconcile this type of value with historical value.

I confronted this issue elsewhere, such as in the case of the renovation of a house built by R. Schindler in the Palm Springs area. The current owner is renovating the house to pass it on to his daughter. Since the structure is not subject to protections, he has total freedom to carry out the work as he pleases. Nonetheless, he engaged an architect in order to avoid making errors,[113] he acquired the original drawings from the Schindler archives and is trying as best he can to follow them [Figure 28].

Hollin Hills[114]

The neighborhoods of single-family homes developed after World War II to house families of modest means during the post-war Baby Boom are numerous. Responding to the heavy demand for low-priced housing, some of development projects demonstrated very intelligent planning. Because they are less well-known, serious problems exist for their safeguarding today.

In the Washington, D.C., region, several housing developments were built by the architect Goodman. In the largest of these, Hollin Hill, many houses are preserved by their owners because of their simple yet elegant design which has become a factor of increased value. The relationship to outdoor space conceived by the landscape designer Dan Kiley is organized in a very sophisticated way. Each house has its own small outdoor space, but views are always oriented to wooded perspectives and direct views between houses are avoided. Despite the lack of fences, there are no usage conflicts. The different types of homes take advantage of the uneven relief of the site, which had previously been considered unbuildable because of its slope [Figure 29].

At the same time, there are serious questions about the neighborhood's capacity to survive. The very inexpensive construction methods – sheets of pressed board fixed to wooden studs and large surfaces glazed in single-pane glass – today require significant maintenance and updating. The climate and the desire for a comfortable home have led most residents to install air conditioning. The walls, however, are very inefficient in terms of insulation and air-tightness. Thus, to improve living quality and to reduce energy expenses to reasonable levels, the originally very simple, elegant design details have been effaced, loosing little by little their coherence. This is a paradoxical situation, since the value of homes in this neighborhood is largely indexed on their design integrity, together with their level of technical amenities. As is often the case in unique places, neighbors make sure that demanding levels of quality are maintained in renovations so that the neighborhood's authenticity is not diminished, thus negatively impacting the

[113] Ana Escalante, who indicated the example to me and suggested that I visit.
[114] Visited 19 July 2010.

other homes. They defend their interests through a preservation association and a web site.

Whatever the case, the problem of energy economy seems unsolvable. According to one of the neighborhood's residents, replacing windows in his completely glassed-in house would only be cost-effective after 120 years. This attitude, which would be seen as irresponsible in France, must also be considered in relation to the climate. Winters are mild in Washington, and while summers are hot, large shade trees assure a certain level of comfort. Ultimately, this neighborhood is able to maintain itself thanks to its affluent residents who can afford to keep it up and pay electricity charges.

The Presidio, San Francisco

The example of the Presidio combines a park and a group of residences. It is a former military site taken over by the NPS after the army left. Today, the NPS manages both the park and housing development. The desire to conserve and transform the building is in itself a worthy initiative for the site's ongoing existence. The difficulty was in making the complex financially independent while protecting its historic, natural, and cultural resources, which is the fundamental mission of the NPS. It has to be remembered that public agencies are not authorized to generate revenue. It was therefore necessary to create a federally-owned company distinct from any other type of government agency, with a seven-member board of directors. The 200,000 square meters of military housing were transformed into rental housing, very attractive to families due to the situation within a park, the proximity to downtown and to schools, and tax-exempt status. There are about 4000 residents. Additionally, 4000 employees work principally at Lucas Films, which built a complex on a portion of the park where a hospital, demolished, had previously stood. The development has its own comprehensive utilities network including sewerage, with gas being the only exception. There are 800 buildings in all. Of the 72.8 million dollars of annual income from rentals, 58 million is invested in the renovation of further buildings. The U.S. Congress contributed 20 million dollars a year for fifteen years to cover the cost of initial renovations. This exceptional financing program ended in 2013.

II. INTERPRETING MODERN ARCHITECTURE

Iconic homes of Los Angeles

Over the six-month period, I had opportunities to visit numerous houses considered to be icons of modernism. Los Angeles is the city which boasts by far the greatest number of these jewels. The Greene brothers' most beautiful house, in Pasadena, reminds us how very rich the early 20th century and the Arts and Crafts movement were for architecture and design. The private residences of Richard Neutra and Rudolf Schindler reveal the genius of these two architects [Figure 30]. Several "Case Studies" houses are open to visitors. Private individuals such as the Stahls[115] organize sunset visits to allow tourists to enjoy the spectacular views of the city [Figure 31]. Admission fees support the houses' maintenance costs. It should be pointed out that the real estate market for homes by famous architects appears particularly lucrative in Los Angeles, with some agents specializing in such transactions. During a visit organized by one agent, I had the good fortune to enter the house of Alice Milliard, also known as "La Miniatura," built by Frank Lloyd Wright in Pasadena in 1923. The house has been on the market for a num-

[115] Case Study no. 21, built by Pierre Koening. The photographer Julius Schulman published spectacular images of this house perched above the city, surrounded by its swimming pool.

ber of years without finding a buyer.[116] The Ennis house, also built by Wright, was seriously damaged during the Northridge earthquake in 1994, then again by storms in 2005. The villa, judged to be in a dangerous state, has been listed as one of the National Trust's list, "The Eleven Most Endangered Buildings." A bank loan of 4.5 million dollars backed by the Federal Emergency Management Act provided for the most urgent repairs in 2006. Placed on the market for 15 million dollars in 2009, the house was finally signed over to Ron Burkle for 4.5 million dollars on the condition that the mansion be opened for visits twelve days per year. The cost of work to make the house inhabitable will likely surpass one million dollars. On must clearly dispose of considerable means to own and maintain an iconic residence. This the reason many choose to open their homes for paid visits.

Obviously, other regions equally demonstrate a host of magnificent houses. Suffice it to mention the prodigious Glass Houses of Philip Johnson or Mies van der Rohe's Farnsworth Villa which we have previously mentioned, without forgetting Saarinen's houses at Bloomfield Hills or the Walter Gropius house in Lincoln, Massachusetts, etc.

Iconic houses by Frank Lloyd Wright

The architect who created the greatest number of marvels is without a doubt Frank Lloyd Wright. Public admiration for his work is so great that it is sometimes necessary to reserve tickets several weeks in advance for one of the hundreds of spots offered for sale each day. The house built over a waterfall, Fallingwater, is surely the most visited, but one should not neglect mentioning the success of the Prairie Houses in Chicago,[117] the two Taliesen estates, etc. I have chosen here to rapidly describe two examples which are especially interesting in my opinion and which deserve further study, especially since Wright's work is currently being proposed for UNESCO World Heritage designation. Here, I wish to address issues related to interpretation: What does one show in a house museum? To whom and for what reason?

Hollyhock House

Hollyhock House in Los Angeles [Figure 32] was completely ravaged following its abandonment. Its owner gifted the grounds to the city but the house was left to deteriorate. Finally, the City of Los Angeles undertook a major renovation. Greater stake has been placed in the home because it heads the list of Wright's works to be nominated for UNESCO recognition. Very few original materials remained in the abandoned house. The reconstitution has thus relied on documents such as plans, descriptions, and photographs. This is an example of research-based use of documentation, but what is the fundamental purpose of such an endeavor? The living room was 90% reconstituted. It gives a strange impression, because the viewer is not sure which parts are truly original and which are restorations. Similarly, one also wonders about the exactitude of elements resulting from such a far-reaching reconstitution – there are even fabrics, furnishings, etc. – and one has the sense of an interpretation perhaps replete with error and imprecision. The rest of the house, conversely, is in a proper state of conservation but the rooms are empty. Obviously, in a house of these dimensions, everything cannot be restored to its original state, so a level of restoration and historical period of reference must be chosen. Placing emphasis on a single room creates, to

[116] The real estate agent Crosby Doe is in charge of the transaction. The asking price has not been made public, but surely reaches several million dollars. For a comparison, a small Case-Study type house without garden built by Craig Elwood in 1959 sells for around 800,000 dollars.

[117] One can view them from the exterior. Only Frank Lloyd Wright's personal residence and the Robbie house are open for visits.

be sure, a sort of event to attract the public, generating revenue to undertake restoration work. Yet it also raises doubts about the approach.

Hanna House

In the case of Frank Lloyd Wright's Hanna House built at Stanford University in Palo Alto, California [Figure 33], the work invested in interpretation is lighter than in the previous example, the purpose being more to reveal the existing than to restore. Also, this is not really a house museum setting, nor is it a lived-in residence; it is used by the university for receptions and conferences. The first level of interpretation is carried out: the identity of each room is signified by its furnishings. Missing pieces were replaced with commercially available items from Ikea or through the low-cost online marketplace Ebay. These elements have been discretely incorporated so as not to draw attention or have the pretense of replicating the original disposition. The curator then moves to the second level of interpretation, that of communicating parts of the house's rich history and revealing some of its characteristics. This could be the furniture by European or Japanese designers which the Hannahs added to the home, despite Wright's disapproval, after their many travels. Or perhaps the Japanese inspiration for the garden. Or the presence of speakers throughout the house to transmit music from the organ or record player. Such as thematic approach also allows renovation by sections while keeping the coherence of the ensemble. Yet, this remains an interpretative act and thus supposes a contemporary intervention, such as when a Japanese landscape designer was called upon to create a project to give some coherence back to the garden. Interpretation implies judgement and ideas about what is good or bad design. What is appealing about the approach is the ability to choose a maximum degree of restoration and to go no further. Unlike Hollyhock House, it is not necessary to see to what point the restoration was pushed in order to give the place meaning. This represents a more moderate and pragmatic approach.

III. RENOVATING THE MUSEUMS OF THE PAST AND KEEPING THEM RELEVANT

I was struck during the six months of research by the number and variety of additions to art museums. They involve big names in the architecture world just as often as they do smaller firms. One is stunned to realize how often Renzo Piano has been commissioned for these expansion projects. Notably, his firm has completed additions to the art museums of Chicago, Los Angeles, and Fort Worth (Kimball Museum). Norman Foster, for his part, has created additions to the Boston Museum of Fine Arts and the National Portrait Gallery in Washington. Below, I touch on some particularly interesting examples and which also give some idea of Americans' thriving engagement in visiting museums.

Franklin Court Museum

This example is among the most informative I discovered over the six-month period as regards the issues posed by the conservation of recent architecture. The exhibition set-up in this complex built by R. Venturi and D. Scott Brown in 1975 is now obsolete. Consisting of an ensemble of sculptures arranged in a courtyard in the center of a city block and below-ground exhibition galleries accessible via a dark ramp, the museum has become quite outdated. On this visit, I had the thought that Americans have a greater need for interpreting history than the French. This is the same impression one has of Mission 66 where numerous interpretive visitor centers flourish. The case is the same here, and this is one of the

more successful examples. The Ghost House represents Benjamin Franklin's home, demolished in the 19th century, in the form of a metal sculpture [Figure 34]. The evidence used a s a basis for the reconstitution are mentioned: texts, extracts of letters, and archeological vestiges are displayed on the floor.

In this historical context, I am able to better grasp the purpose of Postmodern architecture: how can this story be told without endowing it with a minimum of vocabulary? This is an illustration of the tendency so much in vogue in the 19790s to imbue places with meaning, even the most ordinary ones. This interpretive mode has in itself become a part of history today. This is the difficulty confronted by the architects at Quinn Evans who are in charge of the project. How does one go about transforming this recent-past, each element of which has a particular significance, and put it on display in the context of a new design that visitors will find appealing?

The NPS owns the site. At an early stage in the project, D. Scott Brown, one of the architects of the original design, made a series of remarks insisting on the lack of analysis of the building's historic value by recognized experts and the absence of recommendations and communication about the design process. His words were very poorly received by the experienced team at the Quinn Evans firm and damaged the good relationship existing with the commissioning client. Admittedly, the project had a hard time finding a clear direction or design philosophy, for the plan was to create a contemporary addition imitating the constructive qualities of the existing complex – screen-printed glass representing a brick wall, a perforated shade suggesting a former canvas awning, a reinterpretation of a wooden trellis, etc. – and in this context one can understand the reaction of the architects Venturi and D. Scott Brown, who had preached on favor of ordinary architecture carrying meaning in the slightest of its details, their work rendered incoherent by the renovation project. One sees here the considerable difficulty of adding an intervening layer to a sophisticated Postmodern work of this type. One could also ask why the commissioning client did not solicit the original architects, who are still in practice, to design the renovation. Two explanations can be offered for this situation. Firstly, the NPS tends to work with architects experienced in the field of preservation; secondly, it often proves difficult for architects to re-interpret their own work without trying to create a different project all together. In any case, I found this to be a particularly stimulating exercise from an intellectual standpoint.

Oakland Museum

The Oakland Museum poses somewhat the same problems as the Franklin Court Museum; however, this example demonstrated that the basic architectural form and the background of the intervening architects are determining factors. A peculiar work by Kevin Roche dating from the 1970s, the museum is a very closed construction from the outside, a brutish concrete monolith with steps leading down toward an interior garden. This disposition opens up terraces onto which open dark, outdated exhibition halls. There are effectively three museums placed one on top of the other and built on a pedestal of parking garages, linked together by a system of staircases. Here, the individual elements are not really significative, but the architecture, and especially the landscape work by Dan Kiley who designed the terraces and garden, have a strong presence. It was not easy to find the proper means to enlarge and renovate the ensemble without destroying such strong unity. The question of architectural vocabulary and compatibility with existing materials was complex. Architect M Cavanaro of San Francisco proposed exten-

sions using very simple volumes covered in stainless steel which supplant the unused former patios. Stainless steel is also used for the additions on the interior of the museum, such as the ticket booth. This intervention offered a solution for the handicapped accessibility. Finally, contemporary-style signage was installed, giving a youthful air to the somewhat old-fashioned museum. Here, the choice was made to use elements from the vocabulary of contemporary architecture, without resorting to a pastiche or to literal references. Brutalist architecture receives this type of stratification with more success than Postmodernist works as in the previous example [Figure 35]. I must mention another museum extension project I found just as interesting, the Portland Museum of Art (Oregon) by Ann Beha Architects. While the original building is older than the one in Oakland, the glass makes a clear contrast [Figure 35]. The interior space was imagined in order to adapt not only to the historic construction in which it is inserted, but also the P. Belluschi building from the 1950s to which it serves as an extension. The use of different flooring materials is particularly well imagined; it underscores the boundaries and articulations between the different part of the ensemble.

Additions to neoclassical museums

I discovered that many cities had very similar, neoclassical-style art museums, but the ways in which they have been enlarged vary quite a bit from one place to the next. Historic buildings from the circa-1910 period are generally elongated, clad in stone, and present a sober colonnade on the main façade. Their setting typically within a park makes future extensions possible. In Cleveland and Toledo, Ohio, just as in Kansas City, Kansas, I observed that mid-size cities do not shy away from calling on the greatest names in architecture. In Cleveland, the original building was extended toward the rear with the addition of wings and courtyards in 1976 by Marcel Breuer, and again very recently by Rafael Viñoly. These two buildings offered the opportunity for an interesting reinterpretation of the vocabulary both of the stone courses in the historic façade as well as the 1970s addition [Figure 36]. The first extension made way for infrastructure that had not previously existed, such as the auditorium, cafeteria, and gift shop. It was also the chance to create a second entry for visitors arriving via the parking lot and for groups. The second extension houses administrative offices, workshops, and new temporary exhibition space.

In Toledo, another approach was used. The Japanese architects from the Sanaa firm, recipients of the Pritzker Prize, created a glass pavilion totally separate from the museum. Its curving walls in continuous, full-height glass pay homage to the city's industrial tradition. In fact, the windshields of Ford vehicles assembled in Detroit were produced in Toledo. When the factory left town, the whole region entered an economic recession. The museum extension is a way to conserve some activity and appeal.

The architect Steven Holl designed the extension to the museum in Kansas City [Figure 37]. The existence of a vast, Dan Kiley-designed park allowed for a partially underground extension, its presence signified only by minimalistic glass protuberances. I found the quality of this work quite seductive, with a magnificent play of light on the interior. The vocabulary and materials utilized, minimalistic and hushed, are in harmony with the stone building. The museum is well received by the city's residents. I went to a reception to raise funds for upkeep of the buildings and to enrich the museum's collections. I understood that promoting quality contemporary architecture in existing museums is crucial. Not only is this a

way to attract tourists to cities experiencing an economic downturn, it is also a way to create spaces for the local community to come together in a positive way, inspiring investment in the maintenance of its built heritage.

IV. HOUSES OF WORSHIP

I would like to quickly make mention of certain churches and houses of worship which impressed me. Growth of population in the 20th century, the birth of new movements such as the Church of Christ, Scientist,[118] and the development of Catholic churches due to immigration from Latin America have led to the construction of numerous religious buildings.

I also discovered that the Catholic Church has also financed some very interesting buildings, mostly on the West Coast. A church by P. Belluschi and P.L. Nervi in San Francisco is one of the most surprising examples. One could also cite several remarkable, more recent works. While these do not yet qualify as historic structures, they represent without a doubt a category of edifices worthy for such consideration in future years [Figure 38b]. These include the Cathedral of Christ the Light (SOM Architects) in Oakland [Figure 38a], the Cathedral of Our Lady of the Angels in Los Angeles (R. Moneo) [Figure 39], and the Chapel of Saint Ignatius built by Steven Holl on the campus of Seattle University [Figure 40].

Finally, I would like to mention some other examples of chapels which attracted my attention. I appreciated the simplicity of wooden religious structures built in the Seattle region during the years 1950-1960 by the architects P. Kirk and P. Thiry [Figure 41]. Two chapels built in the forests of Arkansas by E. Fay Jones in the 1970s were well-deserving of the AIA prize one of them garnered [Figure 42]. I particularly appreciated the church designed by Philip Johnson in Dallas [Figure 43]. Lastly, I was fascinated by the MIT chapel in Cambridge by E. Saarinen [Figure 44]. In sum, the subject of the preservation of remarkable religious buildings in the United States deserves to be more deeply developed.

V. EDUCATIONAL FACILITIES

Over the course of these six months, I had opportunities to visit a number of university campuses. It must be understood that every city boasts remarkable historic infrastructures of this type. The expansion of universities in the 20th century contributed to creating one of the most interesting subjects for the study of architecture and modern urban landscapes. One need only cite a few examples to convey the richness and the potential of this subject. It is surely the Yale campus in New Haven which gathers the most remarkable 20th-century buildings. They were designed by P. Rudolph, E. Saarinen, SOM, and Louis I. Kahn among others. The campuses of MIT and Harvard in Cambridge are not to be outdone, with constructions by A. Aalto, E. Saarinen, S. Holl, I.M. Pei, J.L. Sert, Le Corbusier, etc. Sometimes, one finds exceptionally fine works on the edge of campuses, such as the student residences by R. Neutra at UCLA. Chicago alone boasts three campuses: one by SOM (University of Illinois), the University of Chicago[119] and, finally, the Illinois Institute of Technology by L. Mies van der Rohe. One of the most famous buildings on this campus, Crown Hall, which houses the school of architecture, underwent a major renovation only a few years ago.[120] Also worth mentioning is the recent extension of the

[118] Or "Christian Science", a movement founded by Mary Baker Eddy in 1879 in Boston.

[119] This campus is subject to guidelines for the preservation of its remarkable architecture. See H. Hunderman, D. Patterson, and R. Brumstead ("University of Chicago Guidelines for Contemporary Architecture", in *Preservation Technology*, dossier 8, "Restoring Postwar Heritage," 2008, pp. 5-13).

[120] We will return to this example in another section. See page 90.

McCormick Tribune Campus Center by OMA, a project which shows the potential for modifying these Modern-era buildings in the contemporary period. The OMA intervention indeed contrasts with the rigorous geometry of the original building design by introducing lines based on movement and fluctuation (railway transports and the circulation patterns of students) and by excavating below ground to create new spaces, but it gives new meaning to buildings which were no longer well-adapted to their uses.

VI. PUBLIC SPACES

I was struck by two examples of buildings threatened with demolition because of, or perhaps in spite of, their integration of high-quality public space. Public spaces do not have a recognized value that is taken into consideration for protecting the built ensembles they articulate. I will touch on some cases in which modern built heritage is endangered by a lack of adaptation to contemporary urban issues. It must be stated that public parks and landscapes are not treated in this report. They comprise nonetheless a subject that deserves to be addressed, and the work landscape designers such as D. Kiley or J. Halprin merits greater attention. The subject of the preservation of open space in neighborhoods of semi-individual dwellings[121] could likewise be further developed.

Example of the Philadelphia NPS History Center

This architectural ensemble is equally interesting for the quality of the public space serving as its forecourt. The clock tower is a reminder of Philadelphia's history and is echoed by the historic edifice built facing it in the extending park. The unity of materials – brick both as pavement and in building elevations – and the minimalist architecture have not been sufficient arguments against the destruction of the buildings which are no longer properly adapted for museum exhibitions, especially since they are not situated on the main tourist corridors [Figure 45].

What is surprising in the two cases is the practice of "taking back" a space which, while indeed privately owned, had been offered for public use. Almost nowhere besides New York City does one find this type of space, often of small dimensions since it is used as an exchange to obtain the right to build a few floors higher than normally allowed. Even so, it is an interesting opportunity when cities are able to acquire use of such public spaces, and cities should oppose their elimination. This issue would perhaps benefit from closer study in a research project devoted to this very theme. Cities like New York are currently showing that new uses are possible for public spaces[122] other than as space for the homeless to live as can sometimes the perception in the United States, potentially opening the way for major changes in American ways of living.

Example of Third Church of Christ, Scientist, Washington, D.C.

This is an example of singularly unique work, not well enough known and sufficiently misunderstood that it is slated for demolition. Situated only steps from the White House at the center of a city block, this Washington, D.C., ensemble is comprised by a chapel, an L-shaped office and classroom building, and a gallery linking the two [Figure 45]. The building acts as a sort of partition with regard to the existing buildings and reserves an open public space, even though the lot is private, a rare situation in the United States. The disposition and form of the building is reminiscent of the

[121] Neighborhoods of semi-individual housing such as Baldwin Hill Village in Los Angeles, Park Merced in San Francisco or Lafayette Park in Detroit are good illustrations.

[122] See, for example, the travel journal entry concerning Flatiron Square integrated at the intersection and which has become very popular.

AIA building in Washington (Architects Collaborative, W. Gropius Architects). There is a veritable pathway in the interior of the block, rendering a particular spatial richness to the ensemble. In this work one recognizes the intelligence, know-how, and European urban influences of the architect A. Cossutta[123] associated with the genius of I.M. Pei. For the owners, however, the costs of running the church building are too high and its exterior appearance considered too radical.[124] In my view, the fact that the parcel is underutilized also poses a problem. By redeveloping the complex, it would have been possible to create a larger, more lucrative real estate project on the site, placing the worship space on the ground level of an office building, for example. I was surprised that among the commentaries made, few specialists made light of the exceptional character of this work whose appearance was harmless. From the point of view of its brutalist architecture, but also its urbanistic quality[125].

Example of First Church of Christ, Scientist, Boston

This example had a more favorable outcome than the preceding case. The First Church of Christ, Scientist, complex in Boston was protected in 2011 by designation as a City Landmark, thus recognizing its architectural and urbanistic quality [Figure 46]. It is one of the most love spaces by inhabitants, and yet since 2007, different projects developed by the church are cause for doubt about the future of the neo-Corbusean buildings erected by the same architects, Pei and Cossutta, in the 1970s. The 700-foot-long reflecting pool (around 210 meters) is particularly endangered. Despite the complex's Landmark designation, the building with porticos vaguely suggestive of Chandigarh will be surmounted by a new tower, and the auditorium placed at the extreme end of the reflecting pool will be associated with a second tower as well.[126] From the preservationists' point of view, this is a victory. Despite all this, one can truly wonder about the appearance the ensemble will have once it is densified. This compromise seems to be the best possible outcome with these private owners [**Error! Reference source not found.**].

Municipal government centers

I was very interested in the municipal government centers built during urban renewal in the 1960s and 1970s. This movement gave rise to various projects that deserve to be studied in greater depth. Such is the case of City Hall Plaza in Boston, to cite one example [Figure 47]. This sculptural building in raw concrete was built in 1968 by the architects G. Kallman, M. McKinell and J. Knowles. It emerges in a vast open space of a gigantic scale which is very poorly perceived by the population. Multiple projects have been envisioned for reorganizing this space differently, but none of them have ever taken off. Transformation the esplanade thus remains an ongoing challenge. The same issues may be applied to the neighboring building, the Government Service Center designed by Paul Rudolph [Figure 37]. Built in 1971, left unfinished, it poses a problem similar to the one seen in neighborhoods on slab in France: accessibility and use of public space for pedestrians located several levels above the street. This is very important because the public space around which the different planned uses are articulated is underuti-

[123] Araldo Cossutta's status as a preeminent architect of this period must be emphasized. He is the creator of numerous works including the Crédit Lyonnais Tower in the Part-Dieu of Lyon. Cossutta is a Richard Morris Hunt Fellowship jury member.

[124] See http://www.npr.org/templates/story/story.php?storyId=93844919. Web article consulted 7 May 2013.

[125] The ensemble was demolished in 2014 following a seven-year battle Its "brutalist" character situated in a context close to the While House and the fact the congregation lacked enough space won out over this unique ensemble. Particularly, the dimension of its free space was not able to convince the city, which authorized the demolition despite the opposition of preservation organizations and the City Landmark status it had acquired after a previous demolition threat in 1991.

[126] See http://fr.slideshare.net/bostonredevelopment/christian-science-center-revitalization-plan. Accessed 5 September 2015.

lized and poorly maintained. This underutilization can of course lead calling the whole ensemble into question, despite its coherence with the esplanade. Indeed, the parcel visibly is not sufficiently dense in relation to the uses and its situation in the very center of the city. If the building itself is also dysfunctional, this makes for a situation in which demolition is desirable.

The Municipal Administration Center of Dallas designed by I.M. Pei is a spectacular achievement in raw concrete [Figure 49]. Its surrounding park is popular with the public, while the esplanade between the administrative building and the library would benefit from a new design to protect it from the sun in order to accommodate a greater variety of uses. Constitution Plaza in Hartford [Figure 50], Empire State Plaza in Albany, and the Pittsburgh PPG Center built by P. Johnson [Figure 51] could also be mentioned as places where public space could be improved for the preservation and enhancement of the buildings surrounding them.

The Lincoln Center for the Performing Arts in New York, a major urban renewal project instigated by Robert Moses, has recently undergone a very inspiring renovation [Figure 52]. It took about ten years and cost 1.5 billion dollars. Architects Diller Scofidio + Renfro, Fox Fowle and Beyer Blinder Belle completed a redevelopment of the complex that radically transformed its image. The theaters built in the 1960s by E. Saarinen, G. Bunschaft, Harrison and Abramowitz, and P. Johnson were restored – the marble-clad concrete panels had notable problems of stability. But it is especially the esplanade and the reflecting pools that have been renovated following a very contemporary vocabulary that modifies the perception of the whole. In addition, the extension of the Julliard School and Alice Tully Hall (both buildings by P. Belluschi) by the architects Diller Scofidio, Renfro and Fox Fowle offered the opportunity to bring contemporary architecture into the ensemble. Thus, the Lincoln Center, formerly with an old, outdated image, is experiencing a renewal the success of which is proven by strongly reinforced public attendance.[127]

Safeguarding the urban heritage of downtowns: between return and abandonment

I was astonished to see the disparity in the popularity of downtowns, and the two extremes are incarnated in the cities of Pittsburgh and Detroit. In both cases, the departure of industry has seriously affected the city. After once being the prosperous Steel City, downtown Pittsburgh emptied out as offices left downtown. The commercial real estate market, however, was not totally ruined and a certain activity level was maintained. As in Portland, Oregon, the old industrial districts have become opportunities for a young population of active workers who have moved in; they tend work on the internet and have comfortable incomes. It should also be noted that the city has converted to the health services sector, thus maintaining a lucrative industry. This is reflected in the vitality of the businesses and the creation of an organic foods market. The city supports this movement by investing in redevelopment projects on the banks of the Allegheny River, making the city center more attractive. In the process, vacant office buildings are being reoccupied by companies,[128] or else transformed into housing for people who wish to get out of the suburbs and experience a better quality of life without having a car.

There is no evidence of any such strategy in Detroit, unfortunately. Struck by a huge eco-

[127] T. Prudon devotes a chapter to this renovation in *Preservation of Modern Architecture* (New York: John Wiley & Sons, 2010).

[128] At the same time, it should be noted that businesses renting office space are very demanding about renovations conceived to reduce energy costs. The real estate market for existing office can therefore only function if investments are made to noticeably improve performance in terms of energy consumption.

nomic recession following the departure of the automobile industry, activity has completely vanished from the city center. Still, we can commend the restoration of the historic Book Cadillac building, now converted into a hotel by the Westin chain. Even so, most buildings remain abandoned, and some have even been destroyed. Detroit has become a ghost town.

Chicago has managed to avoid this pitfall by transforming some of its remarkable historic buildings into university facilities. One example is the city block where the auditorium and hotel built by Louis Sullivan are located, now a property of Roosevelt University. It must be stressed, however, that in order to maintain this type activity in the city center, the universities must be creative in their expansion plans and willing to adapt spaces to suit their needs. Here, the university built a "vertical campus", that is to say a tower with classrooms and student residences on one parcel in the block.

VII. CONCLUSIONS

Through the study of these examples, we can see that the topic of safeguarding modern architecture in the United States is quite rich and diverse. It seems fundamental to closely consider societal, urban, and political issues in heritage protection. The situation is full of contrasts. Vintage single-family homes represent a flourishing market. Museums readily finance ambitious projects in the interest of attracting greater numbers of visitors. On the other hand, universities have difficulty maintaining their built heritage in the face of real estate and financial pressures. City edifices which afford generous spaces for the public are falling down or risk totally disappearing due to the same real estate pressure. Finally, historic downtown buildings are extremely dependent upon local economic circumstances. The question therefore arises of how to bring all of these issues together in our reflection on the safeguarding of built heritage.

The subject of preserving 20th-century architecture in the United States is virtually inexhaustible. The investigation we rapidly summarize here could be deepened through further research, topic by topic, multiplying the number of pertinent examples and demonstrating more useful techniques and practices. The impressive quantity of constructions from this period, the rapid changes in techniques and materials, the apparent absence of "historical" value, the banal or brutalist character of edifices sometimes perceived as ordinary, all invite one to reexamine both the philosophy and the practices and techniques of conservation-restoration as developed for earlier periods.

The sheer number of 20th-century edifices equally poses the question of how to choose what ought to be saved.[129] Institutions cannot intervene in all of the battles, nor can they finance all of the renovations, and perhaps one should instead develop propositions for prospective protection accompanied by scheduled "sacrifices" of less significant architectural ensembles, which should nonetheless be surveyed and documented. It is therefore essential that the work of gathering information on 20th-century architecture continues to advance, so that its inherent qualities can be better understood and preserved.

[129] We consider, in effect, that the protection of built heritage, when threatened, is an engagement on the part of society and that it requires the mobilization of considerable human, administrative, and financial resources, both public and private, which must not be called upon except when undeniable and irreplaceable value has been established.

PART 3: INNOVATION FOR PRESERVATION : TECHNICAL ISSUES IN THE RESTORATION OF RECENT-PAST FAÇADES

Introduction

The third and final chapter of this report concerns the initial research subject: the means for conserving architecture from the Modern Period by applying current technology. We rely on case studies to illustrate the current state-of-the-art for a given material or execution method used in conservation-restoration. The goal of this chapter is to share research-based approaches to the restoration of built heritage from the 20th century. It is important to note that the chosen examples illustrate not only technical solutions, but also a theoretical reflection on the way restoration is approached.[130]

In methodological terms, we were primarily interested in major works from architectural history in the 1930-1970 period. These are generally the places where one finds experimentation with innovative systems, materials, application methods, etc. Beyond visits and interviews with specialists, we relied on books and publications such as *20th-Century Building Materials* by T. Jester, which details the fabrication and use of materials common in the 20th century and gives examples of restorations.[131] Articles form the journal *APT Bulletin* and the National Park Service's *Preservation Briefs*[132] were also used to give depth to the case studies, as were the *Technology* dossiers from DOCOMOMO..

[130]The work previously cited by Théodore Prudon (2010) also uses case studies to develop knowledge on the restoration of modern architecture.

[131]T. Jester (dir.). *Twentieth Century Building Materials* (New York: McGraw Hill, 1995).

[132]The Association for PreservationTechnology was founded in 1968 by American and Canadian architects. It publishes quarterly bulletins gathering contributions from highly competent architects, engineers, and historic conservators. On the *Preservation Briefs*, see p. 18.

I. RESTORATION OF REINFORCED CONCRETE FAÇADES

Pathologies typical of concrete

Reinforced concrete is one of the most widely used building materials in 20th century construction. Its structural and modeling capacities, its variety of finishes, etc., profoundly renewed the language of architecture. Its experimental use in the first half of the 20th century have now led to the need to treat a number of pathologies. The most common and most problematic are cracks in concrete and steel corrosion. Below, we give a brief overview of these disorders and their causes.[133].

Cracks can develop under the effect of mechanical stresses due, for example, to the expansion cycle (when concrete is insufficiently thick, that is to say less than 4 cm, the steel and concrete do not dilate at the same rate), temporary or isolated weight exertion, insufficient foundations, freezing (if the concrete contains water), etc. Once a crack begins, it allows water and air infiltration which can lead to the oxidation of steel. Once oxidized, the reinforcements change in volume and the concrete bursts under the effect of this pressure, creating new cracks.

Concrete can also deteriorate due to chemical causes. The most common is the carbonation of concrete[134] caused by carbon dioxide in the air

[133] Taken from an article by A. van den Hondel, "Concrete Diagnose: Failure and Repair of Reinforced Concrete" in W.D. de Jonge, *The Fare Face of Concrete: Conservation and Repair of Exposed Concrete.* (Eindhoven: DOCOMOMO Preservation Technology, dossier 2, 1997).

[134] Cement is prepared with calcium oxide CaO which when mixed with water forms calcium hydroxide $Ca(OH)^2$, or lime. This carbonizes

(atmospheric pollution) combined with water which accelerates oxidation. These two elements form an acid which infiltrates through the pores of concrete and neutralizes the alkalinity of the cement more or less deeply. When the concrete is of poor quality or if the steel is insufficiently covered, this acidity creates a corrosive medium for the reinforcements. Thus, through natural corrosion, the steel turns to rust. This can cause disorders ranging from simple surface stains to deterioration of the structural capacities of the edifice. Another phenomenon can cause the steel corrosion when the concrete is brought into contact with an alkaline material such as sodium, potassium, or silica, as in the case of glass aggregates, for example. Sodium corrosion is common in countries where salt is used for snow removal or in marine environments, or when sea sand has been used for concrete preparation. Additives such as calcium chloride can also cause disorders. This additive was frequently used in the 1960-1970 period to accelerate setting time for work done in cold climates and for the creation of prefabricated structures. Over time, it was discovered to also accelerate steel corrosion. Another, rarer type of chemical reaction occurs when gypsum (plaster) is brought into contact with certain clinker slags in the cement. The product of the reaction is very expansive and can damage the concrete.

Electrochemical reactions (galvanic action) can also cause deterioration in steel. These occur when incompatible metals are brought into contact with one another in the presence of moisture. The more the elements are dissimilar in the way they react to corrosion, the greater the effect. Thus, the combination of steel and copper, for example, brings about sometimes disastrous reactions. The introduction of non-ferrous metallic minerals into the reinforced concrete apparatus is not recommended.

with the carbon dioxide in the air, which leads to the formation of calcium carbonate $CaCO^3$. This has the effect of lowering the PH of the cement and corroding the iron reinforcements. The volume of iron oxide being 1½ times greater than that of iron itself, this causes the adjacent cement to burst. See http://fr.wikipedia.org/wiki/Carbonatation (website accessed 31 October 2015).

Repairs

Repairs usually aim at halting the oxidation of steel and thus the deterioration of the concrete. When one can afford to alter the surface, the damaged parts are purged, then the steel is treated with epoxy before smoothing. This method has the disadvantage of leaving visible traces of the patching. This contradicts the monolithic appearance of concrete. It is very difficult to recreate a cement mixture that completely blends with the color and texture of an existing concrete. In the United States, I noticed that concrete is used much less than in France. Initially, it was used to imitate stone, but was soon replaced by the terra cotta in this usage. On the other hand, it was widely used for engineering works: bridges, dams, silos ... In the form of cast-stone, that is to say of prefabricated pieces, concrete is now used once again to imitate stone because it has become inexpensive, more affordable than terracotta in any case.

For repairs without altering of the visible surface of the concrete, other techniques such as cathodic protection,[135] desalination,[136] and realkalization[137] are used. Reinforcement with carbon fiber helps to avoid problems with corrosion.

Finally, it must be emphasized that today, new products are being developed to address the recurrent problems posed by reinforced con-

[135] By sending an electric current through an anode attached to the reinforcement, corrosion is arrested. This solution has limited in works of architecture because it must be installed permanently.
[136] Applying an anode temporarily, with an electric current through the anode to the reinforcement. Negatively charged ions migrate to the anode and are removed after treatment.
[137] A method of re-alkalinizing carbonated zones in concrete consists of sending an electrical charge between a reinforcement, placed in a carbonated area, and an electrode placed in an area having an alkaline environment (electrochemical re-alkalization of concrete: http://www.google.com/patents/WO1987006521A1?cl=en (accessed 20 September 2015). This is similar to re-galvanizing the reinforcement armature.

crete construction. Steel reinforcements coated in epoxy, made of stainless steel, zinc-galvanized, fiber reinforced concrete or reinforced polymer (RFP) reinforcements enable to progressively eliminate the sensitivity of reinforced concrete to corrosion and aggressive environments.

Case studies of repairs on exposed concrete surfaces: Meridian Hill Park and Unity Temple

Meridian Hill Park in Washington, D.C., was built in 1936 by John J. Early. It is a park consisting of terraces with an ornamental waterfall. The retaining walls forming the architecture of this garden are in raw concrete whose visible aggregates were carefully selected to create a play of color and texture. According to a study commissioned by the NPS, owner of the site, by the firm of Quinn Evans Architects,[138] insufficient and outdated underground drainage of the terraces is at the origin of the instability of the large wall on the 16th Street side (tipping over and sliding from the pressure of materials it holds back). To remedy this problem, several solutions have been considered:

- improvement of surface drainage and replacement of the material pushing against the large retaining wall to reduce hydraulic pressure;

- horizontal anchors and underpinning of the wall;

- anchor cables fixed in a foundation block, and pilings driven underneath the wall.

In addition, the parapet of the wall, severely damaged by the varying dislocations of the joints, was already the subject of repairs carried in 2001.

The best solution was chosen by comparing the advantages of each option.[139] The structural solution finally adopted consisted in anchoring the wall in the ground by means of a cable fixed to a concrete block, creating weep holes at the foot of the wall, and driving foundation pilings. To introduce the cable, it was first necessary to open a hole in the concrete wall. The cable and its sleeve are put in place with a drilling machine. Then, concrete is pressure-injected to create an anchor in the ground. After drying, the cables are brought into tension with a hydraulic cylinder and fixed. Holes are plugged. The patching receives a nearly undetectable finish. The rest of the wall is cleaned. The finished appearance results from know-how of the company doing the work.

It is interesting to note that Meridian Park inspired the Water Park built by Philip Johnson and John Burgee in Fort Worth near Dallas, Texas, in 1974. It is possible that the decision process in Washington will one day be applied to the maintenance and restoration of this newer and quite remarkable project.

The question of the appearance of repairs of raw concrete is paramount. For the Boston City Hall, for example, David Fixler, an architect for EYP, explained that 17 shades of cement were needed for the rebuffs to get as close as possible to the appearance all around the wall. "The patches must match."

Unfortunately, it happens that even carefully made repairs fail. The restoration of F. L. Wright's Unity Temple in Chicago did not solve the problem of differentiated expansion between walls and foundations, and the cracks quickly reappeared.

[138] Bpnita Mueller, RMH Fellow 1992, managed this project for the NPS.

[139] There are six points: treatment of runoff water, impact on historic materials, impact on historic landscape, impact on the historic wall, improvement of the condition of an historic property, reliability of the repair. Each option is assigned a number of points, which are then totaled and carried over to the job estimate and the analysis of long-term costs ("life cost analysis") of each one.

This 1909 building is one of the earliest examples in which concrete is used for its visual effect and with its own vocabulary rather as simply a structure to be covered over with another cladding material. The surface was washed and brushed after stripping to reveal the aggregates, achieving a pea-gravel texture. As time passed, cracks appeared in the structure due to thermal constraints; additionally, the concrete was porous with lots of small voids around the aggregates.

By the 1960s, the delicate, washed-gravel surface had suffered severe damage from cracks caused by corroded steel and was covered over with a layer of smooth cement.[140] In 2009, Unity Temple was carefully renovated. First, the 1961 cement which masked the aggregates was removed through very abrasive sandblasting with slag before a new surface was applied using a mixture of liquid cement and gravel no more than ¾ inch thick (1.9 cm). This surface was washed and brushed again just after removal of the formworks to reveal the gravel. For sealing, protective layers of silicone or acrylic were tested, but finally the choice was made to use linseed oil in 2 coats, the first cut at 50% with mineral solvents, the second at full strength. The surface has returned to its original texture.

Case study: Façade restoration, Guggenheim Museum, New York

Evolution of the building: from museum to work of art

The restoration of the Salomon Guggenheim Museum undertaken between 2004 and 2008 is one of the most important restoration projects of the last ten years in New York City. From our point of view, it is also one of the most technically innovative and most interesting from a theoretical point of view.

We should recall that this building completed in 1959 was the last project by the architect Frank Lloyd Wright. Salomon Guggenheim began his collection in 1929 and hired F.L. Wright in 1937; however, construction of the New York building began only in 1957. By then, the architect was 87 years old. In this interval, many intermediate designs were produced. Thus, if the major elements of the project are present from the first sketches of the mid-1940s – a rotunda in the shape of an inverted ziggurat, a small building forming a counter-point and nicknamed "the Monitor," and a tower arranged on a pedestal that frees up the ground space – the architect continued toying with their position, moving them from one side to the other. In the various drawings spanning a period of eleven years, the façade of the rotunda is smooth, sometimes even polished. On the other hand, its color varies from pure white to purplish pink. In some drawings, Wright even imagines a future extension to the museum, leaning against the gable wall of the neighboring building.

The building's construction technique is very interesting. It uses three types of concrete. Reinforced concrete was poured in place for the infrastructure, the slabs of the base, the ramp of the rotunda and its railings, the web walls (partitions perpendicular to the façade separating exhibition halls and bracing the structure), the roof, and the structure of the dome. Lightweight, lime-based concrete was used for the apron slabs, a small sloping portion between the ceiling and the wall of the rotunda allowing the insertion of the glass ceiling panels, and the set-back barriers for the artworks. Finally, for the façade of the rotunda, cement gun, or gunite, was sprayed with compressed air onto a formwork on which the frame was held by hand. For ease of construction, the formwork was placed on the outside and the cement projected from the ramp. The final exterior aspect, strongly textured by the

[140] J. Marston Fitch, *Historic Preservation: Curatorial Management of the Built World* (1982). See chapter on the conservation of concrete fabric.

traces of the formwork, displeased the architect, but was left as it was.

Finally completed six months after Wright's death, the building was not appreciated by the rather conservative-minded New York public. Nonetheless, it became the city's "youngest" landmark in 1979. The second most visited New York City monument after the Statue of Liberty, it was designated a National Historic Landmark in 2004.

This iconic monument has been renovated and expanded several times in the past. The cracks in the faces of the rotunda ramp – the building was constructed without expansion joints – were repaired shortly after completion. In 1968, a first extension was built at the corner of 89th Street by Wesley Peters, Wright's apprentice and son-in-law. More or less in line with Wright's original sketch, this addition would be replaced by a taller building in 1992. It is perhaps during this phase of work that the building was repainted in a yellowish beige darker than at the origin.

In 1975, the driveway was removed and a setback façade in glass was installed on the ground floor by Donald Freed to expand the museum shop. This moment likely corresponds to another painting campaign. This time, a gray-white was chosen. In 1981, R. Meier transformed the archives room into an exhibition room. In 1992, the architects Gwathmey & Siegel designed the extension of the Thannhauser wing on top of the 1968 addition. The architects' interpretation of Wright's original drawing is not to the taste of all the partisans of conservation. In defense of the project, the renowned critic Paul Golberger expressed appreciation for the effect of veil before which the museum can display itself.[141]

During this campaign, the waterproofing of the roof terrace was redone as was that of the dome. The museum's air conditioning system was also renovated. It is integrated within a very discreet bulge in the false ceiling of the ramp. A system combining insulation, vapor barrier, and plaster on the interior was installed on the inner face of the rotunda wall. The Monitor is also equipped with air conditioning, but its façades mostly in glass do not allow thermal insulation; condensation will thus soon cause problems. The cracks in the façade were only partially repaired during this renovation. Expansion joints were created, but exterior cladding was not replaced.

As early as 1992, analysis on the paint samples showed that the original color of the building was beige buff or light brown. However, the choice was made to repaint the building in white. As we will see, during the restoration of 2004-2008 preservationists were divided on the question of color. This episode shows that research-based knowledge is sometimes not sufficient to change the public's image of a work. In this instance, we will see an interesting interpretation of the concept of authenticity in restoration, inspired by practices from the conservation of artworks.

Restoration technique on the rotunda façade

In 2005, the decision was made to completely remove the original cladding, an elastomer known as "cocoon". It was in poor condition and traces of moisture were beginning to appear on the façade. Bubbles and cracks caused concern that the original coating was losing its elasticity and possibly its water-tightness. The removal of all of this cladding was decided, and the condition of the concrete could finally be investigated carefully.

[141] This background is taken from articles by Pamela Jerome, "An Introduction to Authenticity in Preservation" (*APT Bulletin: Journal of Preservation Technology*, 2008), "Restoring F.L. Wright's Salomon R. Guggenheim Museum" (*ICOMOS*, 2009). See www.aicomos.com/…2009_UnlovedModern_Jerome.

The building was suffering from seasonal condensation and erosion of the concrete. Regular deterioration of the facade of the rotunda requires painting campaigns every four years or so.[142]

The particularity of this restoration project lies in the fact that the management of the Guggenheim Museum considers the building as one of the pieces in its collection. Therefore, it is treated with the same care as if it were a work of art.[143] Three firms, an architectural firm and two consulting firms, were engaged separately,[144] demonstrating the museum curators' engagement in their role as commissioning clients. This is all the more interesting because it is rare in the United States to contract with separate companies, but in this case the clients preferred to deal directly with a team of several specialties grouped under the mandate of an architect. The three specialists would report directly to the client, who would then decide on the best option to take.

I had the chance to speak with the managers of the three firms in question which allowed me to understand with greater precision the very thorough study they conducted. The main purpose of the project was to identify the origin of the structural problems and search for restoration solutions.[145]

It sought to apply a more research-based approach benefitting from developments in pathology analysis methods and newer materials. This example has shown that current technology and an ongoing effort to understand these phenomena can lead to more respectful interventions that retain the essence of the original. We will detail the research carried out by the various specialists who led to this innovative project.

Structural investigation

The first task for the Robert Silman Associates structural engineering[146] experts was to identify the origin of the structural problems by analyzing the building's constructive system. As we have seen, there are three types of concrete. Most regular cracks on the façade can be explained by the fact that the original building had no expansion joints. The plywood planks on which the concrete was sprayed measure 4x8 feet, the wall is 5 inches thick (about 15 cm). Originally, the concrete was formulated with a high cement-to-water ratio for superior tensile strength and durability.[147].

A comprehensive study was conducted to ascertain the origin of the cracking problems, beyond the fact that there are no expansion joints. This consisted of:

- Detailed monitoring of the movements on the selected cracks, especially in the bracing walls;
- Creating 3D-laser survey of interior and exterior surfaces;
- Taking samples for repair tests;
- Laser-scan imaging of the building to study its geometry;
- Performing both destructive and non-destructive resistance tests on materials;
- Establishing an exhaustive documentation of the structural elements, including archives of the original concrete plans;
- Conducting a computerized analysis of the structural elements of the building to generate theoretical movements under the effect of changes in temperature and wind force using the software SAP 2000 (Structural Analysis Program).

[142] There were around a dozen different coats of paint.
[143] http://www.nytimes.com/2005/09/01/arts/design/01gugg.html
[144] WASA, RSA, and ICC-ICR
[145] From the beginning, seasonal variations, day/night fluctuations and the lack of a dilation joint were pointed out, but certain other problems required deeper investigation.
[146] Interview with Nancy Hudson, engineer with RSA, 10 July 2010.
[147] "The Guggenheim… restored" (2009); see www.mappei.com.

The monitoring program makes it possible to locally measure cracks and walls movements over a full year. Instruments for measuring cracks, movements, potentiometer wires, temperature sensors, linear potentiometers, and tools for measuring convergence were distributed and installed throughout the building. Special attention was paid to exterior walls. The data was used to understand the direction and magnitude of wall movements and cracks. This information was then related to the analytical model. Daily and seasonal movements were analyzed: they sometimes reached 1 inch (2.5 cm).

Steel corrosion was also conducted. The first observation by engineers is that despite existing fears, the waterproofness of the cladding was not flawed. The concrete had not been infiltrated and the corrosion state of the steel was generally good. The museum was in good general condition, simply requiring exterior work to repair cracks, treat exposed and corroded steel, repair and protect all concrete, and complete some structural interventions on the sixth floor.[148] The knowledge gained through this careful analysis of the building allowed a particularly delicate and precise restoration. The client insisted strongly on pursuing this type of approach and was admitted to spending money on it. This work also demonstrated good teamwork between the different specialists.

The main problem was understanding why the walls on the sixth floor were more particularly subject to variations. Their greater height could not explain the differences from the theoretical model. No documentation exists on gunnite; all the engineers knew was that the T-profiles for the concrete reinforcements were incorporated vertically. A radar study made it possible to determine the exact location of the reinforcements. Finally, it turned out that the horizontal beams, continuous at all levels at the point where they intersect with the vertical T-profiles, are interrupted at the last floor. The T-frames had a dimension of 1 foot 5 inches on all floors except the last, where they were 2 feet 5 inches because of the greater height of the wall. This interruption was invisible to the radar, and it was only by making a destructive survey that the explanation could be found. Meanwhile, the cracks led to corrosion the mesh embedded in the concrete. The engineers also judged that the connection with the bracing walls was weak.

Structural solutions

To compensate for the lack of continuity in the horizontal members on the sixth floor, the engineers proposed carbon-fiber reinforcements to reconstruct the missing linkages. The strips were glued to the inside wall with an epoxy resin. These reinforcements were then connected to the bracing walls with steel angles. A small measure of pre-stressing was introduced. The problem of excessive deformation of the walls of the last floor was solved using hydraulic cylinders to control the slow movements at the top of the wall, at the level of the skylights.

The museum remained open to the public throughout the work process. It took a total of twelve months for repairs and replacements of the façade cladding. The numerous analyses undertaken saved a good deal of money because each problem could be explained and treated individually. Monitoring made it possible to define how the building behaved structurally. The building will be monitored for three to five years, with two monitors for cracking on the south side. This is mainly to be sure that the deformations do not cause cracks elsewhere on the building now that the sixth floor has been consolidated.

[148] http://www.huliq.com/34826/retoration-of-guggenheim-museum-begins.

Investigations for replacement of façade cladding

The architectural conservation laboratory ICC-ICR is in charge of the studying products for filling the expansion joints created, filling cracks, and for replacing of the finish coating by a product similar to the original and which is compatible with the chosen filler products.

Materials conservation was a relatively new topic in the 1980s when Glenn Boornazian, manager at ICC-ICR, undertook specialized coursework in Williamsburg for the maintenance of the buildings he is responsible for in Nantucket. There he met the chemist Norman Weiss[149]. He went on to specialize in laboratory research in Columbia University's master's program in Architectural Conservation, finally creating his own company in 1987.Today, ICR is a materials research laboratory employing twenty people. Initially, they completed studies outsourced by architects, but due to insurance problems, they now work directly with clients as curators. They do scientific work from an historical point of view. Their method is always to explain the reasons for their chosen intervention; for example, the origins of a particular crack in the Guggenheim, for example. They also look at what materials are in contact with each other and search out the most detailed answer possible. They are often criticized for the number of tests they do.[150]

For the conservation project at the Guggenheim Museum, they had to become very familiar with the cracks, which ones moved or remained stable, in order to determine the order in which to treat them. The major suppliers dealing in crack fillers sent samples. The fact is that little is known about these products, except that tests conducted by ICC-ICR have found that information given by the manufacturers does correspond to real performance. Cracks due to the absence of expansion joints had already been repaired in the past, and these repairs had not held. It was therefore necessary to develop a test program to verify the true performance of the products.

Sequence of tests

I had the opportunity to visit the materials testing laboratory and familiarize myself with the equipment used there.

QUV: or "climatic chamber" is a device that accelerates weathering by recreating hot or cold humidity conditions, hot or cold rain, frost, etc.

The petrograph makes it possible to identify and reconstitute an original concrete mixture in order to reproduce test materials having exactly the same composition (aggregates, cement, porosity, density, air bubbles). It thus becomes a matter of recreating a concrete with the same characteristics as the existing support, which is very useful when the samples are limited.

The laboratory also has a device to test resistance and various saws to produce samples of different thicknesses. There is a kind of glaze used to test the porosity of stone before and after treatment. There is an oven, a refrigerator, and two microscopes used for stratigraphic color studies.

Tests are conducted according to standards of the ASTM (Association for Standards and Testing Materials) and adapted according to each cases and its needs. In the United States, the equivalent of the French CSTB agency (*Centre scientifique et technique du bâtiment)* does not exist, so each manufacturer has the responsibility to test its own products and provide their

[149]Information on the ICC-ICR laboratory gathered during the author's interview with Glen Boornazian, New York, July 2010.
[150]From P. Jerome, "Restoring F.L Wright's Salomon R. Guggenheim Museum" (*ICOMOS,* 2009, pp. 1-10). Available at www.aicomos.com/…/2009_UnlovedModern_Jerome. More than 100 paint samples were taken and analyzed.

performance specifications in respect of indications and procedures established by the ASTM.

Perfecting product with manufacturer

Finally, one manufacturer stood out for the development of the products for the Guggenheim Museum. There was a productive exchange in order to find the right formulation. This happened to be an Italian, family-run company headed by a mechanical engineer. Discussions were thus easier than with a large group. They have good products that conform to their advertised performances. The Mappei company invested a great deal in the project. They put their laboratory and technicians in service of the curators from ICR-ICC. They made site visits, conducted tests under different conditions, and so forth.

Since the end of the restoration work, a new phase has begun to examine the behavior of the building, which is very interesting. The owner gives ICC-ICR access to observe the performance of the completed interventions, simply to compare the results to expectations. Fortunately, the cladding is in good condition, as is the building generally, and the concrete shows a proper pH level.

ICC-ICR not only did all the testing necessary for choosing and developing the three products for the façade; they also worked on the application of the material on the construction site. Indeed, the texture of the coating must preserve the traces of original formwork. They therefore did not use the product "mapoplastic" because it was too thick and required a supporting grid. They asked the company Mappei about the possibility of using it without the grid, because its flexibility seemed promising. Mappei replied that calculations showed it to be possible, but the test they performed failed. Glenn Boornazian then went to Italy to work directly with the technicians on the development of the right product, which is compatible with the other repair products used.

Repairs to steel and concrete

Mappei also supplied products for the repair of corroded steel. The technique consisted of stripping them using pneumatic hammers and diamond disc saws. They were then cleaned using a system called "Sponjet." The aluminum oxide particles coated with polyurethane foam could only tolerate a less abrasive cleaning that did not penetrate too deeply into the thickness of the frame. MAPFER 1K from Mappei was then applied to the cleaned steel. This is a mono-component corrosion inhibitor with a cement-mortar base. It provides protection by re-alkalizing the metal and preventing rust. According to the manufacturer, it is an innovative and easy-to-use product that is applied by brush. It even protects against the salty mists of New York. After drying, the damaged concrete sections were repaired with PLANITOP XS, a thixotropic mortar manufactured from Mappei. It is versatile, it is applicable for all types of repairs: vertical or horizontal, wide or narrow. It can be applied up to 10 cm thick, unlike traditional mortars.

On cracks potentially subjected to movement – those created to serve as expansion joints, for example – a rigid system was not possible. Ultimately, the MAPFLEX AC4 product was applied over a bead of MAPEFOAM polyethylene running along the bottom of the joint (the cracks have been previously picked opened). Smaller cracks were recapped using ELASTOCOLOR RASANTE SF, an elastomer underlay with high filling power, mixed with fine sand. Finally, the entire exterior of the building was protected by a flexible mortar. MAPEPLASTIC is the best-selling product of its kind in the world. It is a waterproof, CO^2-based, two-component cement mortar capable of sealing cracks up to 6 mm wide. Designed to be as flexible as possible, it is perfectly suited

to the situation at the Guggenheim, which is subject to significant variations due to fluctuating temperatures and vibrations. In some areas the product is reinforced with a polypropylene fabric to improve its resistance to tension. Application is by projection.

Finally, the elastomer coating must also be flexible. It was decided to use ELASTOCOLOR RASANTE, a filler reinforced by fibers and applied by projection without using compressed air. After drying, the product forms a smooth layer which follows the expansion of the support without cracking. At the street level, an elastic paint and an anti-graffiti product are applied. Product used were ELASTOCOLOR WATERPROOF, an acrylic resin with aqueous dispersion, and WALL-GUARD GRAFFITTI BARRIER.[151]

It should be noted, however, that all this work was carried out without regard to color.

Color and appearance of cladding

The New York Landmarks Commission reacted strongly in rejection against a proposal from R. Sillman & Associates engineers, which consisted of returning to F. L. Wright's first intention, that of a completely smooth building. They considered it in fact possible to completely wrap the building in carbon fiber and thus definitively solve the cracking problems. After debate, the decision was made to preserve the visible traces of the concrete formwork resulting from the initial construction mode, and to preserve the building as it is and not as it was imagined by the architect in his original intent.[152] The architects of the WASA firm do not try to recreate the original intent of the architect but consider the existing building as a document in and of itself. Thus, the formwork marks are authentic traces of craftmanship, even if they present errors, especially since F.L. Wright had finally chosen to accept them. Concrete repair patches must therefore carefully reproduce the pattern on the concrete formwork.

Color was another source of controversy. Indeed, the building was originally in a buff color called "Fresh Butter". For questions of conservation of the current image of the building, and to better integrate with the context, a white-gray which was finally adopted. How was this conclusion reached?

In 1992, during the extension of the museum by the architects Gwathmey & Siegel, F. Matero, head of the Architectural Conservation Laboratory at the University of Pennsylvania,[153] took some samples and did research to define the original color and exact composition of the original coating material.[154]

ICC's analysis confirmed Frank Matero's findings. The *Cocoon* coating is an elastomer that was used in the 1950s for boat hulls. There were six colors offered in the catalog. In the archives of F.L. Wright, Matero found two samples signed by the architect. Samples were taken on the façade of the building. There were many different paints (at least 12 layers). When the building was enrolled on the NRHP, it was already repainted in white-gray. It was then listed as a National Historic Landmark in this color.

However, in 1992, the architects most likely intended to return to the original shade, and

[151]This detailed information is found in the article "The Guggenheim… restored", *www.mappei.com*, 2009.

[152] Among the many sketches for the building we find versions with the rotunda in slick-finish white or rose color. F.L. Wright had envisioned a powder-based finish material or else marble slabs, which finally gave way to the water-tight "cocoon". Wright's correspondence with the company indicates his dissatisfaction with very visible traces of the concrete formworks on the outside walls of the rotunda.

[153] The master's degree in Historic Preservation offered University of Pennsylvania has one of the best reputations in the United States. The program particularly benefits from its laboratory, which I had the chance to visit in September 2011 and whose equipment is very similar to that found in the ICR-ICC labooratory. The University of Pennsylvania hosted one of the conferences by Benjamin Mouton in winter 2012 organized by the Richard Morris Hunt Prize Managing Team.

[154]F. Matero and R. Fitzgerald, "The fallacies of intent: 'Finishing' Frank Lloyd Wright's Guggenheim Museum" (*APT bulletin, 38*(1), 2007, pp. 3-12).

the stone for the extension was probably chosen accordingly. But the choice of color had divided the preservationist community; maintaining the status quo finally prevailed. It must be said that the original intention of F. L. Wright was to have a white or gray coating, but in another material, for it was a coating with a marble-dust base that the architect wanted. The building was eventually finished with a thin, fresh butter-colored coating, a typical architectural color for F.L. Wright who usually did not use white.

In 2007, the color debate over was reignited during the restoration. Although some members of the Historic Districts Council argued in favor of a return to the original appearance of the building, the technical director of the New York Landmarks Conservancy, the architect Alex Herrera, found it "great they did the color analysis to determine what the original color is. However, I think it's been the other, whiter color for so much longer that it almost means it's earned its historical legitimacy. If you find the original color, you do it more for the intellectual and academic value – you don't have to actually paint it that color." New York Landmarks Conservancy President Peg Breen further stated that "It's more what people are used to now. I think it would be very startling to change the color of the Guggenheim right now." Ms. Woredn recognized that yellow "could be a little provocative at first."[155]

The owner and the preservation architects preferred to say that the institution had evolved. Based on the Venice Charter and Nara's document, they argued for adopting a "progressive authenticity," taking the building's evolutions into account and basing itself on the 1992 statehood. Article 11 of the Charter is quoted in particular: one does not reveal the layer below unless it is absolutely necessary. But since it was necessary to remove the original coating, this argument could easily be countered.

For the architects of the restoration, returning to the original color would have meant taking a position like Viollet le Duc, that is to say, "restore a state of origin," even if such a state never existed. On the contrary, they preferred to follow Paul Philippot's principle according to which it is an illusion to believe one can return to the original state by removing the layers that were added later. As Pamela Jerome suggested, the original color could still be applied if decided in a few years.

Another problem posed by the Guggenheim was the vaporized liquid copper on the concrete elements to emphasize the roof of the Monitor, the small pavilion located next to the rotunda. F.L. Wright wanted to use embossed copper foil panels, but this was impossible. As we will detail below, the windows of this small building were also restored.

Reducing condensation in walls and windows

Due to air-conditioning in the museum, condensation tended to accumulate at the base of the exterior walls, where insulation had not been installed during the previous renovation. It had originally been planned to demolish the cladding at the base of the wall and replace it with an insulation product, but a less destructive solution was found by the Building Envelope Solution company. Using a specially developed projection tool, polyurethane foam was injected behind the plaster wall lining via holes in the bottom of the wall, making it possible to keep the cladding. An infrared camera was used to monitor the regularity of the injection. The company estimated that about one hundred thousand dollars in demolitions and repairs was saved because the process is less

[155]These remarks are taken from B. Sarlin "Guggenheim Hue Is Subject of Colorful Debate" (*The New York Sun*, 2007) available online at http://hdc.org/hdc-2/guggenheim-museum-color-choice-attracts-attention-to-restoration-question.

invasive and could be done after the museum's closing hours.[156]

Progress in the fight against condensation led to the installation of an air barrier on the sixth floor, the insulation of all walls, and the replacement of single-pane glazing and skylights by thermal-break profiles.

The condensation problems also led to modifications of the windows and skylights of the Monitor. Despite many attempts to keep the joinery, replacement was eventually decided. The architects organized a two-day peer review to discuss window renovation options.[157] The methodological approach that was been developed is particularly interesting.

Design was different on the three levels of the Monitor. After several versions, cold-formed profiles in galvanized steel were installed in 1959 with a combination of fixed and outward-tilting components. In 1994, storm windows in the form of external fixed panels were installed as a way to temporarily address the problem of condensation caused by the air-conditioning. The intervention was completed on the upper level by replacement with double-pane glass, which the original window joineries allowed. In both cases, condensation was reduced without being completely eliminated, especially on the window joineries that were not insulated.

In 2004, it appeared after investigation that the metal frames were in good condition. According to the preservation standards we mentioned previously, these should have been kept in place. However, these original windows had the serious disadvantage of generating condensation in winter and summer depending on humidity and temperature conditions inside the museum. This condensation rendered the space inapt for exhibitions, causing above-average air conditioning and dehumidification needs and negating the desired transparency towards the exterior.

As part of the restoration of the building, treatment options were explored by the WASA architects. It is very interesting to note that software developed by the Laurence Berkeley National Laboratory, "Therm 5.1," was used to study the performance of the various options considered. This system calculates the U and the condensation factor. The National Fenestration Rating Council has published an index of condensation rates available on the internet as the Standard NFRC 500, which explained why the storm windows gave unsatisfactory results. The option of inserting a thin heating strip in the joinery to prevent the formation of condensation was considered, but the idea was abandoned because of the high level of maintenance it would have required. Options for the use of new materials such as pyrogel[158] insulators and ceramic coatings were considered not investigated further. Cutting the existing frames to create a break in the thermal bridge between inside and outside was also impractical because the results of such a laborious operation could not be guaranteed without tests.

The decision was made to replace the windows. The options came down to 10 cases for which condensation rates were studied. Each case was then analyzed according to 13 established criteria for preservation and constructability. The agency developed a design for replacement windows in steel which kept the original character of the joinery, but finally no manufacturer was able to provide such a model. The choice was then oriented toward aluminum joinery with a thermal break. A prototype allowed for testing water-tightness and strength according to the ASTM standards.

[156]Guggenheim C, www.foam-tech.com/case…/GuggenheimCS.pdf

[157] These are detailed in A. Ayon and W. Rose, "Reglazing Frank L. Wright's Solomon R. Guggenheim Museum in New York City" (*APT Bulletin, 42*(2-3), 2011, pp. 59-65).

[158]Pyrogel insulation materials are made from silica aerogel reinforced with unwoven fiberglass.

Indeed, there is a significant contradiction between the fact that the thermal break must be as continuous as possible and the fact that this weakens the structural capacity of the window. Fragments of the original joinery were archived by the museum.

This renovation is informative. It demonstrates the degree to which usage requirements can lead to the replacement of windows. Personally, I find the solution unsatisfactory. It was not possible to faithfully replicate the original elements, nor was it possible to maintain the original hardware that had remained in place up until then. This example illustrates the many contradictions one encounters in the conservation of modern architecture, whose material value is not always recognized. If the windows had been several centuries old, it is likely that a different solution would have been found because an historical value and authenticity would have recognized. The result here is a sacrifice of the original substance in order to gain more usable museum space.

Conclusion

It is worth underlining the fact that historical and technical research and exchanges among specialists guided this restoration process, surely one of the most innovative in recent years. In-depth investigations in all specialties made it possible to find exactly the solutions called for. Of course, this is an example of a made-to-measure operation, appropriate for a building as unique this one. But even though identical methods cannot be applied to every concrete building suffering from stability problems due to the cost and time involved in such studies, one would do well to draw inspiration from the rigor of this investigation, the inventiveness of the solutions found, and the richness of the debates making it possible to work through consensus rather than simply impose decisions.

Total cost of the three-and-a-half-year renovation program reached 29 million dollars. Its dedication coincided with the building's fiftieth anniversary.[159] Overall, the objectives set by the architects were satisfied:

- Maintain the historic character of buildings as well as their original materials
- Maintain changes that took place over time
- Keep distinctive features
- Repair elements rather than replacing them; or, when necessary, replace them
- Treatments must not engender further problems
- New work must not destroy historic character; it must be differentiated from yet compatible with the existing building
- Recent work must be reversible and not affect historic materials
- In a rehabilitation process intended for standards compliance and reducing energy consumption, avoid radical changes that could destroy materials essential to historic character
- Do not add historical elements without evidence
- Maintain the historic use of buildings.[160]

Fallingwater

Structural stabilization

The stabilization of the cantilevered expanses of Fallingwater by the structural design office of Robert Silman & Associates presents a very interesting case study. Legend says that during construction in 1936, workers refused to re-

[159] R. Pogrebin, "The Restorer's Art of the Invisible" (*New York Times,* 10 September 2007).
[160] Presentation by Pamela Jerome.

move the formwork from this daring structure built in the heart of the Pennsylvania forest.[161]

In fact, as soon as the formworks were removed from the first level cantilever, a shift of 1.75 inches (4.5 cm) was recorded. If a slight displacement is normal, this value is too significant. Shortly after the second-level formworks came off, a crack appeared in the parapet of the terrace. According to the measurements taken during Mr. Kaufmann's lifetime (until 1955), it appears that the cracks continued to grow and that the deformation became more pronounced.

J. Matteo, the engineer in charge of the renovation project, explained to me that when he did the structural analysis of the house in 1995, the deflection of the 5-meter cantilever was 7 inches (17.8 cm). At this time, supports were installed under the terrace because a modeling showed that it was nearing the breaking point. Work began in 2002. It appeared that the cause of the problems was that the reinforcements were both insufficient (16 steel beams) and were improperly placed. It would seem that the original engineer interviewed about the deformation of the structure exclaimed "Oh my God, I forgot the negative reinforcements!"

For a lightweight solution, external prestressing was chosen. This solution was not possible on the second floor because there is not enough room. The cantilevered beams were reinforced with twelve prestressed reinforcement bars a half-inch thick linked with fasteners passing through the concrete parapet beam. The cantilever was been raised by ¾ inch. This may not seem like much, but the decision was made to maintain the deformation, stabilizing the beams without straightening them. This made it possible to retain the windows in particular.

After an analysis according to methods outlined by the Secretary of the Interior's Standards for the Treatment of the Historic Properties,[162] the decision was made to repair rather than demolish and rebuild. Radiography and sampling were used to determine the constructive mode. Research was conducted to better understand construction techniques of the time, the type of steel used and its available lengths, and so on, for while the materials were the same as today, their application was different.[163].

Work was planned for the four-month annual closure period in winter. Flooring was taken up in the living room to access the beams.[164] Cables were installed and put in tension on the parapet. Once this apparatus was in place, it sufficed to reseal the holes in the guardrail and reskim the finish coat.

Repairing the suspended staircases

An issue of authenticity arose for the suspended stairs. Rain fell continuously on the steel tubes and the angle of the concrete step had already been repaired many times. Strict respect for the principle of authenticity would have meant leaving in place the scaffolding that maintained the step in its original material. But design was recognized as the most important value in this case, and the staircase was completely rebuilt in prefabricated concrete.

The canopy over the staircase connecting the main house to the guest house was very difficult for the engineers to understand: what held

[161] This story is in fact a myth. Or more precisely, the result of confusion, because it seems to have instead been on the jobsite for the Johnson Wax offices in Racine that workers were reluctant to take down supports from the mushroom column prototype. According to the story, the architect Frank Lloyd Wright took it upon himself to personally verify the soundness of his concept.

[162] See *Standards & Guidelines*, p. 26.

[163] For a description of the characteristics of the steel extracted onsite, see article by L. Dean, "Analyzing and Characterizing the Steel Used at Frank Lloyd Wright's Fallingwater" (*JOM*, available at http://www.tms.org/pubs/journals/JOM/0303/Dean-0303.html).

[164] The illustrations found in annex and the above explanations are taken from an article by D. Trelstad and R. Silman, "Preservation Engineering: Present, Past, and Future" (*APT Bulletin*, 30(3-4), pp. 27-32.

it up? Computer modeling demonstrated that there was no need to intervene, even though the slim support posts and the considerable size of the cantilever gave the appearance of being problematic.

Other repairs

Investigation of conservation problems at Fallingwater began in 1988. One of the major problems the WASA architectural firm had to address was moisture penetration.[165] The vast surfaces of the terraces and roofs and failing waterproofing had contributed to the development of humidity-related pathologies. In addition, the skylights were leaking, the corner windows had no vertical members to seal the connection where the two sides meet, and additional problems of condensation occurred under the waterproofing membranes due to a lack of thermal insulation on the concrete terrace slabs. The very damp environment around the stream and the dense forest setting contributed to ongoing humidity.

The first task was to create sealing overlaps, which had never been done. The main points of infiltration were indeed at the junctions between horizontal and vertical surfaces; these required special treatment. Copper and copper alloys are frequently used to make small-scale sealing overlaps such as flashing on masonry, because it is stable to corrosion. It can easily be incorporated into fresh mortar, even saturated with moisture. Aluminum, on the other hand, is attacked by the fresh Portland cement mortar unless it is protected. Lead, finally, while very malleable, proved too fragile to be used on the terraces where the many tourists lean and put weight on the sealing overlaps concealed under the stucco. Lead was used for overlaps between non-accessible roofs and masonry. Fiberglass insulation panels were installed on the terraces and covered with a bituminous waterproofing known as Siplast. A Kemper-system type liquid membrane was applied to ensure sealing of the visible parts of the edges of rounded slabs. Finally, drains were installed to prevent water from stagnating on accessible terraces. When the natural stone slab cladding was returned to the exterior of the terraces, the sealing of the joints had improved. A vapor barrier was also installed to limit the effects of condensation beneath the layers of waterproofing.[166]

Sealants around glass were redone so as to limit the penetration of air and water.

For surface repairs of exterior stucco, ThoRoc HBA, a cement- and polymer-based filler product manufactured by Degussa Building Systems, was used successfully.

Repairs completed at Fallingwater are interesting because it was essential to carefully maintain the appearance of this world-famous landmark. Originally conceived as a weekend house, a number of details of protection against humidity and moisture infiltration had been neglected. The team of architects and engineers managed to stabilize the cantilevers and introduce certain elements while respecting the architectural appearance.

Other work included installing an expansion joint where the canopy and guest house meet; restoring oxidized window frames and doors; restoring furniture damaged by ultraviolet light, humidity and water penetration; replacing of steel hangers on the stairway; waterproofing the terraces; and repointing of joints on the external walls.

[165] When I met with Pamela Jerome and Angel Ayon in New York, they discussed with me their work on Frank Lloyd Wright buildings. For more information, see the article by N. Weiss, P. Jerome, and S. Gottleib, "Fallingwater Part 1: Materials Conservation Efforts at Frank Lloyd Wright's Masterpiece" (*APT Bulletin*, 32(4), pp. 44-55; and P. Jerome, N. Weiss, and H. Ephron, "Fallingwater Part 2: Materials-Conservation Efforts at Frank Lloyd Wright's Masterpiece" (*APT Bulletin,* 37(2-3), pp. 3-11.

[166] Interior humidity can migrate to the concrete slabs and condense under the effect of the temperature differential with regard to the exterior. The vapor guard blocks this migration.

The house, which has received 4.5 million visitors since its construction, has thus been able to continue its mission, welcoming about 160,000 visitors per year.

II. REPAIRING STONE FAÇADES

Introduction

A characteristic of modern construction is the use of stone for cladding rather than the load-carrying blocks used in traditional construction. The most common pathologies of stone used panels are breakage of under-sized fasteners and the sometimes-insufficient qualities of stone in subjected to weathering. Today, fasteners are generally made of stainless steel, but it is not uncommon to find galvanized steel clips on facades mounted in the 1960s. We know that when steel is not well protected, it is prone to corrosion and therefore likely to lose its structural capacity.

The failure of stone itself is sometimes due to thermal hysteresis[167] when materials are used in conditions different from those in which they are normally found. As in the case of the Carrara marble panels used on the exterior of the Amoco Building built by E. Durell Stone in Chicago in 1972, these disorders can be significant. Although the effects of thermal hysteresis on marble have been known since the 1920s, it was not until the 1970s that they were more carefully observed and taken into account. Temperature variations can cause deformation of panels between their inner and outer faces, known as "dishing." The calcite crystals that make up marble are anisotropic and move under the effect of heat. When the temperature goes back down, they do not return to their original position. This results in a progressive deformation which can lead to the panel losing strength. Additionally, stone is a natural material whose structural capacities may vary from one quarry block to another. It is therefore advisable to ensure the homogeneity of its performance at the time of installation. Otherwise, serious pathologies can result, leading to the removal of all cladding panels and their replacement. The Amoco Building is a good example. Granite panels were eventually substituted for the marble ones in order to better meet the requirements of temperature variations. Breaks in panels, which often appear around the fasteners, may also be caused by structural constraints in the façade or insufficient sizing with respect to wind force, for example. Chemical attacks from acid rain, freezing, water penetrating into cavities are factors which can deteriorate stone façades.

Regarding thicknesses, it should be noted that limestone is generally used in greater thicknesses in the United States – 2 inches (5 cm) – while in France, the stone is cut to about 4 cm thick. For granite, as early as 1932, the National Building Granite Quarries Association (NBGQA) described the cutting process as almost entirely mechanical and was recommending panels 1 ½ inches thick. These panels are held in place by galvanized metal side anchors covered with asphalt. They fit into holes drilled on the sides of the panel and filled with plaster of Paris.[168] After the war, manufacturers were indicating 1 inch- or 7/8-inch-thick stone panels to be sufficiently resistant. The installation type changes: corner brackets help to carry the weight of the cladding on each floor. The anchors are made of bronze or steel and are enrobed in cement mortar which penetrates into the holes in the masonry. After the 1950s, the use of thin stone veneer became more widespread due to the fashion for using curtain walls in construction.

[167] This expression is taken from P. Loughran's work, *Failed Stone: Problems and Solutions with Concrete and Masonry* (Berlin: Birkhaüser, 2007). Hysteresis refers to traces left on an object from an action exerted upon it, an inscription of the influences to which it was subjected.

[168] M. Sheffler, "The Development and Conservation of Thin Stone Veneer" (*Preserving the Recent Past,* 2001, pp. 25-30).

It was also at this time that the use of prefabricated concrete panels and composite panels on a concrete support or metal honeycomb spread. Standardization expanded. Fasteners were simplified. Elastomer products for horizontal joints replaced mortar. The number of lateral anchors, now in stainless-steel, increased.

It is important to note that some sealants can also be defective or damage stone by migrating or bleaching.

The advantage of double masonry walls is protection against infiltrations. Moisture can enter the cavity but will run off against the inside wall and be thrown out at the foot of the wall via weep holes. However, it is advisable to ventilate the cavity so as to avoid the creation of mold that can end up ruining the masonry. The other advantage is that this method allows for exterior thermal insulation while retaining the appearance of the stone façade.

Some installations are problematic today. This is the case, for example, of prefabricated concrete panels covered with marble. As we mentioned in the case of the Amoco Building, the marble tends to deform, causing it to detach from the concrete support. In this case, replacement must be considered, even if experiments injecting sealants has worked for some repairs. The problem is that the marble continues to deform if it is subjected to significant temperature variations. An example of this can be seen on precast concrete panels covered in travertine at the Kennedy Center in Washington, D.C., or at Lincoln Center in New York.[169] The rapid prefabrication of these panels made them popular, but the wearing-out of stainless-steel fasteners or epoxy glues now more than fifty years old makes them dangerous today.

[169] K. Normandin, "La technologie du béton précontraint habillé en marbre: les techniques de stabilisation », in Y. Andrieux, editor, *La réception de l'architecture du movement moderne : image, usage, héritage* (Saint-Étienne: Presses de l'Université, 2005)

Repairs and replacements

The most common repair methods consist in first sealing the anchors with epoxy and not mortar, for better durability. It is also possible to connect a panel with defective fasteners to the adjacent panels. For cleaning, mild detergents with an alkaline prewash and a slightly acidic rinse are used. Newly developed mechanical cleaning methods must first be evaluated on-site before being used.

We will now detail an interesting case of a modern stone façade restoration and another involving travertine paving. We will also discuss businesses working in the field of stone restoration. The objective of this section is to improve knowledge on solutions for safeguarding natural stone in its most typical uses in modern architecture.

Example of the National Gallery of Art

The case of the National Gallery of Art in Washington is of special interest. Its two buildings – the East and West Wings – are covered in the same stone, a pink Virginia marble (sandstone in reality, but resembling marble) but which is used very differently in each case. The East Wing was built in the years 1937-41 by the architect A. Pope in the neoclassical style. Its stone wall is self-supporting, that is to say it carries its own weight from bottom to top, while the rest of the building is metal-frame construction. The blocks are 5 inches thick. In the case of the building built by I.M. Pei in the 1970s, each course of blocks is supported by metal brackets fixed to the concrete frame. As the stone serves as a simple cladding, it is only 3 inches thick.

In recent years, deformations have been observed on the façades of the West Wing, the more recent of the two. The reasons for these distortions have been difficult to explain.[170] A

[170] Interview with Susan Wertehim, managing architect for renovation work at the NGA / NGA Deputy Administrator services.

study was commissioned from Robert Sillman & Associates, a specialized consulting firm, which concluded that a combination of factors had resulted in the stones exerting their weight on each other. This overload caused problems, since the stone was only intended as a veneer carried by steel brackets fixed in the concrete structure. Fortunately, the blocks resisted compression and there were few breakages. Several solutions have been studied, such as the simple removal all the stone panels followed with a coat of stucco applied on the brick wall behind. Total replacement of the panels has also been considered. Ultimately, since the stone on this building has been recognized for its architectural value and because it is the element ensuring the coherence of the architectural ensemble of the museum, it was decided to preserve the appearance of the building in the very best way. The chosen solution is to dismount the cladding blocks one by one and put them back in the same place after cutting and resizing. The operation was not simple; each of the 17,000 panels is 3 inches thick (8-9 cm) and weighs 225 kg. For the façade restoration, 85 million dollars were added to the 150 million-dollar budget for the West Wing funded by the federal government.

This is more accurately a maintenance project than a conservation measure. The construction technique used for the stone façade of the East Wing, built in 1937-41, was no longer used in the 1970s. A study was conducted to locate the sandstone quarry in Virginia; stone of the same dimensions was no longer available. The architect I.M. Pei wanted to make the façade look like a "wallpaper", a modern, suspended envelope that played on the massive appearance of the west wing. This impression was reinforced by very fine mortarless joints. The facade was been very finely executed, but for such perfection, today we must pay a certain price to preserve this technique of construction.

According to John Matteo's interview with R. Silman & Associates,[171] the National Gallery of Art's project raised a very interesting question. They worked directly for the museum. The problem is that the small wedges used as spacers between the stones as they were layed were not removed by the company. This resulted in pressure building up in the facade when the concrete structure of the building contracted slightly. This demonstrates that the interface between the architect and the engineer did not work well. The architectural appearance of the facade was paramount in the eyes of the architect who wanted to give the impression of a continuous facade. The joints between the elements were undersized, and now the panels had to be planed down by a few millimeters [Figure 71].

Pavement at Lake Shore Drive Apartments

The Lake Shore Drive Apartments built by Mies van der Rohe in Chicago presented an interesting conservation problem.[172] The problem generally posed by esplanades of this type, paved in travertine pavements, is the evacuation of water. The construction system consists of a bituminous, waterproof layer and thin stones laid in the traditional method on a mortar bed. The first problem to solve is that of evacuation surface water to avoid puddles and frost which end up damaging the stone. Stagnant surface water erodes the stone and makes it slippery. The second problem is the evacuation of the water which infiltrates under the paved surface. Most of the time, the distance between the finish pavement and the waterproof sub-structure does not allow for any grading that would allow the water to drain

[171] Matteo defines himself professionally as a "preservation engineer," as opposed to engineers who produce technical feats. 21 July 2010. R. Sillman & Associates restored Frank Lloyd Wright's Kentuck Knob as well as Gustavino's vaults on Ellis Island, for example.

[172] Gunny Harboe brought my attention to this case. The explanations and illustrations are taken from an article by K. Itle and H. Hunderman, "The Modern Plaza: Making More from Less" (*APT Bulletin*, 42(2-3), 2011, pp. 53-57).

properly. This is susceptible to cause leaks, potentially causing problems in supporting structure beneath the surface pavement, especially given the limited number of drains overall. Finally, it is impossible to raise the finished level which must correspond with sidewalks and the thresholds of the building.

To resolve the challenges at Lake Shore Drive Apartments, Krueck and Sexton Architects teamed up with the WJE engineering firm. The travertine slabs have a surface area of 42 square inches and are 1 ¼ inches thick. They are placed on a 1-inch deep mortar bed directly in contact with the waterproofing layer applied to the concrete slab. As current standards require a 2-inch mortar bath, it was clear that the device needed to be modified. In the 1980s, the waterproofing had been repaired and the slabs had been laid back in place according to the same design. More than 30 years later, the travertine slabs have begun to show signs of deterioration in the form of microcracks. In 2007, at the time of the renovation project, it turned out that only 20% of the slabs remained free of cracks.

Studs still remain the best-performing type of pose for this type of pavement. The joints are left open and water is evacuated by creating sealed slopes beneath. In this scenario, the stone must be strong enough to support its own weight and that of pedestrians and even vehicles. This solution was considered for the esplanade at Lake Shore Drive Apartments, but the slabs would have needed to be recut to meet resistance criteria, an unthinkable option if the original appearance were to be retained. It would have been necessary to use thicker slabs, up to 3 inches, more than the available thickness. In addition, each slab would have weighed 230 kg. A third option was to reinforce the slabs with another material to increase their traction performance. Thus, laying on studs would have hidden numerous drains to compensate for the lack of slope. Carbon fiber with epoxy seemed to be appropriate to give good structural capacity to the travertine pavement. This option was tested, but the cost proved too high (40% more). In addition, the accelerated aging tests did not give any guarantees on the durability of the solution. The thickness of the concrete slab could be picked down to gain a ¾ inch, which allowed to create a slight slope with a layer of cement mixed with polymers.

The other solution was to lay the stone on a bed of mortar with joints, itself placed on a porous material allowing the water to filter down to the waterproof layer. This solution was imagined for areas of the esplanade with the heaviest traffic. But this disposition increased the thickness of the ensemble, requiring an adaptation at the level of the thresholds. This example demonstrates a restoration of a 1950s plaza that benefited from up-to-date technology and materials, such as carbon fiber, epoxy glue, and tougher sealants which allow the slopes to be removed, but it required a great deal of attention to details of laying and the treatment of the thresholds. A slight difference between indoor and outdoor ground levels was ultimately required. It is barely visible at the threshold.

Masonry Preservation Group, inc.

I was fortunate to have the chance to meet Joe Garabino of Masonry Preservation Group in Philadelphia. This company has existed for 35 years and employs 85 workers plus another 13 as office personnel.[173] In Philadelphia, an accident caused by a falling stone led to sampling and investigation on all façades, a procedure which has since been made compulsory in all cities. The particular installation system, using steel anchors that corrode and cause breakages

[173] Interview with Joe Garabinole, 29 July 2010.

in the cladding makes the façades very sensitive.

Cast stone reinforced with carbon fiber is commonly used to replicate façade stones. In some restitutions, fiberglass is used, as in the cases of the Terra Building and Union League Building in Philadelphia. Cast stone can be used to replace stair treads, balustrades, and to do repairs... For high-rise buildings, concrete and stone repairs consist mainly in injecting penetrating sealers, smoothing out surfaces, draining water from slopes, injecting epoxy into cracks, sealing joints and cracks, replacing steel reinforcements and coating them with urethane or epoxy, replacing expansion joints, etc. [Figure 72]

Old Town Hall in Philadelphia was an interesting building to restore (by Vittetta Architects). The Vermont marble used for this building contained iron oxide which had caused running streaks on the clear stone. This renovation was similar to that of the Capitol in Washington. It was necessary to clean the stone by misting, using no chemicals or abrasives because the stone is porous and must keep its surface layer so as not to deteriorate.

III. CURTAIN WALLS AND WINDOWS

Introduction

According to J. Kelley,[174] two types of curtain walls exist: those whose main purpose is fire protection – these are usually clad in masonry or terracotta tiles – and those whose main objective is speed of execution and low cost. These were developed after World War II. The two systems have one thing in common: they are both sensitive to humidity, but for different reasons.

The Chicago School, after the rebuilding of the city around 1890, developed the skyscraper with metal framing; Chicago's Reliance Building is the epitome.[175] The curtain wall made of terracotta components is became widespread, but it is not well adapted to the different movements of the framework and the cladding, as we will see.

The main problem of the modern curtain wall is the loss of redundancy of constructive systems in order to maintain their performance.[176] Economy dictated the use of lightweight materials, but these had to be complemented by an adequate fire protection system. Weight had to be minimized, and construction carried out in the factory rather than on-site. The new stylistic vocabulary led to using of more and more glass, generating a different aesthetic. Extruded façade elements can be prefabricated and delivered to the construction site ready for use. After World War II, ornamentation was totally abandoned; aluminum was developed with inexpensive profile sections available.

Lake Shore Drive Apartments, built in Chicago by Mies van der Rohe in 1949-51, was the first residential building constructed with a fully glazed curtain wall.[177] The steel, aluminum, and glass elements were assembled on the roof before being lowered into place. The project was somewhat experimental. The reactions between the different metals was not very well known at the time, and the dimensional tolerance of the panel in the frame was taken very well into account. The aluminum curtain wall is suspended on the outside of the steel structure and the horizontal joints are expressed architecturally.

The curtain-wall aesthetic began to show up in many U.S. cities in the 1950s. Lever House was

[174] J. Kelley, "Twentieth-century Curtain Walls: Loss of Redundancy and Increase in Complexity," in D.F. D'Ayala, *Structural Analysis of Historic Construction: Preserving Safety and Significance* (Boca Raton: CRC Press, 2008), pp. 25-31.

[175] See further below.

[176] H. Hunderman, "Curtain Wall Development: The Loss of Redundancy," in *Preserving the Recent Past,* pp. 3-9.

[177] S. Kelley, "The History of the the Curtain Wall: From Craftsmanship to Machine-Made," in *Preserving the Recent Past,* pp. 9-18.

built in New York in 1952 by SOM architects. The curtain wall with stainless steel profiles is placed on an interior structure. The simplicity of its appearance hides a rather complex composition which incorporates protection from the spread of fire through its concrete floors and railings. Soon, this kind of façade would become very common thanks to the development of the aluminum industry.[178]

Curtain walls of the 1950s and 1960s typically have rain protection on the outside and protection against moisture inside. Expansion and retraction of the frame are taken into account. The different layers are ventilated and drained to ensure indoor humidity control. The components are easy to install from the inside and light to carry. Today, these particularities are a hamper to the evolution of these structures. It is often the joints that fail. Envelopes lose their seal to air and water. The weak point of curtain wall construction is precisely its lightness. It offers poor protection against external atmospheric conditions. As part of the improvement of energy expenditure, it is advisable to replace expanses of glass and their defective fittings. Most of the time, replacing single-pane glass with double-pane is problematic. Heavier glass leads to the replacement of joinery or even the addition of vertical supports (mullions). In many buildings, the lack of sensitivity in the renovation of joinery and glazing has led to significant loss of character. Further progress is still therefore needed in this aspect of restoration of 20th -century architecture. Another difficulty currently posed by curtain walls is comfort in the summertime. The significant increase in sunlight is not sufficiently countered by reflective glass or interior Venetian blinds. Installation high-performance glass can help reduce air-conditioning costs, but the curtain wall remains an inefficient mode of construction. We will now detail some interesting cases of renovation or maintenance of original curtain walls.

[178] The curtain wall at Lever House was renovated by the SOM architectural firm in 1998. The airtightness of the glazing and the capsules of the stainless-steel uprights were redone, the steel corner pieces which hold the glass were replaced by aluminum mounting pieces. Single-pane glass was replaced by single-pane glass of the same type. Using dual-pane glass would have compromised the integrity of the design.

United Nations Building[179]

Description

The UN headquarters in New York was one of the first post-war buildings to use a curtain wall of such vast surface are.[180] The constructive system employed at the UN building was particularly innovative for its time because the façade stands forward from the floor levels. It is designed as an assembly of windows held in place by a reinforced grid of vertical pieces installed on the structure beforehand.

Investigations

The design office of R. Heintges & Associates was responsible for the research and development of curtain wall replacement solutions for the United Nations Secretariat.[181] The historical study shows that the elements used are standard, but they were implemented in an innovative way. The parts of the curtain wall are therefore not unique or irreplaceable. The diagnostic study shows that the suspected problems can in fact be observed: neither waterproof nor airtight, showing deformations, staining, the interior finishes deteriorated, broken glass, faulty and over-compressed joints. A borescopic inspection through a hole drilled in an upright also revealed the corrosion inside the aluminum casings. This diagnostic, when compared to the constraints that a glass envelope must be able to support according to the standards of today, led to the deci-

[179] UN Headquarters visited 24 July 2010.

[180] The façade of the Equitable Building constructed in Portland in 1948 by P. Belluschi is not considered to be a true curtain wall because is dual-pane glass is held in place in metal frames. See B. Kaskel, "The Metal and Glass Curtain Wall" (*Preserving the Recent Past 2,* 2001, pp. 190-211.

[181] R. Heintges, "The United Nations Secretariat Curtain Wall: History, Current Condition, and Future Restoration" (in T. N. Prudon, *Restoring Post-War Heritage*, DOCOMOMO *Preservation Technology*, dossier 8, 2008, pp. 37-48).

sion to completely replace the curtain wall. It is precisely the original construction mode of the curtain wall that led to its replacement, because selective removal and modification could not be done without compromising it.

Constraints on the renovation

I met Areta Pawlinsky from the Heintges design office. She explained to me the constraints this façade is subjected to and what must be taken into account in the design of a contemporary curtain wall. In the first place, the pressure between the inner and outer seals must be equal. Water must be allowed to migrate outside through a drain to the exterior. If pressure is not equalized, the water could be sucked inside. The curtain wall at the UN was not balanced in pressure and there was only one joint sealing it, whereas today, at least two are used. The curtain wall must be conceived in such a way as to take into account the movements of the building in the design of the joints. The sealants used on the original curtain wall at the Secretariat, which included caulk, were insufficient for its degree of expansion and contraction.

Knowledge about phenomena of corrosion caused by dissimilar metals being in contact was still incomplete in the 1950s, particularly as regards the juxtaposition of steel and aluminum. When water is present, especially in the case of acid rain, an electrochemical reaction occurs which damages the least noble metal. With the insulating materials being of short-term durability and the design of the elements being defective from this point of view, this is what ended up occurring with the curtain wall at the UN.

The understanding of lateral loads (wind and earthquake) has evolved significantly since the 1950s and the façade no longer met the current criteria. The analysis of wind loads on the building, according to current criteria, have shown that it was necessary to take into account loads one and a half times greater than those which had been initially calculated. Although the original façade was still in good condition, from this point of view, the security concerns were too significant, especially with corrosion on the uprights adding to fear of a weakening of the façade.

Thermal performance is also much more demanding today than it was 55 years ago. The main problem of this façade, apart from heat loss through its single-pane glass, and excessive heat rise in summer because of its east-west orientation, was condensation. This had occurred in the support elements and caused corrosion of the hidden aluminum components.

The enameled glass window ledges have been replaced by laminated glass to prevent breakage due to thermal stress. The clear windows were covered with a film to increase solar reflection from 7.5 to 57.5%. This led to breakages of the original, not tempered, glass because of the pressure exerted by the adhesives. In any case, the glass had to be modified to have higher insulation and solar protection properties.

For the new curtain wall, one of the constraints was to check for water penetration under the effect of the wind pressure. Dynamic tests with thrusters such as aircraft engines and water spray can simulate real conditions. Air infiltration is also difficult to predict. In general, window frames alone cannot ensure airtightness, but also the joint with the masonry or elsewhere on the structure. Envelopes always leak, the question is how to evacuate the water that ends up infiltrating to the outside. The United Nations Building was the subject of research in this direction.

What is clear is that conservation of the curtain wall at the United Nations would have been

quite difficult when considered from the angle of its performance. I also learned that one of the major constraints was increasing the degree of security of the façades from risks of attack. The glass had to be blast resistant. To this end, triple-pane glass was used; its weight required increasing the thickness of the uprights. It was agreed that since the original transparency of the curtain wall had been lost decades previously when the reflective film was applied, there was no need to restore it, and the tinted glass used in the restoration is thus reflective to ensure maximum thermal performance.

Nevertheless, issues about authenticity were raised among preservationists interested in 20th-century heritage. Their opposition to this project comes from the fact that the decisions were made without public or peer review. The security constraints and the particular status of the UN in New York partly explain this approach. However, the promising intentions made by R. Heintge to make this renovation an example for the conservation and restoration of curtain walls in modern architecture have failed.[182] The original appearance of the building has been totally altered. But who will remember that appearance once a certain amount of time has passed?

Conversely, in the case of the renovation of the Lever House completed by the SOM agency, the decision not to install double glazing was made precisely so as not to alter the delicate profiles and the appearance of the façade. Nevertheless, it must be recognized that the exterior appearance has indeed been modified, and that there is a sort of tendency towards uniformity among all the transformed curtain walls. This is likely what will take place when the 1958 façade of the Inland Steel Building in Chicago is renovated under the direction of the same Frank Gehry-associated architects. The goal is to make it a LEED-certified office building.

Renovation of Crown Hall, Chicago[183]

This example offers a counterpoint to what has just been stated about the UN. Improving the energy performance of the façade of an historic building often proves very difficult, or one may simply decide not to do it and to compensate by other systems. As shown by the case of Crown Hall, it turns out that the best solution may be a return to the original systems. Built by Mies van der Rohe in 1956, Crown Hall has been a designated Chicago Landmark since 1997 and a National Historic Landmark since 2001.

Architects McClier and Krueck + Sexton conducted the renovation of the building in 2005. It was very degraded following an earlier, insensitive renovation and due to a lack of maintenance of its structure and metal frames, largely oxidized. In addition, some expanses of glass were broken as well as some of the travertine floor slabs. The project benefited from public aid and was in fact overseen by a commission. It is interesting to note that to renovate the other building on campus, tax credits were applied, even though they are less interesting on the individual level than is Crown Hall. This building's protected status has led to the creation of a sort of historic district all around it.

Crown Hall had already been renovated in the 1970s. Its large windows were replaced at that time. During this renovation, corrosion was found on the inside and outside of the envelope. This can be explained in part by the fact that the natural ventilation by the tilting window ledges had been blocked, rendering condensation even more problematic.

[182] According to interviews I had with Kyle Normandin (21 July 2011) and Pamela Jerome (3 September 2011).

[183] Visited on 2 May 2010, and 3 September 2010, with architect Gunny Harboe.

As part of the recent renovation, the Transolar design office and Atelier Ten completed a project to reduce energy consumption by 50% while improving comfort for occupants. To improve comfort in summer and winter they proposed:

- Increasing vegetation on the south and west
- Reopening the tilting window frames on the main level and the transoms at the basement level for natural ventilation, and automating half of them for night cooling
- Replacing laminated glasses with more efficient glass (anti-emissive and with a better solar protection factor)
- Installation of new Venetian blinds to improve light diffusion on the ceiling and limit the use of artificial light
- Creation of an air extraction at the periphery and placing diffusers with variable geometry in the center of the building to totally renew the air volume mechanically
- Installing more efficient automatic lighting to reduce internal input
- Modification of rooftop air handling units to preheat incoming fresh air by recovering heat from the exhaust air
- Augmenting thermal insulation on the roof by 3 inches
- Adding anti-glare screens to improve conditions for computer usage
- Creating an air extraction directly on the roof for rooms in the basement, which could be air-conditioned if necessary
- Using the underfloor heating system for cooling, and improving heating efficiency
- Restoring natural cross-ventilation in the basement.

For the renovation of the façade alone, the budget was 4 million dollars. Initially, it was planned to replace the tempered glass panels with double glazing, but this modification was too costly. Additionally, given the size of the glass panels, they had to be least ¼-inch thick to comply with regulations, but it was important to maintain the dimensions of their original profiles. A good compromise was found. The mounting pieces for the glass were modified to take into account this increased thickness. The resulting bevel better secures the glass without modifying the perceived dimension. Further, it should be noted that heating is inexpensive because the campus produces its own steam. For replacement of the glass in the lower part (2.40 m high), frosted glass was chosen because the same quality of glass as used in the original is no longer available. In the upper part (3.05 m high), the clear glass was kept.

The renovation project had to be carried out in only 15 weeks and in confinement conditions because of the presence of lead in the paint. The steel was sandblasted to the raw surface followed by the application of three layers of epoxy primer. Window blinds were improved to fight summertime overheating and ventilation via the tilting window ledges returned to operation. This is an example of an original device being used to improve comfort when improving the performance of the envelope was not possible. The restoration of Crown Hall was hailed as a success[184].

Empire State Building[185]

The Empire State Building is one of the most famous monuments in New York as concerns the history of 20th-century architecture. Its recent renovation poses a multitude of questions

[184] As recounted to me by Gunny Harboe, at least. See also "Ludwig Mies van der Rohe, Crown Hall IIT, 1956" in *Reinvigorating 20th-Century Masterpieces* (A+U, no. 3, 2010)

[185] Visit with Frank Prial of Beyer Blunder Belle Architects, October 12, 2010, and again with the Serious Materials firm on July 28, 2011.

which underline the specificity of modern heritage treated with contemporary approaches and techniques. Again in this case, it was a question of updating of the mechanical services, but also improving the efficiency of the envelope. The renovation has enabled the building to become a benchmark in sustainable development in the U.S., reducing its annual energy consumption by 38% and its carbon dioxide emissions by 105,000 tons over the next 15 years. The hope is to preserve the building's status as a "Modern Icon", at the forefront of innovative when it was built in 1931 and apply the experience to other buildings of the same type.

The Empire State Building had several hundred different tenants before the renovation, and the rents were very low. There was a majority of very small premises like medical offices. The owner wanted to renovate the building to attract larger tenants by offering operating costs competitive with those in the new-construction market. Mechanical services were updated and monitored by Johnson Systems. It was agreed that in order to limit operational costs, air conditioning and light would be turned off at 6 o'clock p.m.

The project also included the renovation of 6500 windows (with solar protection), the installation of more than 6500 insulating barriers behind the radiators beneath the windows, the reduction of electricity consumption in the offices, the renovation of the central air-conditioning system, replacing the constant air volume by variable, on-demand volume, and updating the controls system.[186]

The company Serious Materials completed the transformation of the glass in 2010. Originally specialized in joinery in pultrusion fiberglass and resin as was used for the renovation of the Hancock Tower, the windows of the Empire State Building had been changed in the 1980s to aluminum and dual-pane glass. It was decided to keep these and modify only the glazing. A proposal to inject foam to limit condensation in the aluminum frames was not accepted. The innovative process developed by Serious Materials consisted in the creation of a third layer in the vacuum of the double glazing through the insertion of a polyester film, thus doubling the air space. This film has a sun-block coating on one side and low emittance on the other. The same coatings were applied to the glass, but on the interior faces. In reality, it is the gas within the air gap that offers resistance to conductivity, more than the intermediate layer. The air gap vacuum makes it possible to pass from R 2 to 3; using a gas makes it possible to pass to R=4, and xenon to R=6, i.e. a final performance of W=0.8. Performance is comparable to triple glazing but with the weight of double. This process should allow an HVAC savings of 17 million dollars. To the north, the cavity is vacuum-filled (TC88), a very slow process. All windows are 100% UV-treated and they cut the hot infrared rays of the sun.

The window frames are brought to a room on the second floor of the building in batches of fifty, which corresponds to a day's work. The windows are thus removed and reinstalled within a 3-day maximum turnover. The joinery and double glazing are disassembled. The only waste produced is the caulking seals of the glazing that cannot be reused. Even the aluminum spacers are reused. The glass is cleaned while the new spacers are being prepared. On a table, the new assembly is put together: a spacer reduced by half is positioned on a pane of glass, then the film, a second spacer and the second pane of glass. Everything is then sealed by passing through a press. Upon exit, the film is not yet very well stretched. The panel is then passed into a kind of oven that stretches the film. The whole is then sealed with putty. The

[186]BOMA Magazine, May-June 2010.

last operation is the most delicate and the longest. It consists of emptying the two cavities to make way for the Zenon-type gas. This takes several hours. Finally, the joinery is reassembled, and the frame is repositioned in its original opening. I was very impressed by this process. Admittedly, the actual performance of the device cannot be fully guaranteed, nor can its durability, since it depends mainly on the tightness of the cavities containing the gas. But tests conducted on-site – a small demonstration with an original window and a modified one put in contact with a heat lamp and a fridge – are very convincing.

The architects Beyer Blinder Belle carried out a complete renovation of the building's sprinklers and mechanical systems for the different flows of users in the building. They also conducted a very nice restoration of the main hall which is a protected space (we must remember that interiors are rarely protected in the United States). The entry hall has regained all its magnificence thanks to the restoration of the ceiling frescoes and the new lighting project. The reinterpretation of various elements such as storefronts and fixtures according to current needs and regulations is also an excellent example of how current technologies can help preserve original concepts – and even materials – found in modern buildings.

The renovation of the Empire State Building is certainly one of the most interesting buildings from the point of view of conservation and modernization of a 20th-century building. It is important to emphasize the significant effort and investment made by the owner to upgrade the building and ensure its future.

Warren Petroleum Building, Tulsa, Oklahoma[187]

I was interested in this building because its glass façade has an interesting solar protection system on the exterior. I wanted to find out if this protection preserved the original facade elements and whether the interior comfort and the energy expenses were satisfactory. The building, built in Tulsa, Oklahoma, by SOM in the 1960s, is still in operation, and I had the chance to meet members of the building maintenance and management staff. This example helped me to understand the impact of a functioning office building on its mechanical services, especially when the original, unmodified façades are in place [Figure 76].

Until 1996, the Warren Petroleum Building had only one occupant. It is an austere building, well maintained by its current owner. In the 1980s, the oil crisis led all major oil companies to leave Tulsa for Houston. Previously, the sector employed 55,000 in the city, only half of which remain today. Tulsa has not developed as much as had been hoped in the business of offices. The building was thus sold for one million dollars, and five million more were spent to bring it up to contemporary standards. This investment made it possible to lower operating costs and thus attract tenants. The work consisted of changing the air conditioning units, modifying the partition walls and lighting, and adding dropped ceilings, which proved more difficult than anticipated because of the five-foot grid size rather than the 4 feet 8 inches usually standard for false ceiling panels. Previously, there was no false ceiling, only sheetrock. The renovation has not been evaluated by professionals and no historical research was conducted beforehand, disappointing because certain elements were removed during the renovation, including a pivoted door. I found that the building had lost much of its interest on the interior and had become rather commonplace.[188] It has been transformed to into a multi-tenant facility. The current management sees no benefit to NRHP registration, although the building is eligible;

[187] Visited 22 February 2011.

[188] Photographs of this building were published by *Architectural Record*.

they could have benefited from tax credits for the renovation. Typically, the individual tenants do their own adaptation work, but here, management handled all the renovation. This is perhaps what has kept an overall consistency in the building despite its varied occupants.

There are leaks all around the window joinery, but this problem has not yet been addressed because no work was done on the façade. This is an original façade of single-pane, green-tinted glass, with screens of tinted gray glass placed in front of the facade, similar to the UNESCO building in Paris that I studied a few years ago. The role of this element is not apparent to the people who handle maintenance, and the full renovation of the mechanical services was made without really taking it into account. Management has considered the option of modifying the glass but wonders how long it will take for the investment to pay for itself. An elastomer coating was applied on the balconies to improve their water-tightness. The joinery is aluminum. Management believes that it would be too complicated to install dual-pane glazing; it would be necessary to replace all the façades. As the façades have not been modified, it is instead all the mechanical systems that have been updated to guarantee the current level of performance.

As for mechanical services, there are 105 cooling units that were replaced around 1975. The operational costs are two dollars and fifty cents per square foot, as opposed to three dollars before the recent renovation. The technical rooms are located on the roof. There are also two boilers for hot water that have been preserved but improved by a device that increases combustion. Four years ago, fan coils replaced the old, individual air-conditioning units. The large cooling chimneys and wet coolers are hidden on the roof and placed above the roof. The repair of their supporting structure alone cost 60,000 dollars. In the offices, the climatization comes from the false ceilings. An engineer is permanently present in the technical room to check the operation of the machines and monitor all temperatures inside the building. The occupants can ask him to raise or lower the temperature of a particular sector or room; all is managed by the program. The re-cooling of fresh air is too complicated to put in place; there is therefore no recycling of fresh air. The engineer, however, follows weather reports ,and when the night-time temperature is estimated to be 70 degrees Fahrenheit or less, he simply draws outside air into the system. There were four engineers in the 1960s with the building was running 24 hours a day. Today, the building use is limited to office hours. Gas is inexpensive now. Ten years ago, it cost four dollars and fifty cents, nine dollars in 2006, and three dollars and fifty cents today. It is therefore the main energy source for the boiler. Management's goal is not only to update the facility, but also to increase its value by being at the forefront of techniques.

The manager considers that it is a beautiful building with a high ceiling height of nine feet (2.75 m). Updating the facilities has increased the building's current value more than fivefold compare to its initial value. The managers have a certain architectural sensitivity, but most of the original interior materials were lost during the renovation because their value went unrecognized.

The small space that finishes the building at the base will be transformed into a hall for weddings, etc. Since there was not tempered glass on the ground floor, it had to be installed. Only one or two factories in the United States are capable of producing such expanses. In the 1996 work program, two panels were changed, those at the corner of the building where skateboarders come to practice. The panels were brought by train and then installed thanks to a rolling scaffold. It took a many

people to set the joints all around because of the weight of the panels.

The interest of this example is that it demonstrates that it is not always necessary to change curtain walls from the 1960s in order for a building to remain attractive and gain in energy performance. However, I was struck by the lack of understanding of the sun protection system, whose effectiveness could not be verified. All building performance is based on the operation of the air-conditioning system.

John Deere Headquarters

I wanted to study this iconic 1960s building by E. Saarinen for its exceptional state of conservation. I was greeted by Craig S. Mack, Manager of the General Office Facility,[189] who explained to me that the entire building is laid out on a 3x6-foot grid, which has allowed for many re-arrangements without altering its quality. In each corridor there are cabinets housing the cabling for computers. HVAC[190] and lighting systems are placed in the original false ceilings that have been maintained; trenches in the floor are used to pass electricity. There is no fire protection and no sprinklers. Standards for fire safety are not the same as in Chicago. In the 1960s, it was common to make no provisions in this regard.

The building is not yet fifty years old, but it will become a landmark in the coming years, so it has been carefully maintained and updated to fulfill the conditions of a landmark registration. There are 1600 employees in both buildings, the main one and its extension completed a few years later by the architects K. Roche and J. Dinkeloo.

The entire main building is oriented north-south. There is no lack of sunlight, and all around there are views of nature. There are no curtains or blinds for the summer, only for the reflection of snow in winter; otherwise there is no need for them. The glass is reflective and the exterior louver-type screens in thick metal protect the façades quite well. Window framing was changed two and a half years ago to incorporate dual-pane glass and thermal barriers [Figure 77]. Since then, 30% has been saved in heating each year and now only one boiler is turned on instead of two. On the other hand, I was unable to learn whether there had been any savings in air conditioning. The original laminated glass has been replaced by dual-pane glazing. The investment has already been recovered through fuel savings.

In the extension, the glass roof mimics the form of a traditional farmhouse. Mr. Craig says that only 10% of the sunlight passes through this canopy. On one side, blinds are sufficient to block the summer sun. The Corten steel structure has retained its original color; being on the interior, it does not soil users who come into contact with it. If we were in Chicago, the Corten steel structure would be much darker because of the heavily polluted atmosphere. Employees work in an open environment that promotes teamwork. The offices have been opened up and transformed into meeting spaces. There is no frost on the Corten in winter. Air-conditioning coolers are in the lake where they generate a small fountain. Interiors are Japanese-inspired with their sliding doors, false ceilings, and furniture selection.

I was very impressed by the building's condition which proves that regular maintenance and updating consistent with the building's original qualities are essential. This is also a very successful example of façade replacement, very carefully executed. The sunscreens placed before the façade render the window joineries less visible; incidentally, their replacement is thus less problematic than in the case of a conventional curtain wall.

[189] Visited for an interview on August 1, 2010.
[190] HVAC: Heating, ventilation and air conditioning.

CIGNA Building, Bloomfield, Connecticut

This building interested me because it was almost demolished a few years ago but was finally renovated instead. I was received by the building's maintenance managers.[191] Today, it serves as the headquarters of a health insurance company [Figure 78]. It was built in the late 1950s by SOM Architects of Hartford, Connecticut. In the late 1970s, an addition was created with exactly the same characteristics as the original 1957 building. Fryer and Associate, an architecture office in Hartford, handled the renovation. About fifteen years ago, the independent electricity generator was removed and had to be extracted from the building, which proved to be complicated task. The generator is now located outside. It produces electricity for the computers – the facility is all-electric – and supplies steam for the kitchen as well. For heating, there are three boilers which were replaced fifteen years ago. All air conditioning is computer-controlled. Pond water was used for the sprinklers and the cooling circuit in the past, but this system has been changed.

The lobby still has many of its original features, with the exception the access controls and carpet. On the other hand, the offices were fundamentally modified, especially as concerns the false ceilings of which not a single original element remains. In the corridors, the original acoustic ceiling tiles have been preserved. The cafeteria is a very nice space, located on the edge of a pond, very open, with an inclined ceiling. The basement has then interesting role of connecting the different buildings. The patios were designed by I. Nogushi, who also created the sculpture representing a family.

The façade is in good condition. Windows are original and have not been replaced because of the high cost. There are not many leaks or infiltrations. Apparently, there is no problem with corrosion or condensation even at the window sills, along which the air conditioning units have been kept in place. Levels 1 and 2 receive air conditioning from the basement, the other levels from the roof. The replacement of glass sections costs between five and six thousand dollars and requires the use of scaffolding and suction cups.

The interest of this example lies in its demonstration that preserving original elements in an office building can also be based on a pragmatic approach by the owners. The character of a building as conveyed by the façade design is recognized as an important attribute. If the necessary updates to technical elements are possible, the façade can be kept as is. This obviously results in greater energy consumption, but the work of replacing the glass would be so complicated that it is preferable to maintain the existing.

TWA Terminal, JFK Airport, New York

We observed in the first part of this report that a building must meet the Fifty-Year Rule in order to qualify for the NRHP register, a rule commonly accepted and supported by the government. For state and city registers, this criterion does not always apply, as was the case for the TWA terminal at JFK Airport in New York, built in 1962 by Eero Saarinen. Designated a New York City Landmark in 1994, only 32 years after its construction, then closed in 2001 when the company ceased operations, the structure was named as one of the ten most endangered places by the NTFHP in 2004. It was placed on the NRHP in 2005. Saarinen's iconic 1962 building was finally rehabilitated by the airport authority in 2008 for 19 million dollars. Asbestos removal and the restoration of the concrete hull and interior ceramic cladding will allow it to reopen soon as the reception area of the Jet Blue terminal. Jet Blue has built its own crescent-shaped terminal around the historic building, a choice originally criti-

[191] Visited on August 30, 2011.

cized by conservation experts. Unfortunately, the entire terminal could not be saved. A trumpet-shaped departures hall was demolished only after having been moved at a price of eight hundred thousand dollars. The argument was that its renovation would have cost 1.2 million while the the main building was the real priority, and that it impeded Jet Blue's ground operations. An appeal has been filed to verify the compatibility of this decision with Section 106.

Plans remain undetermined for the terminal after renovation, but work continues nonetheless. The main problems facing the architects Beyer Blinder Belle are repairs to claddings – small circular tiles that had to be replicated in three different diameters and multiple shades to precisely match the original – and the incredible inclined curtain walls conforming to the strange shapes of the hull. The expanses of glass are held in place with rubber joints of a complex form; the metal members ensure rigidity and support, but do not have any window-framing function. Identifying a manufacturer of rubber gaskets able to replicate worn-out joint profiles was a complicated task. In any case, there is no question here of installing double glazing or improving the thermal performance of the envelope. The building is being restored with the same level of care as an old historic building would receive. I find this example very stimulating because it shows that more recent architecture is a subject of consideration in renovation planning.

IV. TERRACOTTA FAÇADES

Terracotta is a material widely used for facade cladding and ornamentation from the 1880s through the 1930s. It became a very popular material due to its fire resistance and its ability to be readily molded in forms of endless diversity. A good example is Chicago, with its 245 buildings covered with terracotta imitating stone.[192] These various elements and claddings can have significant thickness; they are fixed to the vertical support using metal anchoring. The stability problems of terracotta as it was implemented in the 1880s to 1930s period in the United States have appeared over time. Cycles of expansion and contraction due to temperature changes leave fine cracks that favor the penetration of water. Cornices and window sills are particularly sensitive to degradation of this kind because their horizontal surfaces retain water. Cracks also occur in the mortar sealing the different elements together, likewise due to atmospheric variations. Over time, corrosion attacks the metal anchors that secure the pieces, and the anchors finally give way.

I had the opportunity to visit a jobsite where a façade assembled in terracotta was being restored in Chicago by the architect Mary Brush.[193] Through a careful examination of the façade — during which the architect and structural engineer probed the façade while attached with shoulder belts, using rappelling methods! –, pieces that were damaged or ready to fall off were located and plotted on a drawing. The elements were then dismounted by the professional company [Figure 86].

Generally, the elements are then replaced by fiberglass replicas. This material is relatively expensive, but it is light and very durable. When examined at close-range, the replaced elements differ in appearance from the terracotta. However, from a distance, this difference is not perceptible.

In cities like Chicago, terracotta-clad façades are frequent. The illustrations [Figure 87] clear-

[192] Loughran, P. (2007). *Failed stone. Problems and solutions with concrete and masonry.* Berlin: Birkhaüser.
[193] RMH Fellow 2005

ly show how damaged cladding elements can break.

Restoration of the Reliance Building, Chicago[194]

Description

The Reliance Building is remarkable not only for its elegant terracotta façade, but also for the inventiveness of its metal structure.[195] It is the first building to be entirely clad in terracotta. Built between 1890 and 1895 by the architect Daniel Burnham's associate Charles Bowler Atwood, with whom Root collaborated, it was later enlarged by Atwood. Originally consisting of 4 levels placed atop the ground-floor bank offices, it was elevated to 13 floors in 1895. The construction technique used on the façade is innovative for its time, using a steel grid to hold the attached elements and windows, thus allowing the masonry supporting wall to be eliminated. The steel skeletal structure is clad in a ceramic façade resembling porcelain, in a Gothic-inspired style. The particularity of the building is its long strips of windows, making it one of the first almost building almost entirely of glass, a precursor to the modern curtain wall with its vast expanses of glass. This is the very expression of the "Chicago window," the large bays equipped with sash windows flanking a fixed-frame window in the center.

It is one of the first buildings in which the vertical members in the bays support the rigidify of the structure, and in which bracing is integrated in the façade, unlike its predecessors.[196]

In 1994-96, the protected building, such as the National Historic Landmark, benefitted from a major 17-million-dollar restoration, including 5 million contributed by the city. It was converted into a hotel[197] and a vast renovation campaign of the facades had to be undertaken. Indeed, after inspection of the 14,000 terracotta elements, it appeared that many were broken or cracked. Studies showed that they were under heavy stress because the structure was under compression from the weight of the building and the façade had dilated. In addition, corrosion of the cast-iron angle brackets and the steel frame damaged the cladding. The ceramic elements could not be removed without damaging adjacent pieces. The renovation involved putting in temporary expansion joints at each level moving down from the top and the angles. This resulted in a relaxation of structural stress, allowing the removal of 3000 pieces, of which 1000 were reinstalled, 2000 replaced with new terracotta pieces, plus 500 pieces repaired on site.[198] In addition, the structure was repaired and cleaned with alkaline and low concentration acids.[199] The rusty anchors were replaced with new ones in stainless-steel. The frame and angles were finished with epoxy paint. Despite their exposure to the weather, they were still in good condition. The cornice taken down during the World War II was restored by a lighter-weight version in cast aluminum, recreated on the basis of old photographs.

[194]Visit in company of the architect of the restoration, Gunny Harboe, September 3, 2010.
[195]Gunny Harboe, whom I met in Chicago in September 2010, took me on a visit of this building and explained its renovation. Also see Harboe's article with S. Kelley, "Restoration of a 19th-Century Curtain Wall: The Reliance Building of Chicago, USA," in *Docomomo Preservation Technology* (dossier 3, 2000, pp. 60-65)
[196]See S. Kelley (2001) and J. Kelley (2008), *op.cit.*

[197]http://articles.chicagotribune.com/1993-07-15/business/9307150306_1_baldwin-rookery-building-eminent (consulted May 20, 2015).
[198]S. Kelley, "The American Skyscrapper Heritage: History and Treatment" in *More than 2000 Years in the History of Architecture: Safeguarding the Structures of our Architectural Heritage,* international congress proceedings, Maison de l'UNESCO, September 10-12, 2001 (Paris: UNESCO, 2003, pp. 274-279); and "Des exemples américains: les premiers gratte-ciel de Chicago," in M. Jantzen (dir.), *Fontes, fers et acier dans l'architecture. Etude, détection et conservation des métaux ferreux dans les bâtiments,* conference proceedings, Nancy, November 16-18, 1995 (Paris: Les cahiers de la section française de l'ICOMOS, pp. 85-90); see also Pridmore (2003).
[199]J. Kelley, J. (1997). "Des exemples américains: les premiers gratte-ciel de Chicago" in M. Jantzen (dir.), *Fontes, fers et acier dans l'architecture. Etude, détection et conservation des métaux ferreux dans les bâtiments,* conference proceedings, Nancy, November 16-18, 1995 (Paris: Les cahiers de la section française de l'ICOMOS, 1997, pp. 85-90).

V. RENOVATION OF CAST-IRON FAÇADE ELEMENTS

While not a very widely used in the second half of the 20th century, I still faced an interesting involving repair and replacement of cast iron panels. When Chicago's first curtain wall was being developed, cased iron was used to make the pilings on which buildings. For storefronts, cast iron also proved to be more economical. Today, panels of this kind suffer from severe corrosion damage, as in the case we detail below.

Storefront renovation, Carson Pirie Scott Building, Chicago[200]

The cast-iron panels on the street level had been very poorly maintained. During recent renovation work, the building had to be brought up to code, and the cast iron panels thus had to be reattached to the structure. Alkaline electrolysis helped to halt corrosion by galvanizing. Some elements had to be re-cut to avoid coming too close to contact with the ground. Before galvanizing, it was necessary to remove the industrial resin that had been used as a primer on the panels; they were coated with epoxy for good protection. It was also necessary to solve the problem water seepage behind the panels. The small holes piercing the panels were filled with epoxy resin and stainless-steel fasteners were used to reattach them to the structure. Larger holes required the creating molds to reconstitute certain areas. This substitute material is less expensive than cast-iron. As for the new pieces replacing those too damaged to be repaired, they were molded in their entirety. The scale of the pattern had to be adjusted before being executed in resin. In the lower part of the wall, however, some bronze castings were put in place because this metal is not fragile like resin and it is less susceptible to corrosion. For the awnings, it was impossible to make them in cast-iron because this would require expansion joints; aluminum was therefore used.

Gunny Harboe pointed out to me that some panels are different from others. The buildings were successively enlarged over time, and this is visible in the panels of the storefront facings. The part built by Burnham has a poor reproduction of the panels; their proportions are different, and the execution is not as fine. In the 1960s, Holabird and Root created molded aluminum panels. The panels wrapping the rounded corner were falling loose and were redone. The awning was restored, but the glass roof was not because of its great expensive. A total of twelve million dollars, of which the city provided ten, plus two million in tax credits, was necessary for this renovation.

Behind the marquise, the original colors were found, different from those from the 1960s that were known up until then. Indeed, there was so much corrosion that the façade had been repainted many times over and the original color was lost. Debates took place concerning the color, because the green was supposed to imitate bronze, but finally, the color discovered behind the awning was used as the basis for the restitution, with the resulting green color darker than bronze.

There was no trace remaining of the original cornice that had been removed. The only informati0n available indicated that it was initially planned in marble and but was finally executed in terracotta. For the restoration, a reproduction in terracotta was envisioned and a project developed with stonemasons; however, for cost reasons it was ultimately executed in fiberglass-reinforced concrete. This alteration is not discernable from the street. This is a good example of using innovative materials developed for new construction in the restoration of an historic building.

[200] This example was described by Gunny Harboe during a visit and interview on September 2, 2010.

VI. CONCLUSIONS

By examining these restoration case studies, we have tried to illustrate the ways contemporary analysis, verification, and construction techniques are applied to the restoration of 20th-century structures. Technological innovations for safeguarding built heritage represent a monumental field of study. Obviously, traditional techniques for construction and repair are also utilized in restoration work in the United States. To give one illustration, I was stunned by the treatment of ceramic cladding in the renovation of the TWA Terminal at JFK Airport in New York. This impressive structure built by E. Saarinen in the 1960s was renovated in 2010 by Beyer Blinder Belle architects, becoming the entry building for JetBlue Terminal. Threatened with demolition due to its poor capacity to adapt to evolutions in air travel, the building was finally saved thanks to the intervention of experts and support from the airline company. Two of the building's specificities led to a very attentive restoration. Firstly, the masons had to replicate the cladding in small, round ceramic pieces of 1 to 1.5 centimeters in diameter (*ceramictiles*) in the proper color range so that the patched areas matched the color and patina of the cladding in place. Executing the patches required the workers' total attention, demanding a level of care not unlike what would be necessary to restore a Roman-era mosaic and using the very same methods [Figure 88]. Secondly, the highly complex **curtain walls** were returned to their proper state thanks to the identical reconstitution of the joints. Originally in rubber, they were finally redone in neoprene, since rubber is no longer used today. Recreating these gasket joints was essential. Without this, the building could not have been renovated because the expanses of glass are held in place by this complex joint which is itself simply inserted into the very fine aluminum structure.

REPORT CONCLUSION

Introduction

Throughout this report, we hope to have provided the reader with a better understanding of the safeguarding of architectural heritage from the second half of the 20th century in the United States, in consideration of that country's historical, social, economic, urban, technical, and other pressures. The vast quantity of post-war constructions and their simple, sometimes banal or even "brutish" appearance can certainly go against the grain of [disturb] architectural sensibilities oriented toward earlier periods judged to be more ornate and noble. We hope, in spite of all this, to have given enough high-quality examples to demonstrate that the protection of modern architecture is indispensable for conserving the memory of the talent and inventiveness of contemporary societies, beyond the purely functional or economic issues confronted by architecture field. It is urgent to foster awareness of the significance of this more recent heritage before further irreparable destructions occur. Learning from the errors of the past is a way to build a future which places value on that which already exists, rather than choosing demolition simply in the name of efficiency.

We equally hope to have contributed to furthering knowledge about the specificities of the American approach to conservation-restoration. In conclusion, we would like to revisit certain points which seem fundamental.

Fostering technical know-how and best practices

We recognize the limited durability of techniques and materials used in the years 1950-1970, today coming to the end of their lifespan, the impossibility of adaptation to new uses, poor energy performance, high maintenance costs, etc., as threats posed to fragile modern heritage; it is incumbent to find suitable solutions. At the same time, this report has demonstrated that it is possible to resolve most of these concerns through projects following a conscientious, knowledge-based approach. It is a question of deepening skills, cultivating and disseminating quality techniques, and keeping the focus on innovation.

This research gives an overview of the issues raised in the safeguarding of 20th-century architecture. How is the restoration of more recent structures approached and put into practice? What theoretical challenges does it pose for preservation specialists? What are the legal, economic, physical and other obstacles to preservation? Which buildings are concerned by restoration? What techniques are used to repair them? Who are the experts? Where do they draw their inspiration and skills for preserving 20th-century masterpieces? What materials and techniques do they use? ... These are some of the questions to which we have attempted to respond here.

Learning from others

We mentioned in the introduction that the initial research topic had evolved over the course of the six months spent in the United States. The richness of discussions and the opportunities for meetings and site visits allowed to broaden some perspectives which were perhaps too limited at the beginning, too focused on the resolution of purely technical problems. We submit here a summary of the most pertinent points.

Public involvement is one of the keys to preservation in the United States. In my opinion, the French context would greatly benefit by opening to the public the debates, ranges of

choices, and decision-making carried out by specialized commissions. It would be beneficial for preservation organizations to be more involved in administrative processes and in bringing attention to edifices.

I admired the **methodological approach** to safeguarding, often academic in style, with each step publicly debated. Openness to a large number of specialists encourages the ongoing evolution of practice.

I also appreciated the extent to which architects involved with historic buildings regularly **publish** information on the work they do, products and systems used, problems that have arisen, etc. I found that the freedom and perspective taken by some architects regarding historic structures could lead to bold contemporary additions, which better adapt buildings to today's uses while making them stand out.

Finally, I particularly appreciated an attitude which does not put all its focus on materials or technology but **also promotes the quality of manual work**. Qualified artisans are essential for new construction just as they are with restoration of older buildings. It is incumbent to maintain this skill base while still fostering technological innovation, the development of new materials, etc. A film on architect Frank Gehry's work on the Music Experience Project, a museum in Seattle, is of particular interest in this regard. It details the steps in the design of a building with a complex form using CATIA software developed by Dassault Systems. At the conclusion of this process, Gehry reminds us that technology is totally useless without the irreplaceable skills of human hands. This is an important lesson to remember if we do not wish the heritage from ages past to end up as a reconstructed pastiche using modern techniques serving simply to preserve touristic, postcard-style views. It is important that built heritage remains a living thing that continues to evolve with the rhythm of society, offering quality, elegance, and culture.

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ANNEXES

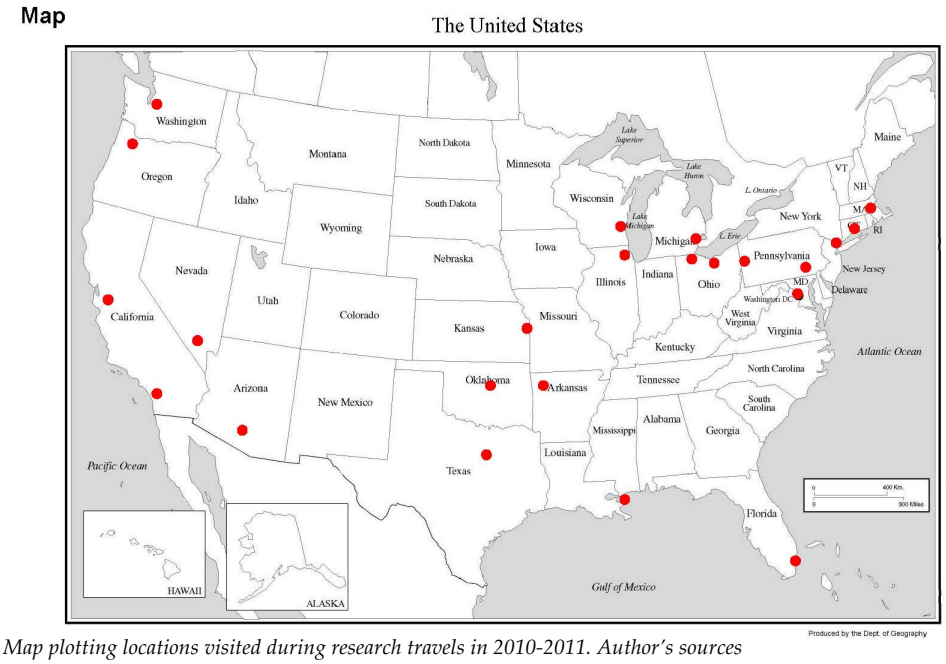

Figure 1: Map plotting locations visited during research travels in 2010-2011. Author's sources

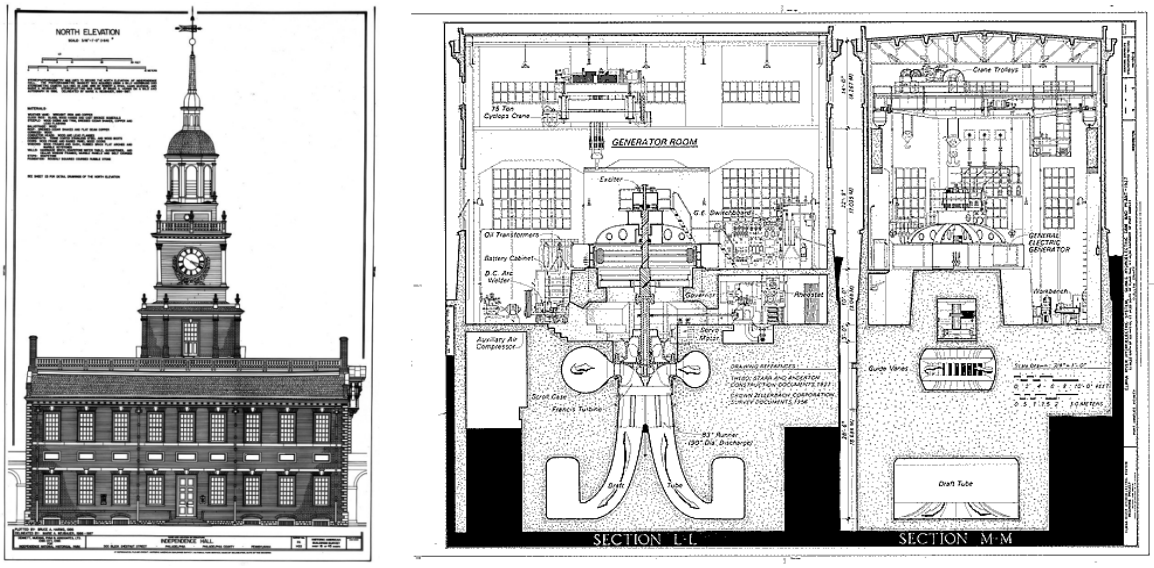

Figure 2: Examples of survey drawings completed in the HABS and HAER programs by the NPS and housed at the Library of Congress. Source : HABS and HAER website

United States	France
1816: Safeguarding of Independence Hall in Philadelphia (site of the signing of the Declaration of Independence in 1776) under pressure from historical societies	1830: Creation of the post of *Inspecteur des Monuments historiques* by Guizot ; Mérimée is named Inspector in 1834; the *Commission des Monuments historiques* (MH) established in 1837
1853: The Ladies' Association saves Mount Vernon, the home George Washington, laying the groundwork for historic preservation protections based on the action of individuals – a "grassroots movement" – often with patriotic motivations	Circa 1850: E. Viollet-le-Duc and J. Ruskin present confronting viewpoints on the conception and methods for the restoration of historic monuments
1872: Creation of the Yellowstone nature reserve	1879: Creation of the *Musée des Monuments français*
1906: The Antiquities Act makes the destruction of protected sites (natural, archeological, or pre-Columbian) punishable by law	1906: Establishment of criteria for the designation of historic monuments, corresponding principally to prehistoric sites and medieval buildings
1916: Creation of the National Park Service (NPS), which administers historic sites too large for management by private owners, such as Civil War battlefields	1913: Legislation in favor of the protection of historic monuments. During the 1920s, the notion of "historic monument" is extended to include private properties
	1920: Legislation for financing historic monuments; designation of World War I battlefields as historic monuments
1931: Designation of the first historic district in Charleston	1930: A second law on historic monuments modifies the 1906 law; legislation regarding designated natural sites; creation of a second level of preservation protection: *inscription à l'Inventaire supplémentaire des Monuments historiques*
1933: Initiation of the Historic American Building Survey (HABS)	
1935: The Historic Sites Act voted into law by Congress (New Deal era), making possible the preservation for public use of historic sites, buildings, and objects of national importance, with the goal of inspiring and benefiting the United States	
1949: establishment of the National Trust for Historic Preservation (NTHP)	1943: amendment of the 1913 law and establishment of a 500-meter perimeter around protected monuments
	1957: first-time designation of a edifice constructed in the 20th century, the Théâtre des Champs-Élysées, just two years after the death of the building's architect, Auguste Perret
1966: National Historic Preservation Act (NHPA), creating the new status of National Historic Landmark (NHL), a designation conferred by the President	1962: Legislation on protected preservation districts ("Loi Malraux")
	1964: Drafting of the Charter of Venice
1980: National Trust Main Street Program	1984: "Historic Monuments of Tomorrow" underscores the enlargement of the heritage field to include rural architecture, technical and industrial heritage, etc.
1995 and 2000: Conferences launched by the National Park Service's Recent Past Initiative	1987: Conference at La Tourette 1989: Recommendations from the Council of Europe 2000: Creation of the distinction *Patrimoine du* xx*e siècle* (20th-century Built Heritage), a designation by regional cultural affairs services (DRAC)

Figure 3: Parallel chronology of important dates in historic preservation in France and the United States, drawn from Norman Tyler, Historic Preservation: An Introduction to its History, Principles, and Practice (New York and London: W.W. Norton, 2000. 2nd edition, 2009), and Françoise Choay, L'allégorie du patrimoine (Paris: Éditions du Seuil, 1992).

Figure 4: The condition of Mount Vernon at the time of acquisition and its present, restored state. The site receives around one million visitors each year. Sources: (left) Clements Library photographic collections; (right) photograph by the author, July 2010.

When the descendants of George Washington offered to sell the dilapidated, neglected property to the State of Virginia for two-hundred thousand dollars in the mid-19th century, their proposal was rejected. Ann Pamela Cunningham, a woman from genteel South Carolina society then in her thirties, decided that something had to be done to save the historic home of the first president of the United States. She founded the Mount Vernon Ladies' Association in 1853. Through a fundraising campaign promoted by influential women of the time, and in spite of political tensions which would lead to the breakout of the Civil War, they raised the necessary sum to acquire the estate and launched an initial restoration in 1859. This was the first association created for historic preservation in the United States, and it was a citizen initiative.

Today, Mount Vernon remains in the hands of the "Ladies" and has been a designated National Historic Landmark since 1960. An expert historic restoration has been ongoing for over a century attempting to return the estate to its condition in 1799, the year of Washington's death. The analysis of letters and other documents, samples, survey drawings, etc., were necessary to return the site to its historic appearance. The ambitions of the renovation were summarized by Ann P. Cunningham:

> Ladies, the home of Washington is in your charge; see to it that you keep it the home of Washington. Let no irreverent hand change it; no vandal hands desecrate it with the fingers of progress! Those who go to the home in which he lived and died, wish to see in what he lived and died! Let one spot in this grand country of ours be saved from change! Upon you rests this duty.

This desire to freeze a moment of time entailed, in reality, a restoration plan. According to the lexicon of the Standards, this is at once a *restoration* (demolition of more recent additions to return to a previous state recognized as more historically significant) and a *reconstruction* (reconstruction of previously-destroyed parts, to serve goals of historical interpretation). Thus, among other projects and interpretations, the mill and distillery which lay in ruins were rebuilt in a rustic style – one in 1932, the other in 2011 – in a distant corner of the estate. This reconstitution surely bears witness to the intelligence – and practicality – of the estate's former master.

Specific protections are applied to the view of the Potomac as seen from the terrace on which the house rests. In the 1950s, a consciousness developed about the necessity to preserve the environment on the opposite bank of the river in neighboring Maryland, where urban sprawl was becoming a threat. Frances Payne Bolton, a "Mount Vernon Lady" and congresswoman, acquired 250 hectares

and created Piscataway Park in 1961, making possible the protection of six miles of river frontage and preserving the site "as it existed in Washington's time."

Figure 5: View from the portico of the home of George Washington. The site is perfectly preserved, despite the density of constructions which can be seen, for example, in aerial photos. Photo by author, July 2010.

The case of the protection of Independence Hall in Philadelphia

The lack of restrictions on areas surrounding historic monuments sometimes creates situations which might surprise French observers. We take the example of Independence Hall in Philadelphia to which we previously referred as being one of the very first edifices Americans wished to preserve due to its great historical importance. Since 1979, the building benefits from a UNESCO World Heritage designation. On the federal level, the building is part of Independence National Historic Park created in 1948 and managed by the National Park Service. The park's perimeter also includes Independence Mall, a grassy esplanade opened up by the demolition of buildings on three city blocks. Inspired by the National Mall in Washington, D.C., the space was created at the time protections were put in place in the 1950s.

The contrast between the preserved aspect of the building within its immediate context and the perception of it when seen in perspective from further down the Mall speaks for itself. It is a perfect illustration of the reason so much importance is attached to monitoring construction permits in the periphery of designated or registered historic monuments in France. One observes that two office buildings effectively dominate the perspective of Independence Hall. The building on the right (Penn Mutual Life Insurance Company) is an Art Deco work, while its extension (Mitchell Giurgula Architects)

dates from 1972, aggressively asserting its modernity in the axis which was created to be historic. If we only look back to the hostile debates provoked by the construction of the Grande Arche de la Défense in Paris, we can understand how negatively a similar project would be perceived in France, if it were possible at all.

Figure 7: Independence Hall as seen in its context at close range. Author's photo, July 2010.

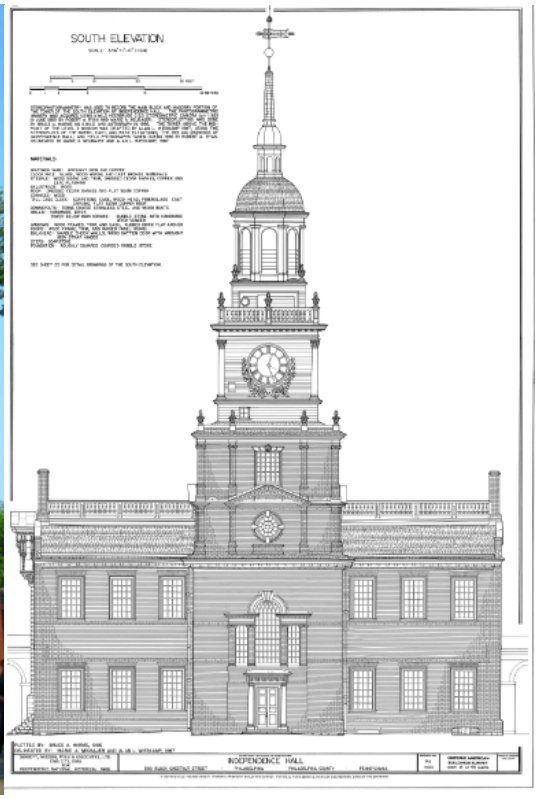

Figure 6: Independence Hall Complex, survey drawing by the National Park Service. Courtesy of the Library of Congress, Prints & Photographs Division, reproduction no. HABSPA,51-PHILA,6- (sheet 18 of 45)

Figure 8: Independence Hall as seen from the Mall. Author's photo, August 2011

Figure 9: Building by Mitchell and Giurgula Architects placed in the axis of Independence Hall. This building is comparatively well received in the United States for its integration of a piece of the façade of an 1840s neo-Egyptian style building and for its sensitive articulation. The older façade advances in front of the new one, providing a space for access stairs down to the underground parking facility. Author's photos, July 2010.

Another contradiction has appeared recently, a new manifestation of the ongoing evolution of heritage consciousness. A new visitor center was created to better present the Liberty Bell, so closely associated with the Declaration of Independence. The bell was originally placed in the tower of Independence Hall, and later in another visitor center built in the axis of the Mall by the architects Mitchell and Giurgula in 1975. Since this earlier center accommodated only about a hundred people and was thus judged too small, it was decided to create a larger one, better adapted to current expectations. It opened in 2003. In spite of efforts by the NPS to save the former center by selling or deconstructing it, it was demolished in 2006[201].

For now and the foreseeable future, the bell is displayed in an accessible, comfortable, air-conditioned visitor center allowing it to be appreciated without having to go outside. Above all, the building borders the Mall rather than being placed in its center. During construction of the new visitor center, it was decided to take advantage of the opportunity to reveal vestiges of houses destroyed in the 1950s and 60s to make way for the Mall. A small act of repentance for history's sake?

Figure 10: Suggestive of preservation's contradictions, the foundations of buildings destroyed to create Independence Mall can be observed today through openings in the floor (one recalls here the Franklin Court Museum referenced earlier). The arrangement of the new visitor center allows one to enjoy the view while protected from the burning heat of summer. Author's photos, August 2011.

[201]Photos of the former visitor center are accessible online: http://en.wikipedia.org/wiki/Liberty_Bell_Pavilion.

Year	Number of NHL buildings	Location	Architect	Principal 20th-century buildings	NRHP
1960-1966	730	Chicago	FL Weight	Robie House 1913	863
		Newyork	C. Gilbert	Woolworth Building 1913	
1967	28				29
1968	53				56
1969	74				360
1970	197	Chicago	L. Sullivan	Auditorium 1889	884
			L. Sullivan	Carson Pirie Scott 1891-1960	
			FL Wright	Coonley House 1907-1909	
			Atwood Root	Reliance Building 1895	
			FL Wright	Unity Temple	
1971	142	L.A.	Greene bros.	Gamble House 1908	1039
		L.A	FL Wright	Aline Barnsdall's complex 1921	
1972	127	Chicago	FL Wright	F.L. Wright's house and studio	1512
			L. Sullivan	People's Federal Savings and Loan Association 1917-1918	
1973	117	Bloomfield	E. Saarinen	Cranbrook	2179
		SpringGreeen	FL Wright	Taliesin East 1909-1959	
1974	126	Scottsdale	FL Wright	Taliesin West	2185
		Washington DC	Burnap, Peasley	Meridian Hill Park	
		Springfield , Il	FL Wright	Dana House (1902-1906)	
		Bartlesville	FL Wright	Price Tower (?)	
		BearRun	FL Wright	Fallingwater	
1975	75			Radburn 1929 (2005 NHL)	1966
1976	129	New York		Chrysler Building 1928-30	2088
		Philaadelphie	Howe Lescaze	PSFS	
1977	35	San Francis-co	B maybeck	First Church of Christ, Scientist 1910	1474
1978	70	Detroit		Ford River Rouge Plant	3182
			A. Kahn	GM Building	
1979	18				3617
1980	29			Greenbelt hd	4348
			R. Hood	McGraw-Hill Building 1931	
1981	5			Hoover Dam	619
1982	16			Empire State Building	4752
				Daily News	
1983	17				4331
1984	21	L.A	FL Wright	Sturges House	3777
1985	57				3417
1986	31			Metropolitan Museum	2186
1987				Harvard Stadium	2291
			E. Saarinen	Gateway Arch	
			Harrison	Rockefeller Center	
1988	11				2998
1989	53				2567
1990	12				2225
1991	31			Marine County Civic Center	2009
1992	21				1878
1993	37			Baldwin Hills Village 1941-42	1565
1994	23				1609
1995	6				1524
1996	16				1544
1997	39				1582
1998	9				1570
1999	10				1524
2000	16	Chicago	FL Wright	Heurtley House	1551
		Columbus	H. Weese	First Baptist Church 1965 (2000)	
			Eeero Saarinen	Irwin Bank d' de 1954 (2000)	
			E. Saarinen	North Christian Church (2000)	
			W. Gropius	Gropius House	

2001	19	Chicago	Mies van der Rohe	Crown Hall	1420
		Colorado		Rocky Mountain National Park Admin. Building	
2002	5				1690
2003	22				1380
2004	6	Plano, IL	Mies van der Rohe	Farnsworth House	1546
2005	12			Guggenheim Museum	1612
2006	10			Eames House	1270
2007	7		L. I. Kahn	Beth Sholom Synagogue	1423
2008	7				1324
2009	2		L.I Kahn	A.N. Richards Medical Research Laboratories	1238
2010	3				1102
2011	11				1076
2012	3				1165
2013	9				1065
2014	2				771

Figure 11: List of buildings registered as National Historic Landmarks since 1960, drawing attention to the principal modern buildings. State by state figures on National Historic Landmark buildings are available online at https://en.wikipedia.org/wiki/List_of_U.S._National_Historic_Landmarks_by_state (website accessed September 5, 2015)> Figures on structures built in 20th century are provided by the author after analysis of this web data but may contain errors. The discrepancy between the number of 20th-century buildings and principal edifices is due to the fact that technical facilities or buildings registered for reasons other than their architectural quality were not taken into account, or because they are Beaux-Arts or Neoclassical buildings from the very first years of the century. Data sorting by author.

Figure 13: Replacement windows for historic models, and view inside an historic home in Washington, D.C. with original double-hung windows (18th century). Photos by author

33

34

35

Recommended: [33-35] Original metal windows were appropriately repaired as part of the rehabilitation of this historic industrial building.

WINDOWS

RECOMMENDED	NOT RECOMMENDED
Retrofitting historic steel windows and curtain-wall systems to improve thermal performance without compromising their character.	
Installing clear, low-emissivity (low-e) glass or film without noticeable color in historically-clear windows to reduce solar heat gain.	Retrofitting historically-clear windows with tinted glass or reflective coatings that will negatively impact the historic character of the building.
Installing film in a slightly lighter shade of the same color tint when replacing glazing panels on historically-dark-tinted windows to improve daylighting.	Introducing clear glazing or a significantly lighter colored film or tint than the original to improve daylighting when replacing historically dark-tinted windows.

36

37

38

Recommended: [36-38] Original metal windows were retained and made operable during the rehabilitation of this historic mill complex. Installing patio slider doors as interior storm windows was a creative and successful solution to improve the energy efficiency of the existing windows.

Figure 12: Example of guidelines for the treatment of metal-frame windows in historic buildings. Source: NPS

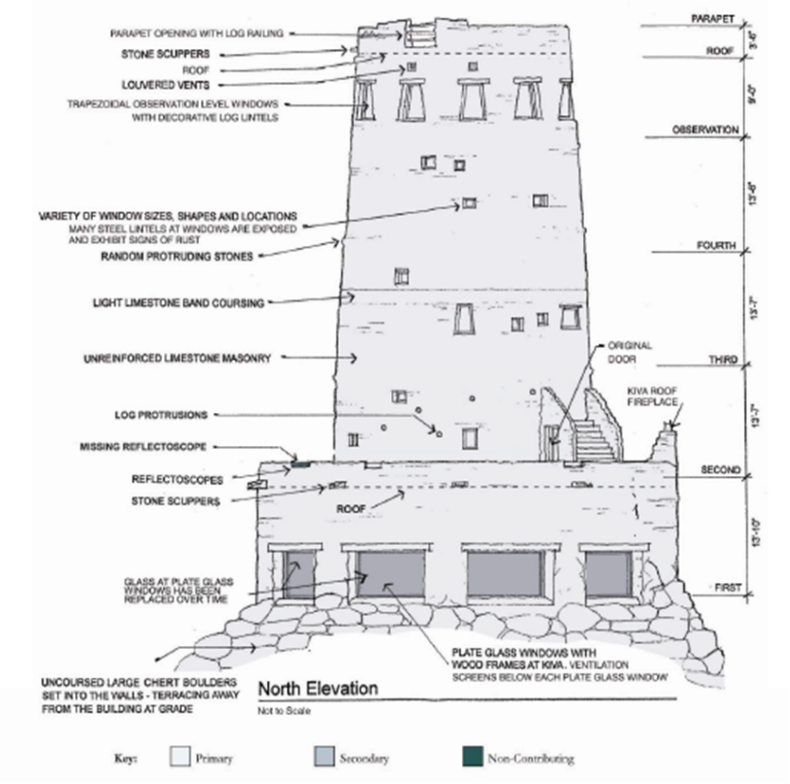

Figure 14: Desert Watch Tower, diagram of historic significance. Source: NPS / Page & Turnbull Architects

Element (Description of building element and material)	Historic (Yes or No)	Character-Defining (Primary, Secondary or No)	Conditions, Comments, and Recommendations (Good, Fair or Poor - Provide comments or recommendations)	Images (Photographs)
Desert View Watchtower				
Exterior, North Façade (DN-1): Tower (See Elevation on Reverse)				
Limestone wall	Yes	Primary	Fair. Thinner stone courses found at upper levels. Several stones protrude past wall surface. Water appears to be infiltrating the veneer. Many of the steel shelf angles are rusted. Many areas of the wall need repointing.	
Sandstone wall	Yes	Primary	Fair. Thinner stone courses found at upper levels. Several stones protrude past wall surface. Water appears to be infiltrating the veneer. Many of the steel shelf angles are rusted. Many areas of the wall need repointing.	
Petroglyphs, various stone	Yes	Primary	Good. Embedded in limestone wall.	
Rough-cut log infill	Yes	Primary	Good. Located at top of exterior staircase.	
Decorative rough-cut log lintels (x2) above doors	Yes	Primary	Good. A steel lintel is obscured by the log lintel. Log shows extensive checking. Repair/replace in kind, where necessary.	
Thin-course decorative limestone stonework [See Figure1]	Yes	Primary	Good. Located at the second floor level on tower.	
Log protrusions (x4)	Yes	Primary	Good. Two located at thin limestone infill with petroglyph, two located above location of original door.	
Single-panel, rough-hewn, wood door located at left side of staircase	No	Secondary	Fair to good. Evidence of moisture infiltration.	
Brass hardware	No	Secondary	Good.	
Steel-sash pivot windows, trapezoidal (x5)	Yes	Primary	Good. Sash shows evidence of rust and water infiltration. See interior for further analysis.	
Glazing	Yes	Primary	Good.	
Decorative log lintel above trapezoidal windows (x5)	Yes	Primary	Poor to Good. A steel lintel is obscured behind the log lintel. A few log lintels have fallen out of place, repair or replace in kind as necessary.	
Steel lintel	Yes	Primary	Fair. Many of the steel lintels are exposed and exhibit signs of rust.	
Steel-sash pivot windows, rectangular (x2)	Yes	Primary	Good. Sash shows evidence of rust and water infiltration. See interior for further analysis.	
Glazing	Yes	Primary	Good.	
Limestone lintel above rectangular windows (x2)	Yes	Primary	Good. A steel lintel is obscured by the limestone lintel.	
Wood-sash fixed windows, square (x10)	Yes	Primary	Good. See interior for further analysis.	
Flagstone staircase [See Figure 2]	Yes	Primary	Good.	
Limestone screen wall	Yes	Primary	Good.	
Limestone treads and risers	Yes	Primary	Good.	
Incandescent lighting, located at first floor near staircase	No	No	Good.	
Limestone parapet	Yes	Primary	Good.	
Parapet opening with log railing (x1)	Yes	Primary	Good.	
Limestone scupper (x1)	Yes	Primary	Good.	

DN-1-Figure 1 - Thin course limestone stonework with petroglyph and log protrusions

DN-1-Figure 2 - Flagstone exterior stair at east side of tower

Figure 15: Desert Watch Tower, systematic analysis of elements. Source: NPS / Page & Turnbull Architects

Figure 16: Manufacture Trust Company, New York (G. Bunschaft and SOM Architects) Source: http://www.archdaily.com/113501/new-landmark-for-manufacturers-trust-company-building/ *(website accessed September 10, 2012)*

Figure 17: These two contemporary constructions in Georgetown were certainly commented upon by the Commission of Fine Arts. In the first case, a desire for continuity of forms and materials is nonetheless contradicted by the type of windows and the garage door. In the second case the choice of a contemporary addition seems acceptable. Photos by the author, July 2010.

Institutions for Preservation

• **FEDERAL INSTITUTIONS**		
• R. Biallas	National Park Service	Washington
• J. Fowler	Advisory Council on Historic Preservation	Washington
• C. Madrid French	National Trust For Historic Preservation	San Francisco
• **LOCAL INSTITUTIONS**		
• J. Lindstrom	Commission of Fine Arts, W. DC	Washington
• R. Plumey	New York City Department of Buildings	New York
• J. Danta / E. Cote	Preservation Commission	Philadelphia
• **COMMISSIONS**		
• Commission of Fine Art		Washington
• National Register Hearings		Washington
• City planning commission		New York
• City Landmarks commission		New York

Figure 18: List of institutions visited and commission meetings attended during the research period.

Figure 19: Building by Moshe Safdie situated on the Mall

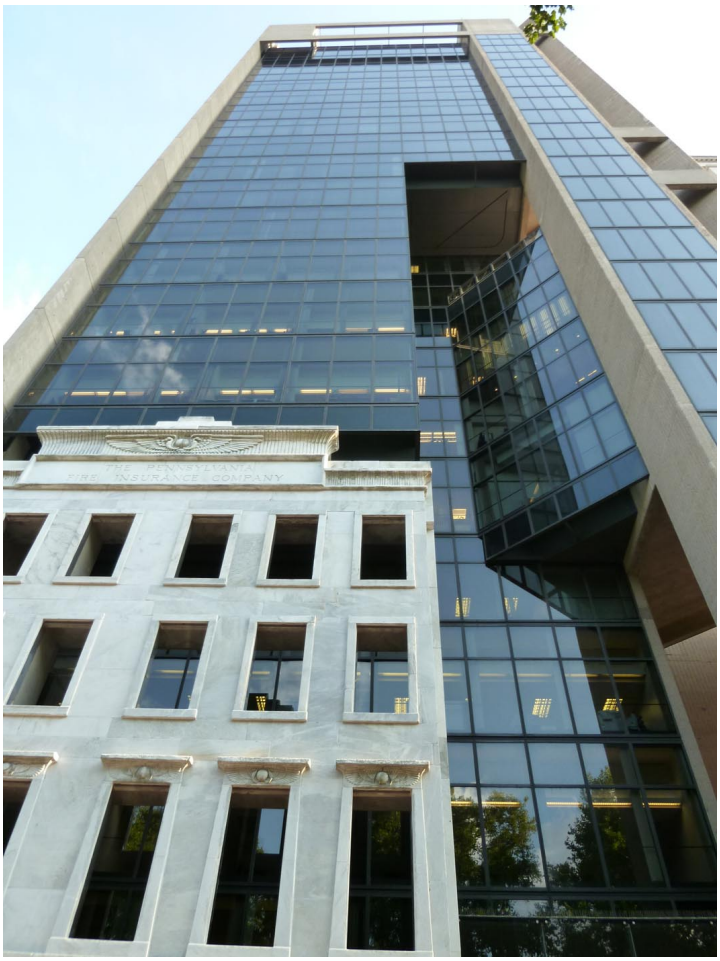

Figure 20: Penn Mutual Life Insurance Building, Mitchell & Giurgola, architets, 1972, in the axis of Independence Hall in Philadelphia

Associations

• **ADVOCACY / ASSOCIATIONS**		
• John Gallery	Preservation Alliance	Philadelphia
• Theo Prudon	DOCOMOMO International	New York
• Yves Deflandre	ESMAE association	New York
• Erica Avrami	World Fund Monument	New York
• Jonathan Fine	Preservation Chicago	Chicago
• Susan Mc Donald	Getty Preservation Institute,	Los Angeles
• Eugenia Woo	Docomomo WEWA Seattle / Historic Seattle	Seattle
• Shane Hood	Tulsa Modern	Tulsa
• Scott Perkins	Frank Lloyd Wright Conservancy	Bartlesville

Figure 21: List of organizations with whom meeting were held during the research period.

Preservation architects

• Quinn Evans Architects	Ti. Roach / T. Jester	Washington
• Vittetta Architects	L. Hoovey / N. Gutterman	Philadelphia
• Ann Beha Architects	A. Beha	Boston
• Einhorn Yaffee Prescott	D. Fixler	Boston
• Robert Silman	J. Mateo / N. Hudson	Washington / New York
• Yves Deflandre architect	Y. Deflandre	New York
• Beyer Blinder Belle	F. Prial / C. Larkin	New York
• Cook and Fox	A. Lehman	New York
• WJE	K. Normandin	New York
• WASA	A. Ayon	New York
• Holabird & Root	M. Brush	Chicago
• Gunny Harboe Architects	G. Harboe	Chicago
• Anna Escalante Architects	A. Escalante / T. Meyerhof	Palm Springs
• Page and Turnbull	R. Todd	San Francisco
• Marc Cavagnero	F. Dunham	San Francisco
• BOLA Architects	S. Sokol Furesz / S. Boyle	Seattle

Figure 22: List of architects with whom meeting were held during the research period.

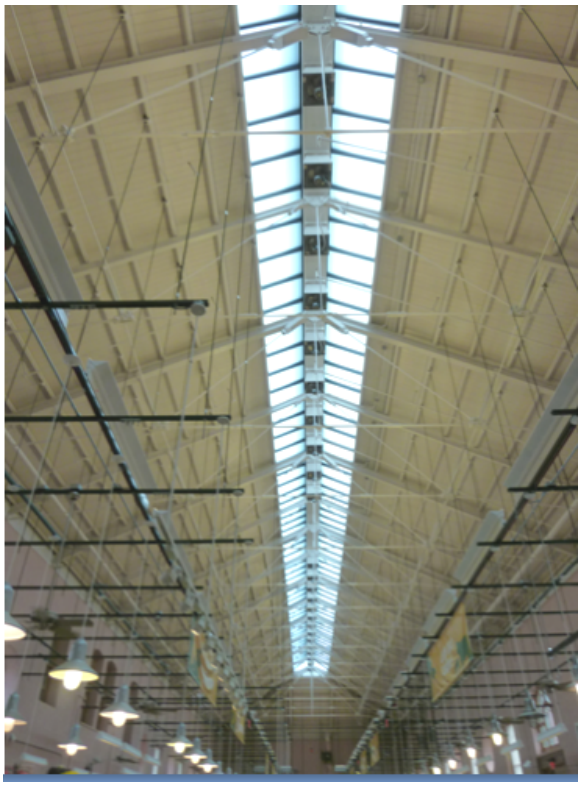

Figure 23: Eastern Market, Washington, D.C., interior view. Renovation by Quinn Evans Architects (Tina Roach, 2009 Richard Morris Hunt Fellow, Project Manager).

Preservation Education, Events

• **PROFESSORS**	
• Michael Tomlan	Cornell University, Itaca
• Randy Mason	University of Pennsylvania, Philadelphia
• Jeff Stein / Lance Fletcher	Boston Architectural College, Boston
• Theo Prudon	Columbia University, New York
• Anne Sullivan	School of the Art Institute of Chicago
• Richard Shieldhouse	University of Forida, Miami
• **EVENTS**	
• Visit organized by the local APT Chapter	Washington
• Modernist week	Palm Springs
• FL Wright Heritage Day	Los Angeles
• Lecture Thom Mayne	Los Angeles
• Sustainable Cities Design Academy	New Orleans

Figure 24: List of instructors met during the research period and events attended.

Figure 25: Baker House, Cambridge. The 1998 renovation allowed for the addition of an accessibility ramp by creating a low wall parallel and similar in appearance to the existing retaining wall for plantings, at right. Photo by author, August 2010.

Figure 26: Seismic retrofitting at the Presidio, a traditional structure in San Francisco. The brick panels are chained with carbon-fiber bands to create diaphragm walls. The steel beams surrounding the upper walls recreate a reinforced armature linking the structure with the diaphragm panels. Vertical concrete armatures were also created.

Figure 27: Edris house, Palm Springs

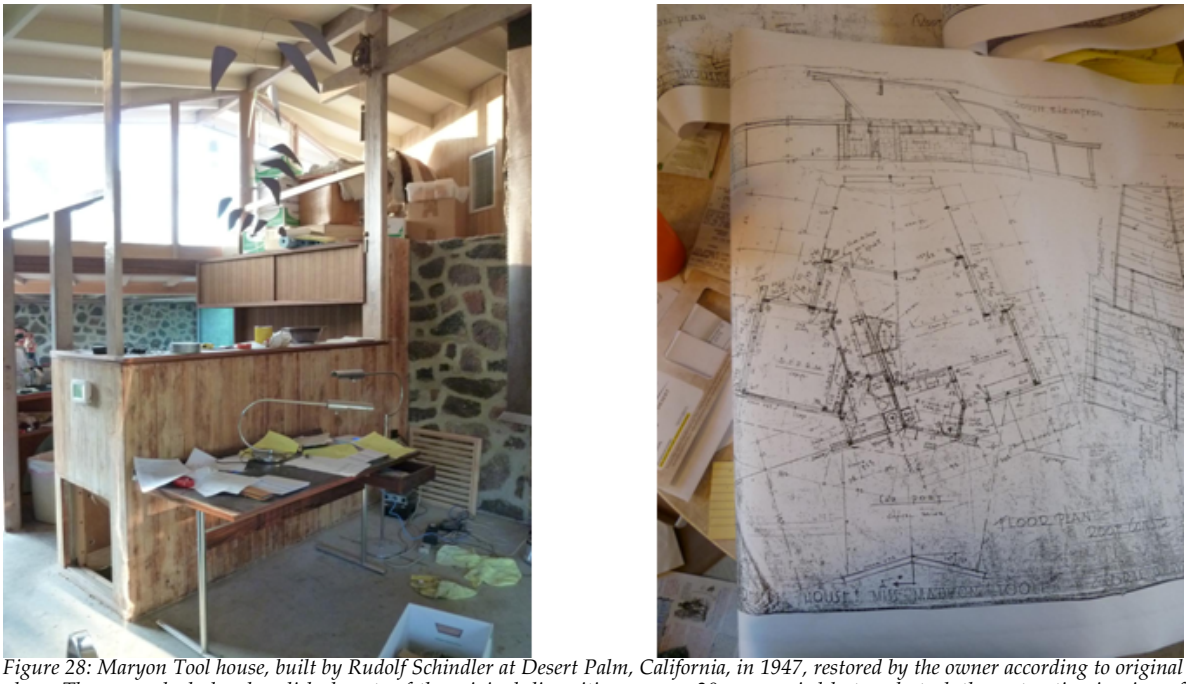

Figure 28: Maryon Tool house, built by Rudolf Schindler at Desert Palm, California, in 1947, restored by the owner according to original plans. The owner had also demolished parts of the original dispositions over a 20-year period but undertook the restoration in view of leaving his daughter an "authentically" reconstituted Schindler house, which has greater value than an altered one. Photos by the author, February 2011

Figure 29: Hollin Hills

Figure 30: VDL Research House by Richard Neutra and Kings Road House by Rudolf Schindler

Figure 31: Case Study Houses in Los Angeles: Charles and Ray Eames house, Stahl house

Figure 32: Hollyhock house

Figure 33: Hanna House

Figure 34: Original entry façade of the Franklin Court Museum (left). Access to the underground exhibition hall is by way of ramp situated behind the wall. The "Ghost House" evokes the historic structure demolished in the 19th century (right). Photos by the author, July 2010

Figure 35: Museums in Oakland and Portland. Two examples of contemporary alterations to existing buildings recognized as local historic landmarks. Left, the Oakland Museum by K. Roche (1970), renovated by Mark Cavagnero, architect, in 2008. The minimalistic intervention is differentiated from the existing building by its stainless-steel placed in interaction with the raw concrete. At right, the Portland Art Museum. The group of three buildings by Pietro Belluschi (1932, 1939, 1978) was enlarged through the conversion of a former Masonic lodge building by the Boston architecture firm specializing in historic contexts, Ann Beha Architects, in 2005. Photos by the author, February and March 2011.

Figure 36: Extensions to the museums at Cleveland and Toledo

Figure 37: Extension of the Atkins Museum in Kansas City

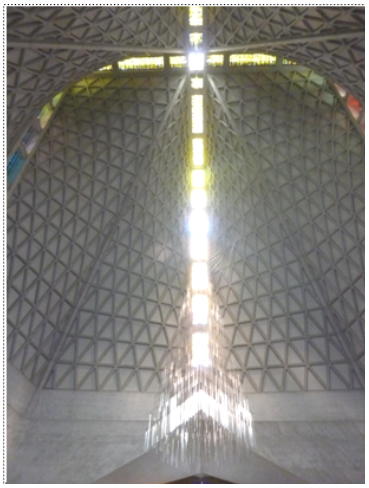

Figure 38: Church of Christ the Light, SOM Architects; a church in San Francisco by P. Belluschi and P.L. Nevi

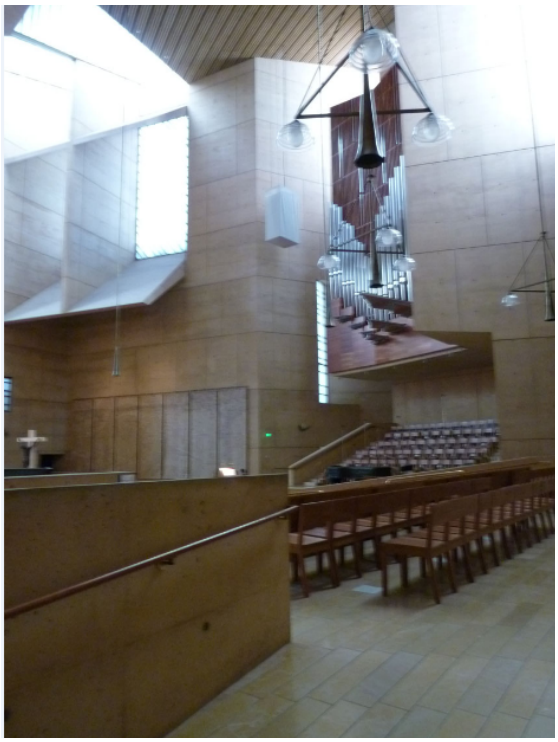

Figure 39: Cathedral of Our Lady of the Angels, Los Angeles, R. Moneo, architect

Figure 40: Saint Ignatius Chapel, Seattle, S. Holl, architect

Figure 41: University Unitarian Church, P.H. Kirk, 1950

Figure 42: Chapels by E. Fay Jones

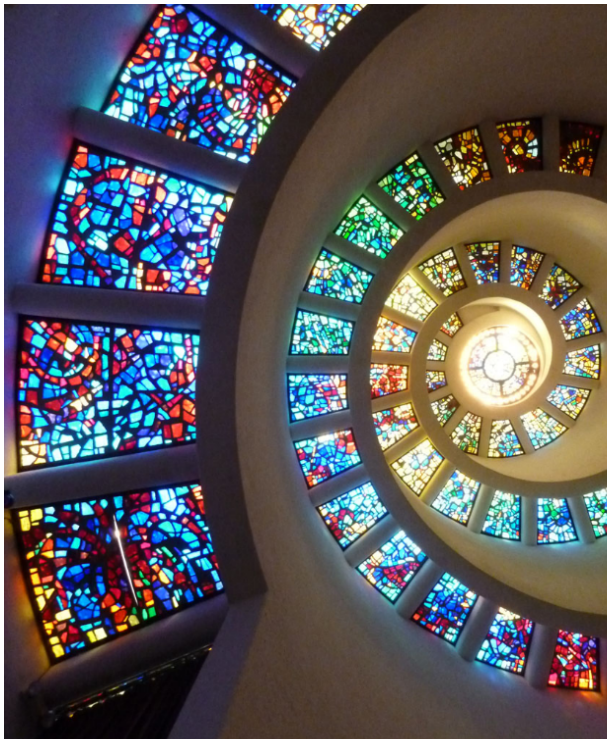

Figure 43: Chapel in Dallas, P. Johnson, architect

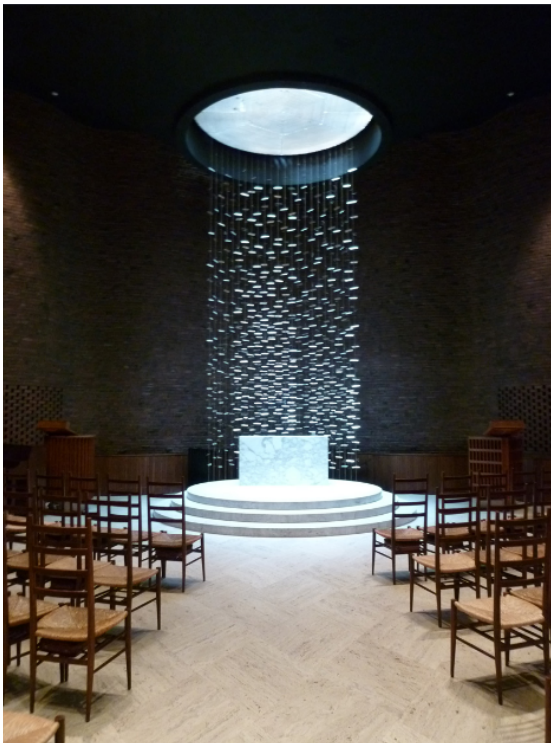

Figure 44: MIT Chapel, Cambridge, E. Saarinen

Figure 45: The failure of preservation of public spaces: demolitions planned or completed despite the quality of the public space. Left, NPS History Center, Philadelphia; right, Third Church of Christ, Scientist, Washington, D.C. Photos by the author, August 2011

Figure 46: First Church of Christ, Scientist, Boston. Privately-owned space offered for public use. The church has submitted plans for densifying the parcel; registration of the site as a Boston City Landmark has only limited effectiveness in opposition efforts. Photos by the author, August 2010

Figure 47: Boston City Hall and its esplanade

Figure 48: Boston Government Service Center, P. Rudolph, architect

Figure 49: Dallas Administration Center, I.M. Pei, architect

Figure 50: Hartford City Center

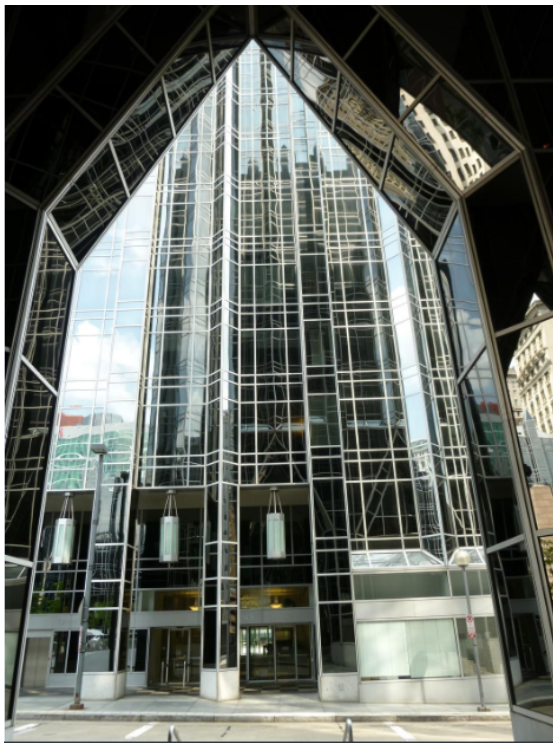

Figure 51: Pittsburgh PPG Center, P. Johnson, architect

Figure 52: Lincoln Center for the Performing Arts, New York

Figure 53: Meridian Hill Park, Washington, D.C.

Figure 54: Unity Temple, F.L. Wright, architect

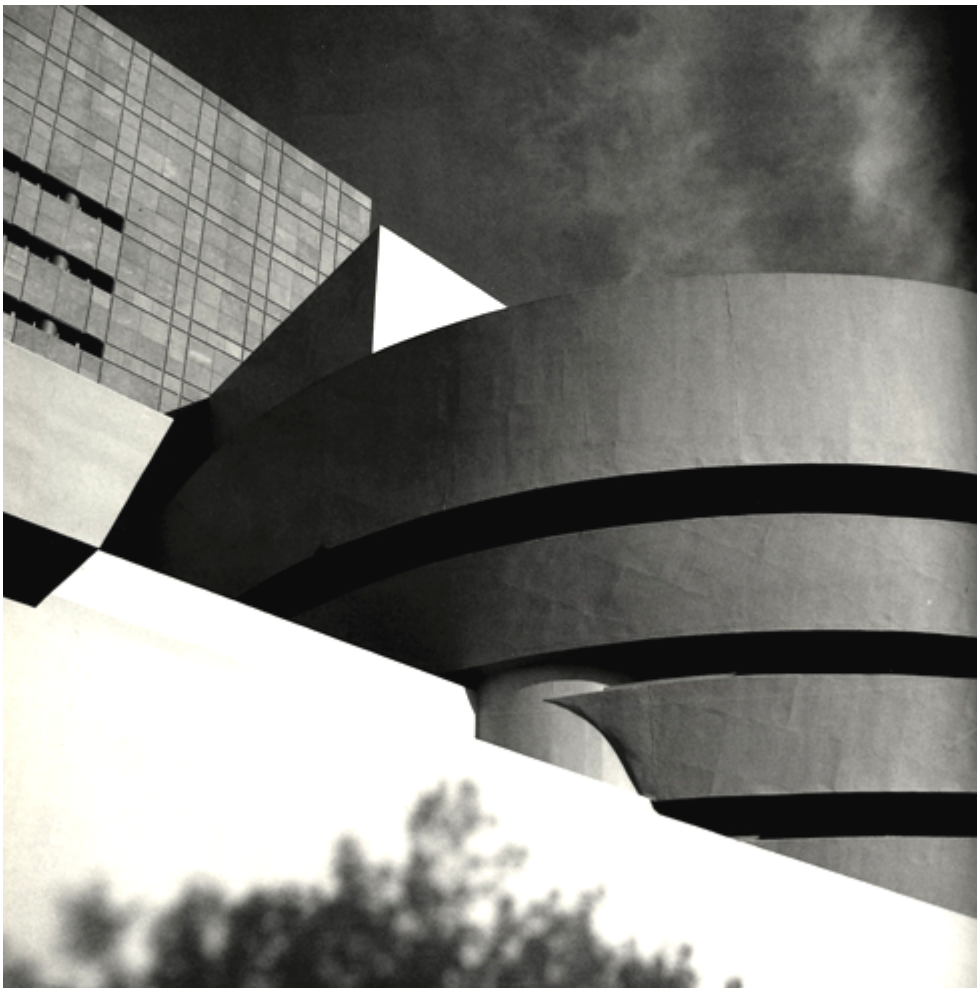

Figure 55: The Guggenheim Museum spiral and its 1992 extension

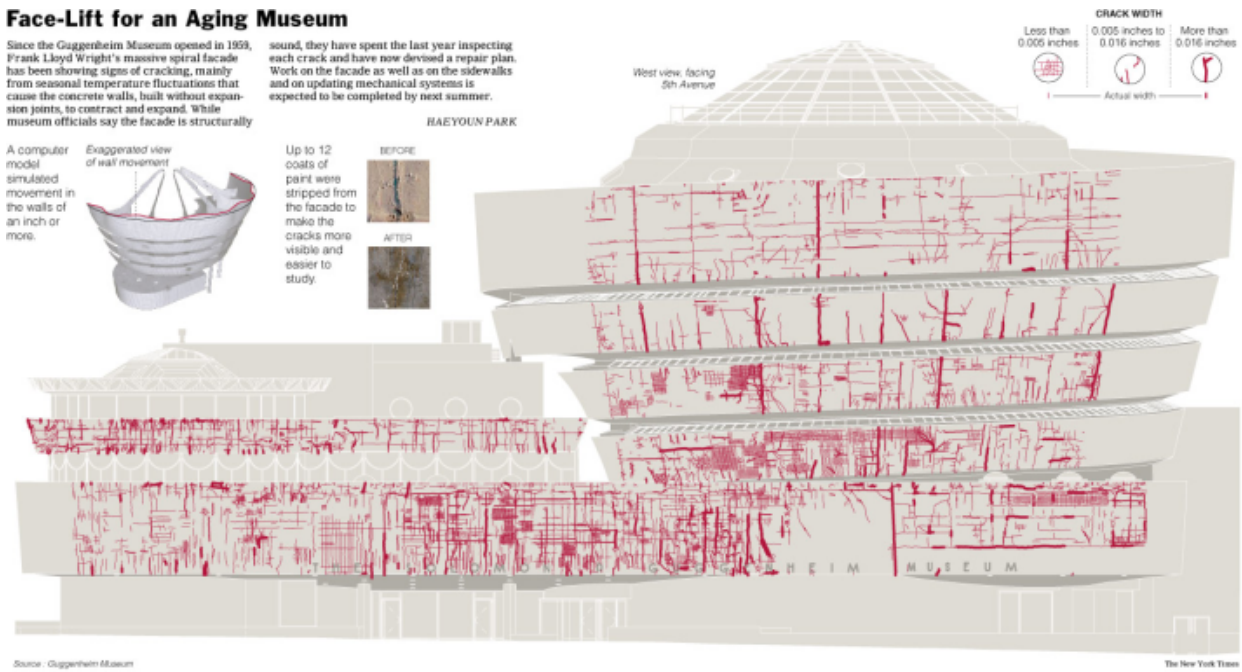

Figure 56: Removal of the cladding allowed cracks in the concrete to be identified with precision.

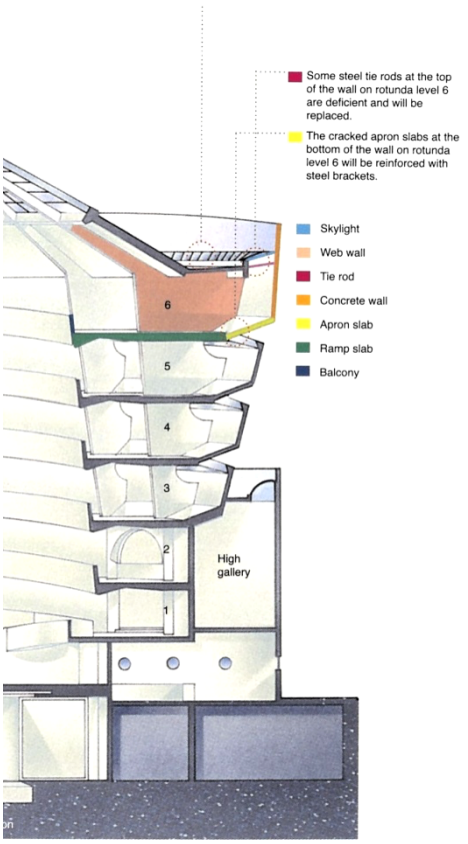

Figure 57: Different types of concrete used in the construction system

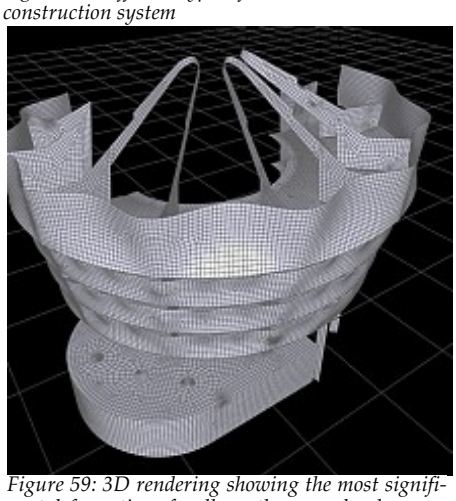

Figure 59: 3D rendering showing the most significant deformation of walls on the upper level

Figure 58: Structural analysis to determine the way the building had shifted

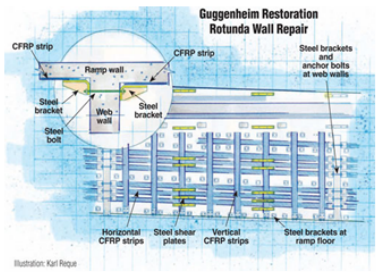

Figure 60: Carbon-fiber reinforcement of the walls of the sixth-floor ramp.

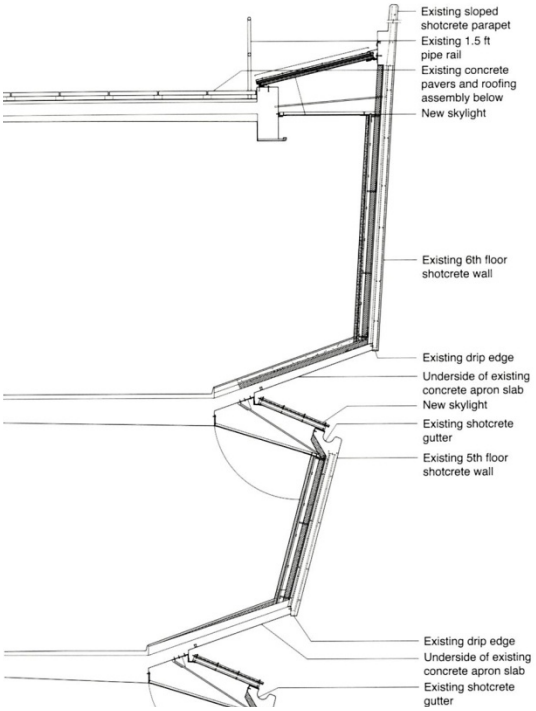

Figure 61: Detail showing the structural reinforcement solution

Figure 62: The Guggenheim Museum in the 1970s. Repairs to cracks in the pedestal are clearly visible. Also worth noting, the building's original "Fresh Butter" color

Figure 63: Samples for testing the resistance of filler products and its compatibility with the cladding. The samples are then placed in the QUV (lower right). At right, a drill core from destructive tests on the existing building. Note the number of coats of paint on the cladding

Figure 64: Cracks are opened up, steel elements rendered passive. Dilation joints are created by disking the concrete and inserting filler. The wall surface is then reconsolidated.

Figure 65: The building in its original color and a sample card of "powel buff" located in archives

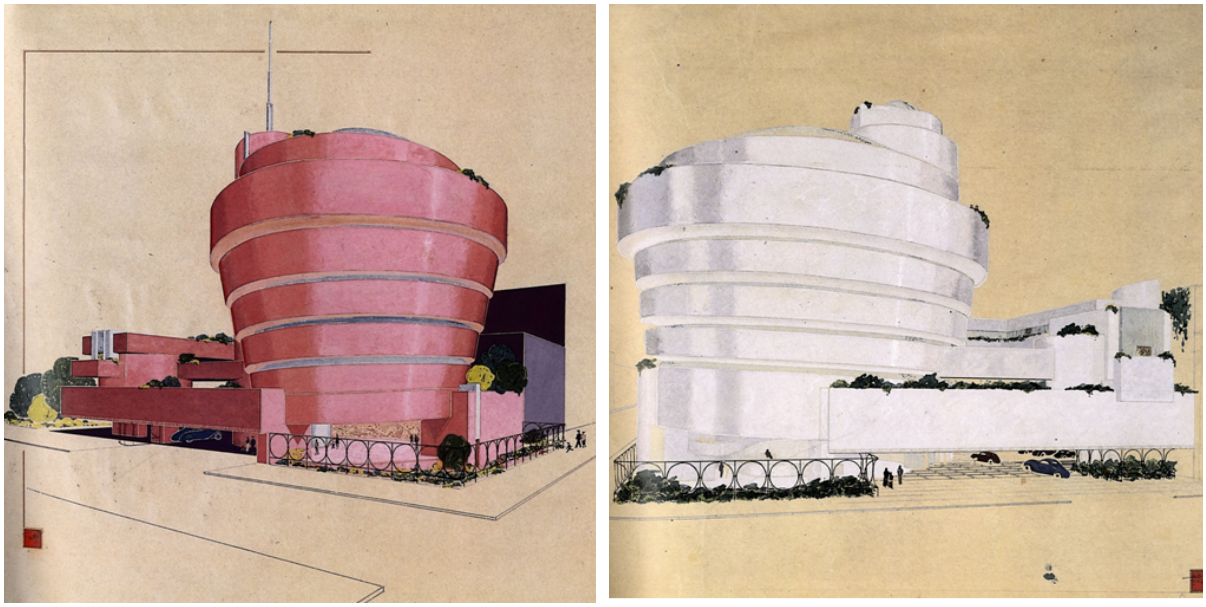

Figure 66: Different renderings by Frank Lloyd Wright showing that the building was intended to have a smooth, glossy cladding.

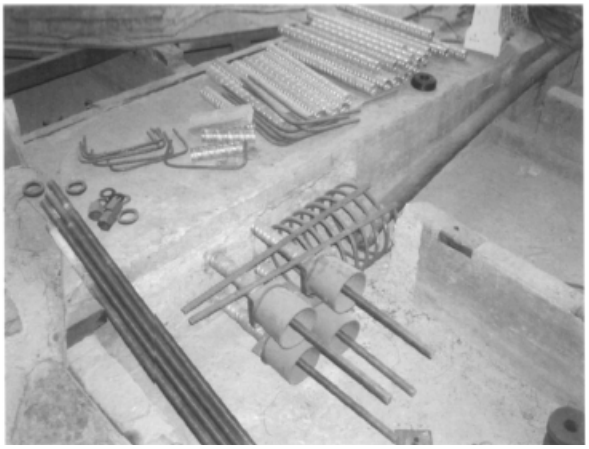

Figure 67: Cracks in the beams of the cantilevered part of the house over the waterfall and installation of cables to maintain the beams in traction following the prestressing technique.

Figure 68: Preparing the cables in the beam for prestressing

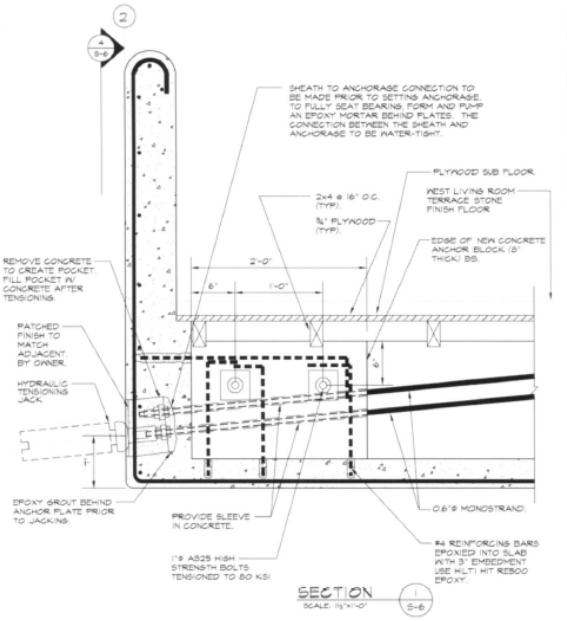

Figure 69: Covering over the guest stairway, F.L. Wright, architect

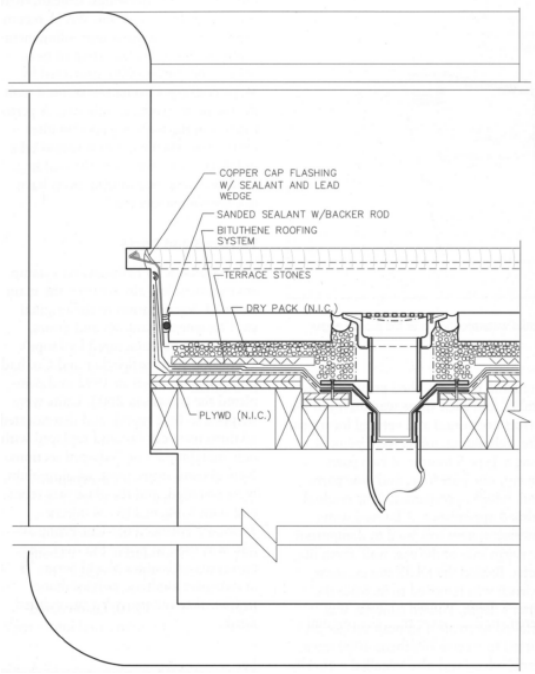

Figure 70: Installation of flashing for water tightness and drains to protect the accessible terraces from water seepage.

Figure 71: Repairing stone on the façade of the National Gallery of Art, Washington, D.C.

Figure 72: Stone repairs in Philadelphia

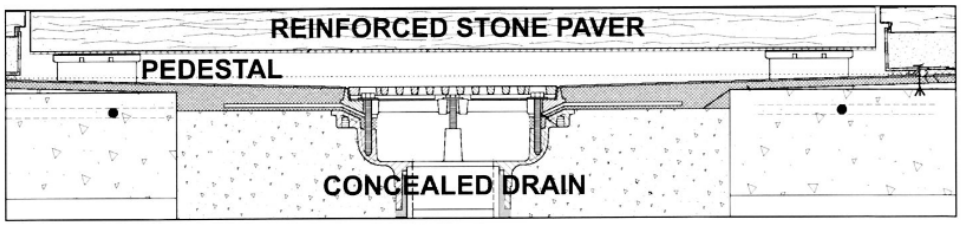

Figure 73: Detail of a section drawing showing reinforcement of the stone and drains at Lake Shore Drive Apartments, based on renderings by Kreueck Sexton

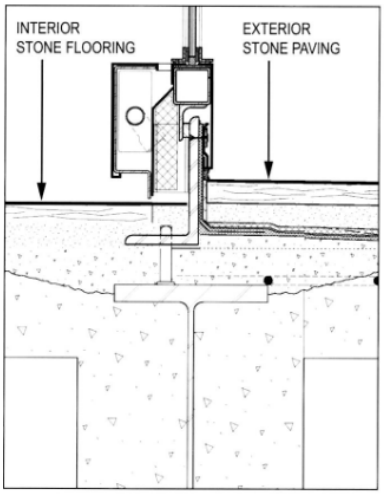

Fig. 7. Section detail at lobby storefront at 860–880 North Lake Shore Drive, showing new offset between interior and exterior paving. Drawing by Krueck + Sexton Architects.

Figure 74: Plaza at Lake Shore Drive

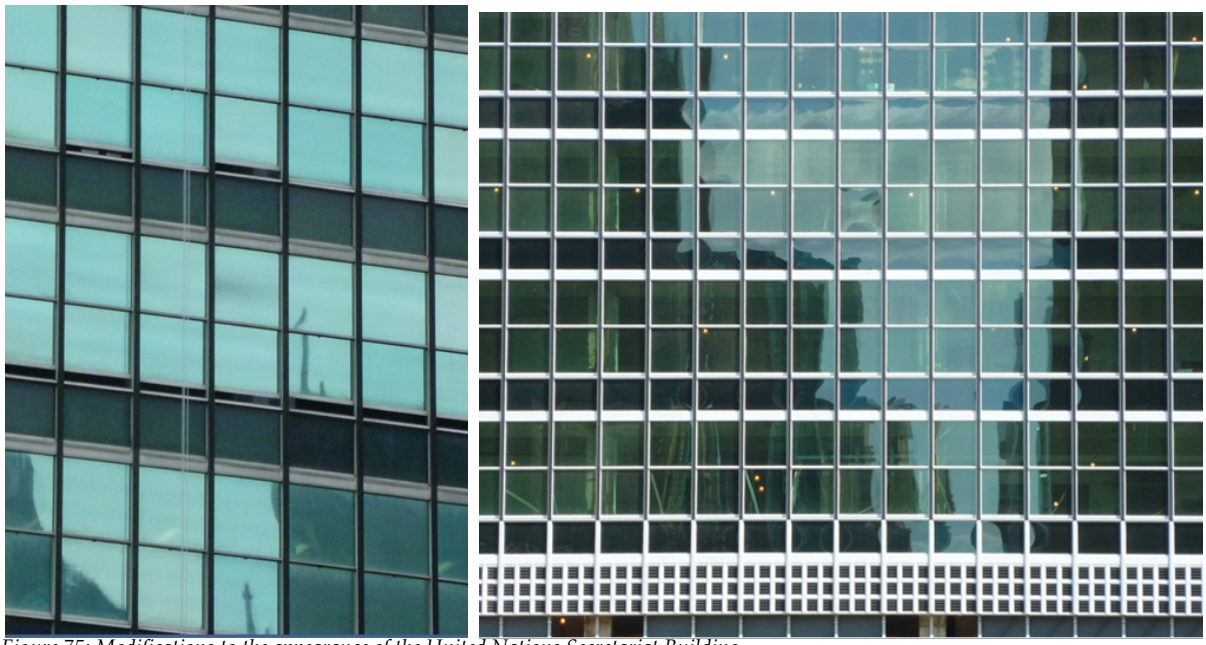

Figure 75: Modifications to the appearance of the United Nations Secretariat Building

Figure 76: Warren Petroleum Building, Tulsa (today International Plaza)

Figure 77: John Deere Headquarters, E. Saarinen, architect

Figure 78: Cigna Building, SOM Architects

Figure 79: Serious Materials: transformation of the windows of the Empire State Building

Figure 80: Crown Hall in Chicago, Mies van der Rohe, architect

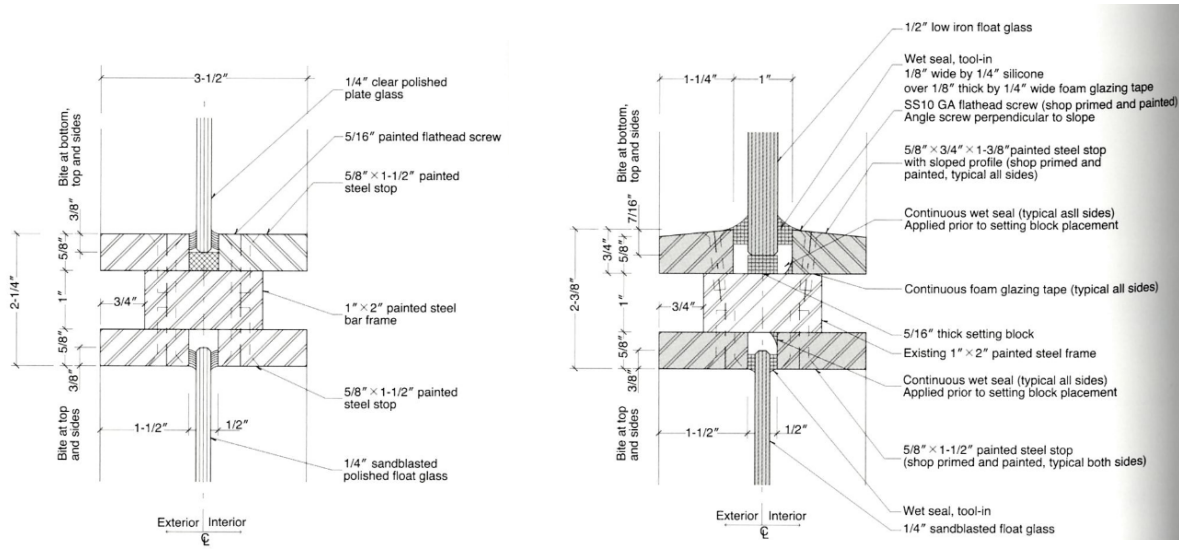

Figure 81: Modification of a constructive detail of windows at Crown Hall

Table 1. Repair and Replacement Options with Description

ID*	Description and Comments
A0	Original uninsulated steel-frame construction, single glazing. Unacceptable condensation resistance.
A4	New commercial steel-frame window by manufacturer 1 with custom thermally broken mullion. Thermal conductivity of steel-frame window is 50 W/mK. Commercial windows are not sold with a thermal break.
A5	New commercial steel-frame window by manufacturer 2 with custom thermally broken mullion.
A6	New aluminum frame with thermal break in all elements. The extrusions are designed to replicate, to the extent possible, the profiles of the original steel-frame elements.
A8 (b)	New insulated-glass unit with inside glazing having a flange that extends beyond the glazing frame. The extended glazing is mounted in the existing single-pane location. Steel trim and rubber spacer are used to build out the frame at the exterior.
A9	Two-piece aluminum cover installed over the interior of the existing steel frame. The cover includes two thicknesses of insulating material (Pyrogel). The original mullion and frame assembly is left intact. No interior insulation on the mullion. IG unit with 1/2-inch air space.
A9-a	Same as A9, but with a combination of insulation and metal cover over the interior of the mullion.
A9-b	Same as A9, but with a 1/16-inch semi-insulating coating (0.9 W/mK thermal conductivity) applied to the interior of the mullion.
A10	Same as A9, except with 3/4-inch (1.2 inch total thickness) IG unit.
A12	Original frames cut longitudinally and refastened with welded or bolted bridges to accommodate an IG unit with 1/2-inch air space.

* The IDs used to label each option are consistent with those used during the project research. The IDs of some options representing slight modifications of those shown on the table are omitted for clarity.

Figure 82: List of options for replacement windows in the Monitor at the Guggenheim Museum k

Table 3. Response to Preservation and Constructability Criteria[1]

Preservation Criteria	A4, A5	A6	A8	A9, A10	A12
Original materials	No	No	Yes	Yes	Yes
Preserve distinctive features	Medium	Medium	Medium	Yes	Yes
Repair rather than replace	No	No	Yes	Yes	Yes
Treatments not injurious	No	No	No	No	Yes
Reversible	No	No	Yes	Yes	No
Energy Conservation	No	Yes	Yes	Moderate	Yes
Other Criteria					
Installation difficulty	Medium	Medium	Low	Low	High
Difficulty at scallop	High	High	Low	Low	Low
Difficulty at doors	Medium	High	Medium	Low	Low
Fabrication cost	Medium	High	Low	Low	High
Condensation resistance	No	Yes	Yes	Moderate	Yes

1. Authors' subjective estimate

Figure 83: Comparison of options and criteria for the replacement of windows in the Monitor at the Guggenheim Museum

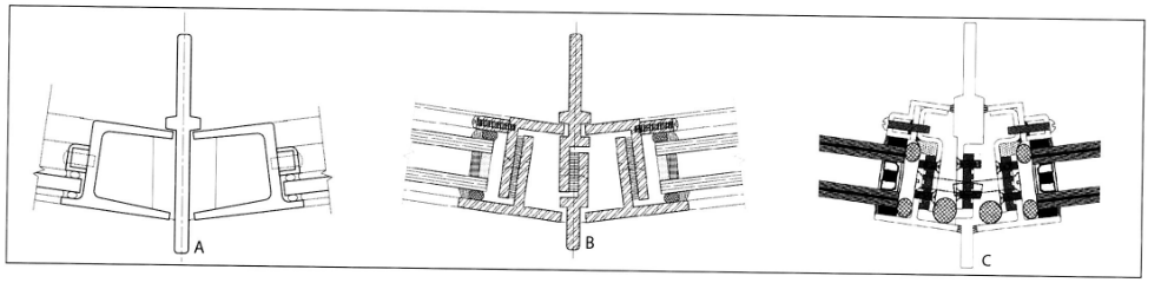

Figure 84: Comparison of windows for the Monitor at the Guggenheim Museum, New York. A: existing windows; B: replacement model in steel proposed by architects; C: aluminum model installed by the construction company.

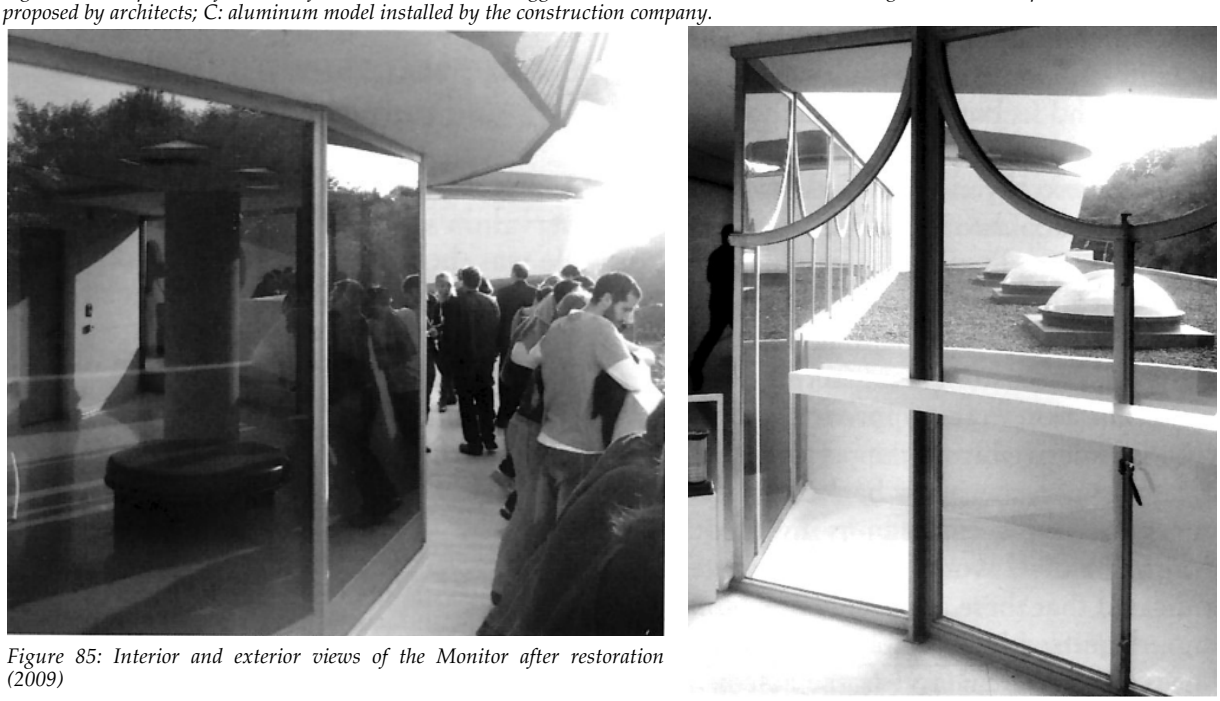

Figure 85: Interior and exterior views of the Monitor after restoration (2009)

Figure 86: Pathologies affecting terracotta in Chicago. Photos by author, 2011

Figure 87: Detain of a terracotta cornice on the renovation worksite at the Univerisity of Chicago. Mary Brush, Preservation Architect, Holabird & Root

Figure 88: Renovation of the TWA Terminal at JFK Airport, New York. The ceramic tiles had to be carefully replicated for the repair work, with meticulous execution by workers similar to that for a precious mosaic. Renovation of the he highly complex curtain walls was made possible by custom recreation of the neoprene joints (gaskets)