

Less Is More

Chicago, Illinois
25-30 September 1997

ABSTRACTS

APT 97

The Association for
Preservation Technology
International



Association for Preservation Technology International

APT97 Chicago Conference: Less Is More

ABSTRACTS

The abstracts included in this booklet were presented at APT97: Less Is More, the 1997 Annual Conference of the Association for Preservation Technology International (APT). The abstracts are organized in chapters by conference topic. Within each chapter, the abstracts are organized by conference session.

Many of these abstracts will be published as complete papers in the APT quarterly technical journal, the *Bulletin*. Information about the *Bulletin* is available through APT at 540-373-1621.

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Cover design: Michael L. Ward
Cover photographs: Leslie Schwartz Photography, Chicago

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TRACK A: THE BIG PICTURE

PRESERVING CULTURAL LANDSCAPES

Chippawa Battlefield Lands Management Plan

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Three kilometers south of Niagara Falls, New York, in a quiet pastoral setting, lies the site of the Battle of Chippawa. On July 5, 1814, the battle pitched British, Canadian, and Indian warriors loyal to the Crown against Americans and their native allies. For the Americans, the U.S. Army came of age. Well trained American regulars fought North America's only true Napoleonic-style battle against a force of British regulars, and won.

The significance of the event to the American psyche is revealed in the grey uniforms worn by West Point cadets, in commemoration of the grey uniforms worn at the battle, and the place of honor of the painting, entitled *Those are Regulars, by God!* at the military bases across the United States.

The site is believed to be the cemetery of the American, British and Canadian soldiers and native warriors killed on the battlefield. It has not been developed and remains much as it was 200 years ago. Plans to turn it into a residential subdivision in 1992 focused community, veterans and native groups, and in 1995 the Niagara Parks Commission purchased the site and the surrounding lands.

The Commission's long-term objectives are: to preserve, protect, and commemorate the historic events and natural resources of the site; to enhance the biodiversity of the site to protect and encourage representation of Ontario's flora and fauna; and to provide opportunities for visitor enjoyment in a manner that respects the natural environment.

Achievement of these objectives is resulting in an interesting spectrum of human and natural history themes to be introduced in an interpretive center and developed through various on-site interpretive devices such as panels and self-guided walking tours. For example, an interpretive trail through the woods might deal with troop movements prior to the battle, as well as natural history themes; and ethnobotanical trail along a creek defining the southern border of the battlefield might tell how the aboriginal occupants used the various natural resources.

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*The Bayside Tract:
Nuclear-Powered Cultural Landscape Preservation*

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Within 125 miles of New York City and 140 miles from Washington, D.C., the western edge of southern New Jersey fronts the Delaware Bay with a remarkable cultural landscape of maritime villages, farms and marshes. Rich in wildlife, soil, and eighteenth- and nineteenth-century architectural fabric, this area has been largely bypassed by the progress of twentieth century development. It is so rich that the Delaware Bayshore of New Jersey has been recently the subject of a comprehensive special resources study by the National Park Service.

Representatives of the bayshore area is the 4,500 acre Bayside Tract of Greenwich Township. First settled in 1685, Greenwich Township had an economy solely based on agriculture and the resources of the bay for three centuries. In the 1960s, the Bayside tract, a collection of farms and tide marshes constituting one-third of the entire Township, was clandestinely acquired by a public utility for a nuclear power plant site. For thirty years, the fate of this pristine cultural landscape was in limbo; historic farmsteads first became overgrown, then crumbled, and a Bayside fishing village shrank with each successive storm.

A breakthrough came in 1993 when the public utility, as part of a wetlands mitigation project, proposed to place the Bayside Tract under an easement with the tract managed for wildlife conservation. Wildlife conservation management would have ceased the agricultural activity and vacated the surviving historic farmsteads.

This presentation will examine the conflicting goals and philosophies of cultural landscape preservation with wildlife management, public access, and private ownership at the Bayside Tract. The presentation will discuss how these conflicting goals were resolved by a local committee intervening in a state-level regulatory process. The resultant Bayside Tract Management balances these goals now and in the future, preventing the loss of a significant cultural landscape on the mid-Atlantic coast.

*Breaking New Ground in a Statewide Parks System:
Answering the Call for Cultural Landscape Documentation and Preservation
in the New York State Office of Parks, Recreation,
and Historic Preservation - Letchworth Park and Lorenzo State Historic Site*

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The New York State Office of Parks, Recreation & Historic Preservation is embarking upon a program of recognizing and signifying the importance of the historic landscapes within system parks and historic sites. Recently completed reports for Lorenzo State Historic Site and two component landscapes within Letchworth State Park, based on comprehensive research and analysis, documented the historic evolution of the landscapes and provided preservation treatment recommendations. Of note, the report prepared for Lorenzo is the first all-encompassing study of a cultural landscape within the Agency's 34 historic site system.

The landscape reports prepared for Lorenzo and Letchworth State Park focus on the research, recording, and evaluation of ten character-defining physical features: 1) the environment, 2) landscape context, 3) natural systems and features, 4) topography, 5) buildings and structures, 6) vegetation, 7) spatial organization, 8) circulation, 9) water features, and 10) furnishings and objects. Concomitant to this process of documentation and analysis, the period of significance was determined for each facility, a determination with profound implications for programmatic operations as evidenced in the resultant treatment recommendations.

The methodology employed in developing the reports for each facility was parallel. However, the differing park and historic site aspects revealed operational and programmatic dichotomies which factored additionally in establishing preservation goals for each facility. Messrs. Curry and Bartlett (Letchworth) and Mr. Fritz and Ms. Bartlett (Lorenzo) will present their respective approaches to cultural resource assessment at each facility and discuss how landscape treatment recommendations were developed within Agency-defined goals.

Both sites are nationally-recognized cultural resources. Letchworth State Park, located in western New York, was originally purchased in 1859 and developed by William Pryor Letchworth, who bequeathed the property to the State in 1906. Lorenzo State Historic Site, located in central New York, was originally established in 1807-1808 by John Lincklaen and after 160 years of family occupation was bequeathed to New York State in 1968.

FRANK LLOYD WRIGHT'S WINGSPREAD

Wingspread: Structural Engineering Solutions to Roof Failure Problems

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A structural analysis of existing conditions in both the Great Hall and East Wing was conducted. Computer modeling was used to show both stresses and deflections in existing members. The model was refined until the calculated deformations very closely matched the observed deformations. This was evidence that future calculations based on that model would represent accurate predictions. Field observations of existing conditions were conducted, including non-destructive evaluations with the use of a borescope.

A comparison of various reinforcing schemes was conducted. Particular attention was directed to those requiring repairs made from the interior, and concomitant destruction of original fabric, versus those that could be accomplished completely from the exterior with disturbance only to roofing materials.

Final structural solutions were resolved in conjunction with the preservation philosophy determined for the project. In the Great Hall, the large wood octagonal roof suffered severe distress in the winter of 1993-94. Permanent strengthening and repairs included linking the lower roof and the upper roof by replacing eight of the 42 zigzag mullions. The lower roof was designed to act as a monolithic shell, with the upper portion in compression and the lower in tension. The shell was made of carbon fiber and was made to act compositely with the existing roof's wood sheathing and rafters. Thus the sheathing and rafters were "sacrificed" to the principle of reversibility.

In the East Wing, the gable roof over the bedrooms and playroom was originally constructed without any ceiling ties or structural ridge beam. The system to strengthen and stiffen this roof was to apply carbon fiber and fiber glass to the wood sheathing in order to create folded plates. The loads at the ends of the plates were collected into new steel beams or into existing walls. A hip end turned at 45 degrees to the main ridge line caused enormous complications for the analysis and design.

Detailed investigations were conducted to determine the best materials to create the thin shell diaphragms and plates. Extensive testing programs proved the strength and stiffness of carbon fiber/epoxy and fiberglass/epoxy layups. The most important property sought was a high modulus of elasticity, E , for stiffness control. Carbon fiber/epoxy proved to have a modulus of elasticity greater than 4×10^6 psi and in some orientations equal to 5×10^6 psi.

For the eight replacement zigzag mullions, $1\frac{1}{2}$ " x $3\frac{1}{2}$ " in cross section, an attempt was made to utilize a product called zebra wood comprised of alternate layers of Douglas fir veneer and carbon fiber bedded in epoxy. This failed to meet required strength criteria in full scale tests and had to be abandoned. Instead, an ultra high strength alloy of aluminum (7075) normally found in the aircraft industry was used.

The Architectural Approach to the Structural Stabilization of Wingspread

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Responding to Structural Failure at Wingspread:

Wingspread, designed by Frank Lloyd Wright in 1939, is, with a central "Great Hall" and four large wings, the "grandest" of the Prairie Houses. One night, in the winter of 1993-1994, there was a sudden movement in the roof structure. The skylight framing at the west end of the Great Hall dropped two to three inches, and several major cracks appeared in the East Wing ceilings. The Hillier Group Architects, with Robert Silman Associates as the structural engineers, designed temporary emergency exterior shoring for the Great Hall. This allowed the continued use of the building while the cause of the failure was investigated and a permanent solution could be designed. A project team of experts in preservation was given the task of developing such a solution. Before initiating design work, the team completed detailed investigations of the structure and helped develop a preservation philosophy to guide the stabilization project.

Forging a Preservation Design Philosophy:

To assist the client, the Johnson Foundation, in creating a preservation philosophy for Wingspread's future care, we used the evaluation criteria for World Heritage Sites. The criteria are important because they address both cultural values and contemporary economic values. The preservation philosophy established by the client was designed to complement its mission statement. The philosophy encompassed recognizing Wingspread as a conference center and yet minimizing change to Wright's design intent, maintaining safety, protecting historic fabric, and maximizing the Foundation's resources.

We responded by developing the following project goals which set clear parameters for the project team:

- Complement Wright's design
- Allow reversibility
- Preserve original fabric
- Minimize visual intervention
- Tell the story of the building's deflection

Design Implementation of the Structural Stabilization at Wingspread

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Collaboration of Design Professionals and Construction Representatives to Ensure the Best Workable Solution:

The nature of the solution required close collaboration between the owner, design professionals, and construction representatives. Traditional boundaries of responsibilities were blurred requiring a group analysis of the problem and the solution from a design intent through its feasibility of construction. The architect, engineer, builder, owner, and various consultants were assembled early in the project, which fostered sharing of information across disciplines.

This collaboration climaxed in the development and implementation of the structural reinforcing rafters for which a full size mock-up of a section of the roof was constructed for means and methods experimentation. Construction techniques, sequencing, specific equipment to be used, and quality assurance checks were tested and perfected on the mock-up prior to working on the actual roof.

Combination of Traditional Building Techniques with Technology Found Outside the Construction Industry:

Extraordinary coordination was required to introduce and implement technology found outside the construction industry for the repair of a residential roof. Whereas the aircraft aluminum reinforcing rafters were fit by carpentry workers, the composite roof structural membrane, made of epoxy and woven carbon, required installation by boat-builders. Both the development of the type and use of these materials and the methods of their incorporation into the project were closely scrutinized by the design and construction team.

Consultation of Experts and Thorough Analysis Lead to Success:

The involvement of expert consultants was invaluable to the project and addressed issues that otherwise would have been very difficult to evaluate. This was especially true during the design of the skylight units.

Similar to considering side effects of a prescription, materials and applications analysis contributed greatly to the design solution and its implementation. Ramifications of various proposals were reviewed with respect to the original fabric of the construction.

An interactive environment bound by a common vision of respect for the original builders and the requirements of the problem resulted in the successful repair at Wingspread.

Moisture Monitoring and Investigations at Wingspread

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During the 1930s, the rules for construction of insulated cavity assemblies were considerably different than those of today. In particular, the literature insisted that for good protection of sheathing materials from moisture, it was considered important that the insulation be installed as close to the outside surface as possible. This is in contrast with the method currently popular which calls for cold-side venting.

The cathedral ceiling assemblies at Wingspread were constructed in a way entirely consistent with the literature of the period in which it was built. The slag wool and cellulosic material insulation was held tightly up against the sheathing in the cathedral ceilings with no provisions for ventilation. Upon investigation, the sheathing was shown to be in excellent condition, with no evidence of moisture damage to the underside.

Because the cathedral ceiling construction differs from the methods currently in use, a program of temperature and moisture content monitoring was undertaken, first in the East Wing, and then in the Great Hall of the building. The results showed through one winter that no damage to the underside of the sheathing would be expected.

The likelihood of damage to the sheathing is known to be a function of the indoor moisture load; buildings with excess moisture loads, such as from wet foundations, are known to have a higher incidence of sheathing moisture damage. The slab foundation at Wingspread shows some questionable drainage patterns. The indoor and outdoor conditions of absolute humidity were compared, and from this it was determined that the slab foundation provides no excess moisture to the space.

A second campaign involved monitoring of the temperature at the underside of the double-glazed skylights, and comparing those temperatures to the dew point temperature of the Great Hall. The windows stayed safely above the dew point temperature. Then the skylight temperatures were considered with a theoretical increase in the indoor humidity, as would occur with group occupancy. It was determined that the allowable wintertime humidity, as might be governed by glazing temperatures with no condensation as the limiting condition, was near 50 percent.

These findings allowed the design of the building to proceed with confidence. The strategy for insulating the refurbished cavities relies on the proven and monitored methods of the past.

TWENTIETH-CENTURY RESIDENCES

Conserving the Legacy of a Twentieth Century Visionary: The Preservation Plan for Russel Wright's Manitoga

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Perched on the edge of a granite quarry above the Hudson River, Manitoga or "Dragon Rock" is the former home and studio of twentieth century industrial designer Russel Wright, whose "American Modern" line of china became a best-seller in the 1930s and 1940s. The house was completed in 1959 and its design and layout exemplify Wright's fascination with the tension between Man and Nature. The detailing incorporates materials such as plastics which were experimental at the time but are now commonplace and which were used in innovative and unusual ways. These materials and applications, while stunning, pose significant conservation challenges nearly forty years later. This presentation will review the findings of a recent Master Plan for the house intended to support the long-term preservation of the house and furnishings.

Pamela Hawkes will present an historical overview of the property, including Wright's design approach and its significant features. She will discuss the philosophical and technical challenges of preserving the house and its associated landscape and making them accessible to the public.

Michael Henry will describe Wright's techniques for construction, lighting and passive solar design, compare them to those of other twentieth century designers such as Frank Lloyd Wright, and identify the challenges they pose for conservation of the building and artifacts.

The unusual interior finishes include natural, organic surfaces used in contrast with reflective metallic foils and paints and shiny plastic surfaces. Wright incorporated fragile organic materials, such as hemlock needles, into his paints, and used sand and metallic powders to create shimmering, glittering effects. Many of these combination are inherently unstable or incompatible. Susan Buck will discuss the analysis of materials and recommendations for their stabilization and conservation.

The Restoration of Top Cottage, the Hilltop Retreat of President Franklin D. Roosevelt

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President Franklin Delano Roosevelt built his hilltop retreat in Dutchess County, New York between 1938 and 1939. The President had purchased seventy acres of land that abutted his mother's estate at Hyde Park and planned a refuge to escape the constant stream of visitors at Springwood, his boyhood home.

The house was constructed of fieldstone and incorporated Roosevelt's ideas about the Dutch architectural heritage of the Hudson Valley. It consisted of a central block flanked by a service wing to the north and a bedroom wing to the south. A covered terrace, with a view to the Hudson River and the Catskill Mountains beyond, was constructed on the west elevation of the central block.

Before he died in April, 1945, Roosevelt was to oversee a series of modifications that introduced living space at the second floor level of each wing and a dormer on the west elevation of the north wing. The work on the north wing was completed between 1940 and 1941, and the work on the south wing was completed between 1942 and 1943. From the time of Roosevelt's death until 1993, the house remained as a private residence. It was occupied by the President's son, Elliot Roosevelt, until 1952, when it was sold. Subsequently, the house was occupied by two generations of the Philip S. Potter family of Poughkeepsie, New York. Over the years, several alterations were made to accommodate the residents. The covered terrace was enclosed, four additional dormers were constructed, and the addition and later enclosure of the north porch was undertaken. Smaller projects, including interior modifications of door openings, the construction of built-in casework, and the relocation of wall partitions occurred as well.

The house was acquired in 1996 by the Franklin and Eleanor Roosevelt Institute, a private, non-profit organization that is now in the process of restoring the building. The restoration of Top Cottage involves the stripping or removal of the accumulated layers of construction dating from after Franklin D. Roosevelt's time. The seemingly simple restoration of an uncomplicated house is made difficult by the use of modern materials, both in the original construction and in the alterations. It is not always easy to distinguish between successive periods of construction in the second and third quarters of the twentieth century. The restoration of the house has provided a unique opportunity to work with the conservation of twentieth century building materials in a comprehensive manner.

Restoration/Conservation of Frank Lloyd Wright's Pope-Leighey House

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This session is a case study overview of the conservation/restoration of the Pope-Leighey House, including:

- a description of the complete planning, dismantling and reconstruction process to ensure that the structural failures that have occurred over the past 45 years, and are typical of Usonian houses, were arrested, thus preserving the house well into the future, and
- a description of our design decisions and construction technology efforts to conserve original materials such as interior and exterior cypress paneling and siding, and windows, to the greatest extent possible.

Background:

In 1989, Quinn Evans/Architects was selected by the National Trust for Historic Preservation to plan and implement the restoration of the 1940 Frank Lloyd Wright-designed Pope-Leighey House. The house had been donated to the National Trust Historic House collection and moved to Woodlawn Plantation in 1965, after it was designated for demolition due to the construction of Interstate Route 66.

At the time of our selection, the National Trust had recognized for a number of years significant structural failure problems in the foundation floor slab construction installed when the house was moved to Woodlawn. Substantial floor cracking, movement, and settlement had occurred in the 25 years since the house had been rebuilt at Woodlawn. Soil deficiencies and foundation design deficiencies had resulted in the failure of the building at its exposed concrete floor.

While the floor failure was the most obvious area of deterioration in this significant Usonian house, our initial planning and survey investigations revealed that substantial deterioration and failure had also occurred throughout the walls and roof structure.

After exploring both dismantling and relocation reconstruction alternatives, Quinn Evans/Architects reconfirmed earlier recommendations that the best long-term restoration/conservation approach would be one that would involve the complete dismantling and reconstruction of the house. Ultimately, our primary philosophical goal was to complete a restoration that would maximize the conservation of the extant original material in the house, primarily the wood walls and paneling, windows, and doors, so that they could survive for a significant time in the future.

This project allowed us a unique opportunity to dissect and reassemble a Usonian house in all its detail and to understand the many unique technical, as well as architectural, design elements that Mr. Wright incorporated in his early Usonian structures.

*Masonry and Roofing Repair at Gillette Castle, East Haddam, Connecticut:
The Failure of a Masonry System*

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Roger Clarke Architect, AIA
Hartford, Connecticut

The Castle, a residence built to resemble a ruin, was built between 1917 and 1926. It is now a popular tourist attraction and a state park.

The building is of rubble stone masonry construction, made deliberately rough, uncoursed, and 'broken' in appearance. Roofs are flat with high stone parapet walls.

Repairs have been made continually to the building to prevent roofing problems, or what were seen as roofing problems. Throughout the building are signs of considerable water penetration. Extensive leaching stains the exterior walls, causing deposits of carbonated lime. Water has penetrated all the exterior walls, over windows, and into and across ceilings down from one story to another. It appears that moisture penetration was a problem even shortly after the completion of the building.

In making a study to assess the prevalent conditions and review the recurring problems of water penetration, an analysis revealed that roofing repairs and repointing work were carried out at approximately ten year intervals. Each repair contract included the replacement of one or more roofing systems. The old roofing was removed and replaced with new materials. The problems of water penetration remained in spite of these measures.

The problems of water infiltration were caused by the porous nature of the stone wall and the lack of through-wall flashings and was compounded by continual repointing with hard mortar. The problem was not one of roofing failure. A small roof was taken as a test site where the parapet walls and roofing were removed to the framing line and completely replaced. New wall flashings were introduced. This approach has been successful and is now being applied to the remainder of the building and other similar structures in the park.

*SPECIALIZED COMMITTEES OF THE U.S. CHAPTER
OF THE INTERNATIONAL COUNCIL ON MONUMENTS AND SITES (ICOMOS)*
(Sponsored by US/ICOMOS)

Moderator:

Stephen J. Kelley, AIA, SE, Senior Consultant
Wiss, Janney, Elstner Associates, Inc.
Chicago, Illinois

Speakers:

Archaeological Heritage Management

Dr. Julia Costello, President
Foothill Resources, Ltd.
Mokelumne Hill, California

Earthen Architecture

Maria Isabel Beas, Registered Architect in Peru
Advanced Graduate Research Candidate
University of Pennsylvania
Philadelphia, Pennsylvania

Vernacular Architecture

Dr. William Chapman
Director of Historic Preservation
University of Hawaii at Manoa
Manoa, Hawaii

The International Council on Monuments and Sites (ICOMOS), established in 1965 and headquartered in Paris, is a non-governmental, non-profit, international organization of professionals and individuals active in protecting the world's building heritage. Included in the objectives of ICOMOS are to 1) provide a forum for preservation specialists from around the world; 2) collect, evaluate, and disseminate information on preservation; 3) to cooperate with international and national authorities specializing in preservation; 4) to develop, adopt, and implement international conventions; and 5) to put the expertise of professional and specialists at the service of the world community.

The United States Chapter of ICOMOS (US/ICOMOS), also established in 1965, and headquartered in Washington DC, is one of 65 national committees that form a world wide network to help achieve the goals of ICOMOS. The Specialized Committees of US/ICOMOS are the scientific and technical organs of US/ICOMOS and should, therefore be of particular interest to APT members. The Specialized Committees, which are allied with the Scientific Committees of ICOMOS and other national chapters of ICOMOS, cover such topics as cultural tourism, economics of conservation, historic gardens and sites, historic towns, adobe, photogrammetry, legislation, and stone.

Three US/ICOMOS Specialized Committees, Archaeological Heritage Management, Earthen Architecture, and Vernacular Architecture, are presented the speakers are ICOMOS members, recognized in their professional fields of work, and active members of the Specialized Committee that they represent.

It is anticipated that new Specialized Committees will be formed to meet the needs of the world community. The newest ICOMOS Scientific Committee on Analysis and Restoration of Structures of Architectural Heritage (ISCARSAH) was formed at the ICOMOS Conference in Sofia, Bulgaria in October of 1996. This new committee, which has since met in Rome in March and Santiago, Spain in September of this year is composed of a world body of esteemed engineers and architects involved in conservation of world heritage in and around their countries. It is expected that ISCARSAH will eventually find a US/ICOMOS component in the form of a Specialized Committee in the future.

CEMETERIES: PRESERVING PERPETUITY

Cities of the Dead: Perpetual Problems with Perpetual Care

Susan I. Sherwood
New York, New York

The inability of sandstones and marbles to survive in cemetery environments led to the emergence at the turn of the century of granite as the monumental material of choice. Even the fittest stones, basalts, gneisses, and granites cannot withstand long-term wet-dry cycling. Unprotected by roofs, parging, or damp-proof courses, tombstones and monuments are routinely exposed to the damaging effects of rain, snow, runoff, and standing water. Mausolea roofs are typically unclad stone, lacking flashing and other water shedding design details used in buildings constructed for the living. Significant water damage to the masonry as well as to interior finishes and sepulchral objects frequently results.

Since the mid-nineteenth century cemeteries have encouraged families to provide an endowment for perpetual care of grave sites and mausolea. Perpetual care agreements generally focus on gardening, but also include stone cleaning, bronze polishing, and iron fence repainting. For mausolea the endowment covered occasional repointing, and as appropriate, cleaning the interior and performing window maintenance. Even at its best, such maintenance is burial site specific and fails to address the preservation needs of the cemetery as a whole.

Guidelines for horticultural and roadway maintenance to enhance site drainage will be discussed. Traditional designs for tombstone installation and mausoleum construction will be reviewed as a basis for designing moisture control retrofits. The presentation will discuss methods for improving tombstone and monument site drainage, mausoleum roof repairs and waterproofing options, and joint maintenance with traditional materials.

*Landscape Preservation Strategies:
The Future of the Rural Cemetery's Historic Landscape*

Elizabeth A. Vizza, Associate
The Halvorson Company, Inc.
Boston, Massachusetts

The rural cemetery movement in America was born with the consecration of Mount Auburn Cemetery in Cambridge, Massachusetts in 1831. Mount Auburn became the nation's first public park of any size, and served as a prototype for the urban park movement of the second half of the nineteenth century. Today, every city in America and many smaller communities are proud of their historic cemeteries designed in the rural or garden cemetery tradition.

The preservation of the historic cemetery landscape presents a number of unique challenges. Foremost among these is the fact that a great many of these institutions are still active businesses. Land development and the resultant alteration of the landscape is an on-going process. The demands and constraints of the cemetery market all have a profound influence on the character of the landscape and the integrity of its historic design.

Today, many of our premier historic cemeteries are at a crossroads, as they face dwindling land resources, reliance on burial and memorialization approaches that accelerate land usage and/or diminish landscape quality, and increasing pressures for recreational and contemplative use. The challenge in planning for the future of these institutions and landscapes is to respect the spirit of their past while being responsive to changing needs.

An integrated response to the issues facing historic cemetery landscape preservation must be applied that addresses monument conservation, horticultural mission, burial and memorialization approaches, and public use philosophy, all within the framework of the fundamental principles governing the cemetery's historic landscape design.

Several case studies will be used to discuss the preservation planning process that The Halvorson Company has employed to develop master plans and implement a host of recommendations for cemetery preservation and development. Work at Mount Auburn Cemetery and Cedar Hill Cemetery in Hartford, Connecticut will be used as reference points.

A Gravestone Conservation Dilemma (and a Possible Solution)

Irving Slavid
Monument Conservation Collaborative
Colebrook, Connecticut

Norman R. Weiss
Columbia University
New York, New York

In the northeastern United States, where historic cemeteries have long been regarded as important cultural resources, no material challenges the conservator more than Connecticut "brownstone." Recent improvements in patching composites for sandstone grave markers—making simple, flat fills nearly invisible—have raised both technical and ethical issues when the areas to be re-created include inscriptions or decoration. The skillful conservator may choose to reconstruct these designs or, if the features seem too large or too complex to reproduce, to patch without details, the latter method creating blank areas that could never have existed in the original. Neither procedure is without its problems, especially when one considers the relationship between visually successful patching and other stone treatments such as cleaning. This paper proposes, and illustrates, another approach based upon installing the patching material below the plane of the original surface by about ½ inch. The technique, used for the conservation of mural paintings and mosaics, eliminates the sense that the fill is "unfinished," despite its being executed without decoration.

TAKING PRESERVATION UNDERGROUND

Preliminary Documentation and Visitor Assessment at the Alpine Tunnel, Colorado: Implications for Site Preservation and Interpretation

Daniel F. MacGilvray, AIA, Professor
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Texas A&M University
College Station, Texas

Patricia A. Stokowski, Ph.D.
Department of Recreation, Parks & Tourism Science
Texas A&M University
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Department of Architecture
Texas A&M University
College Station, Texas

Narrow gauge railroads were fundamental to the development of central Colorado. The Denver, South Park, and Pacific was organized in 1867 and surveyed a route to Gunnison in 1879. Their greatest obstacle was crossing the Continental Divide; after much investigation, Alpine Pass was selected, and to avoid grades steeper than four percent, a tunnel under the pass was required.

At 11,612 feet, Alpine was the highest tunnel in the United States when completed in 1881 and the first to cross the Continental Divide. The old railroad grades and the few remaining structures scattered along them represent a significant historical and cultural resource. The issue addressed in this research is: How can the various federal, state, and local agencies involved best manage the development and conservation of the Alpine Tunnel in order to protect the historic resources and to provide for quality visitor experiences?

Work by researchers focused not only on the documentation of the site and the buildings located there, but also on visitor use of and impacts on the site. The goal is to devise a plan for sensitive and appropriate interpretation of the site to ensure eventual preservation and maintenance of the remaining historic structures.

Field documentation was accomplished according to HABS standards. Visitor interviews were conducted and follow-up surveys were mailed to visitors in their home communities subsequent to the on-site contact. These profiling data will contribute to the development of an interpretive plan and to a computer-animated interpretive video in the next phase.

Repair of Stone Foundations at Historic Sites

Ilene R. Tyler, AIA
Quinn/Evans Architects, Inc.
Ann Arbor, Michigan

Stone foundations are common for pre-twentieth century buildings. The footing typically is a course of wide stones laid dry at the base of the walls. A specification for the foundations of a church building erected in 1860 reads as follows: "The foundations of the Front Gable of Church are to be commended with a layer of Walden rough flags 6 ins thick the whole width of the footings as figured on the section & not less than 3 feet the other way. To be carefully bedded perfectly solid & level on the soil. The walls up to the ground level to be built of rubble limestone from Sibleys quarries, all in large stones well bonded and bedded in mortar & grouted solid." The specification included a recipe for mortar, a typical "clean sharp lake or river sand & well burnt stone lime . . . the whole to be thoroughly mixed and incorporated together and used fresh."

What could go wrong with this careful attention to detail described in the original specifications? Time wreaks havoc with the best-laid plans, and deterioration is inevitable. These 100 to 200 year old structures create contemporary building problems, and provide challenges for restoration.

Lectures and references that address this topic usually focus on the foundation material, construction type or unique geographic conditions of the site, and do not describe or make recommendations specifically for repair of the structural foundation system. The challenge in developing this talk was in compiling relevant information and presenting it in an interesting format. It was easy to find projects that address foundation problems, but not wanting this to be just a series of case studies, I looked for a theme that tied them all together into some concise lessons.

Issues of foundation design:

- soil conditions
- frost depth
- moisture/water problems
- loading and superstructure design
- enclosure of below-grade habitable space

Historic use of materials for foundations:

- stone
- mortar
- concrete

Types of failure:

- earth pressure
- water damage
- deterioration of foundation materials

Case studies for repair of foundation problems:

- Christ Church - Detroit
- Truman Residence
- Grant Farm
- Villa Louis Historic Residence
- The Detroit Observatory

There just isn't any glamour in repairing foundations. Your accomplishments don't show, and most people don't appreciate the effort and money that went into the project. However, a solid foundation holds up the rest of the structure, and must perform well into the future for continued safety and integrity of the historic site.

Design of a Test Blasting Program for an Underground Building (CBUS), Surrounding the Most Important Building in Canada

María Inés Subercaseaux, Architect, M.Sc.A.
Heritage Conservation Program
Public Works and Government Services Canada
Ottawa, Ontario

Marcus V. Van Bers, P.Eng.
Golder VME Limited Canada
Ottawa, Ontario

Gerry Pernica, PH.D., P. Eng.
National Research Council Canada
Institute for Research in Construction
Ottawa, Ontario

The presentation will discuss the mechanism of adjusting the different components of the testing program to minimize impact on the heritage structures, underground structures, landscape, sculptures, and buildings.

Methodology:

1. Preliminaries
 - Setting of base blast parameters
 - Pre-blast survey.
2. Site Preparations
 - Installing hording (site 1-2)
 - Removal of statues
 - Installing monitors
 - Setting up control rooms
 - Safety measures
 - Removal of trees
 - Excavations
3. Blasting
 - Preparation
 - Detonation
4. Monitoring and Feedback
 - Monitoring impact of blast on ground
 - Monitoring impact of blast on buildings (general)
 - Monitoring impact of blast on specific aspects of buildings
 - Monitoring impact of loaded trucks on buildings and ground
 - Evaluation of the recording

5. Treatment of problem areas of buildings
 - Survey of overall problem area
 - Adjustment to blast levels
 - Periodic survey
 - Adjustment to monitors
6. Re-evaluation of results and adjustment of blast intensities
7. Final blasting at desired condition
8. Post-blast condition assessment
9. Re-instatement of sites

These procedures were re-evaluated at the end of the work by the group. Re-evaluation of results and refinement of blasting parameters were developed. The project was developed based on these results.

The second part will discuss the procedures followed in establishing suitable and safe controlled blasting criteria for the eventual excavation of 25,000 cubic yards of bedrock adjacent to a National Heritage Site. In addition to the instrumentation installed on the structures themselves, geophone sensors were installed within the bedrock adjacent to each foundation to assess the ground vibration and frequency characteristics produced from each blast. This data was used in establishing frequency dependent vibration limitations for each structure based on the response of various elements monitored on each building. Vibration decay rates were also assessed to assist in determining appropriate explosive loads and blast procedures for differing sites and distances within the eventual excavation. Procedures for the control of air-concussion and possible flyrock were also identified, including determining specific explosive products and identifying critical areas requiring window protection.

The last part of the paper will discuss and describe the system used to monitor the blasting induced in two buildings closest to the excavation footprint, namely the Centre Block and the Library of Parliament. Because the supply of vibration sensors and recording channels was limited, a presurvey of rooms and offices in the building was undertaken to select the most critical locations and directions (vertical or horizontal) for monitoring. Data acquisition systems were set up at several locations within the buildings to minimize the lengths of cables required to connect vibration sensors to recording stations. Seventy-two responses at about 40 interior and exterior locations were measured to assess the effects of the blasts on the buildings and to assist the design of the rock removal program by establishing safe parameters for blasting. Results indicated that the basement walls of the Centre Block and pinnacles on the exterior of the Library would govern the design of the blasts.

Conclusions by the group will be completed with the final results obtained from Summer 1997 blasting.

DOCOMOMO/US - WHAT IS IT? WHAT DOES IT WANT TO BE?

Moderator:

Gunny Harboe, AIA
Director of Preservation Group
McClier
Chicago, Illinois

Panelists:

Wessel de Jonge
Secretary, DOCOMOMO International
Eindhoven University of Technology
Eindhoven, The Netherlands

Jeffrey M. Chusid
Coordinator, DOCOMOMO/US
Director, Historic Preservation Program
University of Texas
Austin, Texas

Susan Bronson, Architect
Montréal, Québec

During the Preserving the Recent Past Conference in Chicago in March 1995, the charter meeting of the United States Chapter of DOCOMOMO was held. Over the last two years, interest in preserving our recent past and in DOCOMOMO has increased greatly. This session will feature brief presentations followed by an open discussion to explore the meaning and purpose of DOCOMOMO/US. The session will inform the APT community about this topic and provide an opportunity to discuss how preservation of our recent past might be accomplished. Questions will be directed by the moderator to members of the panel to generate a lively discussion including audience participation. Participants will receive a copy of the Eindhoven Statement, the guiding principles of DOCOMOMO.

TRACK B: THE INFORMATION AGE

CODES AND REGULATIONS FOR OLD BUILDINGS

Historic Buildings and the Uniform Code for Building Conservation

Richard S. Beardmore, P.E., President
A-E Design Associates, PC
Fort Collins, Colorado

James D. Reidhead
Restoration Contractor and Consultant
Fort Collins, Colorado

As has been often demonstrated, regardless of which model building code for new construction has been adopted by a jurisdiction, the successful preservation and restoration of existing structures requires an alternative approach to contemporary code interpretation and enforcement procedures. This alternative approach should be based on the recognition that many existing historic buildings, while constructed contrary to current codes, nonetheless possess inherent life safety, proven performance, and integrity that may have well met building code provisions when originally built.

The Uniform Code for Building Conservation (UCBC), an alternative code document developed by the International Conference of Building Officials (ICBO) as a companion to the Uniform Building Code (UBC), has been expressly designed to address the needs of all existing buildings. Furthermore, it specifically refers to, and addresses, the UCBC requirements of historic structures. A general overview using the UCBC and case studies of its successful application will be presented. Alternative code compliance concepts and adoptable administrative guidelines will be reviewed that can further the preservation of a community's existing and historic building stock by establishing appropriate threshold levels of life safety for historic buildings. Building on the concept of conservation code *enhancement*, rather than the strict interpretation of prescriptive contemporary code compliance, is the key principle.

Areas to be specifically discussed include common conservation code issues, minimum life safety standards, evaluation of the performance history and acceptable hourly fire rating equivalency of archaic (historic) assemblies, and "non-destructive" structural evaluation and enhancement techniques. Additional topics to be discussed include building official legal provisions; suggested alternative building code review, administration and approval processes; and the critical role(s) that the conservation, preservation, and design professional plays in the code review and building permit approval processes.

Innovative Solutions for Egress Compliance

Carolyn Alderson
General Service Administration
National Capitol Region
Washington, D.C.

Life safety code compliance for building egress has long presented one of the most formidable challenges to the conservation of interior circulation space. Countering the trend toward creative egress solutions are shrinking project budgets and increasing concern for public safety and liability risk. At the same time, recent developments in fire separation technology offer promising alternatives for reducing architectural intervention and original material loss.

In GSA's National Capital Region, Public Buildings Service, the monumental size of our historic building inventory offers economies of scale that are a valuable incentive for research and development of preservation-friendly products. This presentation will explore cooperative efforts between GSA-NCR fire safety engineers, architectural conservators, and product manufacturers to adapt cutting edge technologies to preserve historic materials and recreate historic detailing while protecting egress schemes. Strategies for promoting the retention of unrated ornamental materials within egress paths will also be discussed.

Highlights include:

- True panel 90-minute door alternatives
- Rated glass retrofit for historic doors
- Adapting accordion fire separation doors for ornamental ceilings
- Assessing archaic material fire resistance
- Sequencing fire alarm installation to eliminate redundant system requirements and minimize penetration of ornamental materials

Seismic Upgrades and Their Impact on Historic Resources

Peter R. Meijer, Associate
SERA Architects, PC
Portland, Oregon

Part 1: Introduction

New increases in seismic zones on a national level have resulted in the advent of adopted building codes specifically drafted to increase public safety in a seismic event. No longer is the State of California the only state to regulate the building industry regarding seismic activity.

These changes have had a pronounced effect on historic structures. At minimum, the new codes have accelerated the evaluation of older structures and raised the public scrutiny of these structures in regard to fire and life safety.

Early and proactive response to these regulations will set the standard for rehabilitation of our nation's historic structures. Without proactive participation, it will be all too easy for our historic structures to be declared "hazardous," not meet new engineering requirements, become financial risks, and ultimately be demolished.

Part 2: Risk Analysis

The levels of seismic resistance fall into four categories, listed in decreasing mitigation impact: 1) hazard reduction, 2) substantial life safety, 3) full 1994 UBC code compliance, and 4) full Seismic Zone 3 compliance.

Following the decision on a seismic upgrade design target, additional evaluation criteria further delineate the amount of physical impact on an existing structure. The determination of a risk factor is the most critical aspect. There is no rule, no guideline, and no correct answer to this question. The risk factor is a negotiated consensus opinion that ultimately must be defensible to the public.

Two of the many criteria used to establish a risk factor are: 1) density/time (the number of people in a given floor, structure, or complex divided by the square foot size of the structure), and 2) collapse mechanisms/time (the length of time that the structural system, e.g., bearing walls, columns and piers, floor, roof and wall ties, framing systems, etc., will support the structure without collapsing during a seismic event).

Part 3: Material Strength Analysis

Current building codes do not recognize the strength characteristics of a built system. Therefore, design engineers are reluctant to provide strength analysis based on characteristics of the system and rely instead on the strength analysis of the individual construction unit (i.e., engineers recognize the strength characteristics, or lack thereof, of clay tile, but do not have data for clay tile walls or clay tile floors). The largest block of missing empirical data is in the strength of a historic structure as built.

Work has begun on the adoption of a new FEMA standard, ATC 33, which considers the building as a unit. ATC 33 is an intensive calculation analysis that hypothetically applies a load to a structure until one of the components breaks. It then continues to apply a load until another component breaks. This process is repeated until full building failure occurs. What is encouraging about ATC 33 is that it is a method which evaluates the strength of a building as a whole system.

Part 4: Preservationist's Role

It is imperative that preservationists advocate a revision in the process of analysis of historic material strength. Practitioners understand that historic structures have sustained loading (i.e., wind loads, dead loads, live loads) for hundreds of years without ill effect. There must be encouragement by building codes to accept the use of FEMA document ATC 33 for analyzing the building as an entire component.

The historic building advocate is able to bring players together, locate resources, plan the analysis, push for the defining criteria (seismic solution), evaluate existing conditions, and recommend approaches for maximum preservation with minimum impact, and take a proactive role in task force evaluations at the national, state and local levels.

Part 5: Financial Incentives

SB 588 provides for the reenactment of the property tax abatement for historic buildings and specifically allows a second 10-year abatement for commercial buildings which undergo seismic retrofit.

SB 1057 provides some limited liability for a building owner who completes a seismic analysis and agrees to a phased improvement of the building.

FIRE PROTECTION AND PRESERVATION

One Approach to Creating a Performance Code for Historic Buildings: The Historic Fire Risk Index

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Preservation Architecture
Ithaca, New York

John M. Watts, Jr., Ph. D.
Fire Safety Institute
Middlebury, Vermont

Most building and fire codes are prescriptive documents that dictate how a building should be constructed or rehabilitated. When applied to historic buildings, prescriptive codes often mandate impractical solutions or those that require unacceptable alterations.

Given their limitations, a global shift away from prescriptive codes and toward performance based codes is underway. Performance based codes have been adopted in building codes in Australia, New Zealand, and Sweden, and many national and international conferences and professional publications on the subject have occurred recently.

One performance-based approach that has gained acceptance uses multi-attribute assessment tools, also known as risk index systems, to analyze and score hazards and other risk parameters. Numerical values are assigned to select safety components, e.g., building height and area, suppression systems, etc., and these values are arithmetically manipulated to create a single mathematical expression for the level of safety provided by the building. Risk index systems have been widely used in model codes and standards since the 1970s.

The first widely recognized risk index system, developed in the 1970s for health care occupancies, was the Fire Safety Evaluation System (FSES), included as an appendix to NFPA 101 *Code for Safety to Life in Buildings and Structures*. Within 15 years, the FSES had been adapted for different occupancies by the NFPA, and had served as a model for risk index systems for high-rise structures in New York City and for existing buildings in the BOCA code. In 1995, the State of Wisconsin adopted a risk index system for historic buildings.

The Historic Fire Risk Index, to be presented herein, is the first index system to specifically address the historic house museum. It is unique in adding to traditional indexes a focus on property protection and in providing credit for the fire prevention measures inherent to the well managed historic site. This presentation will review the genesis of performance codes, discuss their significance to historic properties, and present the HFRI and its future.

*After the Fire: Fire Protection and Restoration Strategies
at the Thomas Kearns Mansion*

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In 1902, mining magnate Thomas Kearns constructed a three story mansion in Salt Lake City that would initially serve as his home. With an exterior constructed of local sandstone and an interior finished in ornamental plaster, decorative wood paneling, and carved wood ornamentation which complemented silk and marble wall coverings, the mansion subsequently served as a state office building and, eventually, the official residence for the governor in the latter portion of the twentieth century. On December 15, 1993, disaster struck in the form of a major fire that destroyed much of the public space on the first floor as well as private spaces on the upper floors. In addition to what was physically destroyed by the fire, most of the mansion suffered considerable smoke damage.

The fire, attributed to an overloaded extension cord serving multiple strings of Christmas lights on a live evergreen tree, developed quickly and nearly trapped the governor's family and several state workers in the building. After the building was evacuated and the local fire department was notified, a chain of events was put into motion which are to be described in this paper. First, this paper describes the techniques employed by the fire department to mitigate further damage to the historic fabric of the building while the fire was being extinguished as well as during the period immediately thereafter. Next, the paper describes the decision process which led to the multimillion dollar restoration of the mansion. Finally, this paper concludes with an overview of the restoration of the mansion which includes refurbishing all affected interior surfaces, integration of fire suppression and alarm systems, and remodeling circulation spaces to enhance the privacy of the Governor's family. The mansion was reopened in time for the Utah State Centennial celebration in July, 1996.

*Response to an Owner's Worst Nightmare:
A Fire at the Historic Exeter Street Theater*

Kevin B. Cash, P.E.
Simpson Gumpertz & Heger, Inc.
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On August 30, 1995, Boston woke to the news that an overnight fire had damaged the historic Exeter Street Theater Building. Located in the historic Back Bay, the building has long been regarded as one of Boston's premier properties. Designed by Hartwell and Richardson Architects and completed in 1886, the granite and sandstone-clad building emulates, in style and materials, other Richardson buildings of the era, including the nearby Trinity Church. The building was designed as a free society meeting hall, and later was converted into the first movie house in the United States. It currently houses retail and office space.

Damage from the fire and the subsequent battle to contain the blaze was substantial. Over half the roof was destroyed, and the interior experienced extensive water damage. The building required immediate stabilization and subsequent restoration, all within the physical and political confines of Boston's premier shopping district during the worst winter on record. This presentation will discuss the response to the disaster, the damage to the building, and the remedial work performed to return the building to its former prominence.

PRESERVATION STANDARDS

The Deployment of Preservation Standards

Lauren B. Sickels-Taves, Ph.D.
Biohistory International
Natchitoches, Louisiana

A major challenge confronting historic preservationists is the use of standards designed for modern materials in the restoration or rehabilitation of historic structures made with vernacular or non-modern materials. The critical issue is the appropriateness of the "modern" standard for the "historic" material. In many cases, these standards are simply not applicable.

The time has come for the development of ASTM-quality preservation standards. The need for them has been heard from architects, conservators, and engineers to name a few, and the range has extended from report guidelines to analytical field testing. This paper examines the burgeoning desire among preservationists for standards formulated for their specific venues and is prepared as the introductory presentation to the ASTM-sponsored session on preservation standards. Using problematic case studies, the issues behind developing standards for material analysis, application techniques, and material performance will be explored. Justification and the philosophy behind the development of preservation standards will also be included.

One major case study to be investigated is mortars: testing modifications have been necessary on separate mortar projects in Canada, Italy, Scotland, and the United States. Not only does this suggest the need for standards, but the need for international interaction as well. To successfully create these documents for preservationists, feedback through individuals in the fields and multi-organizational interaction is vital.

Application of Preservation Standards in Archaeology

Michael S. Sheehan, Ph.D.
Biohistory International
Natchitoches, Louisiana

Two critical issues exist with regard to the application of preservation standards in archaeology: do appropriate "standards" exist for any given situation; and, who is applying them. Archaeologists are often confronted with the challenge of stabilizing buried architectural features, evaluating standing architecture as part of a cultural resource assessment, or preserving other fragile masonry or organic materials. Unfortunately, learning appropriate strategies for dealing with these diverse problems is not a routine component of undergraduate or graduate training. Consequently, archaeologists must frequently rely on "accepted" practice versus "standard" practice. This can result in serious "quality-control" problems.

This paper will focus on the outcome of a number of studies where appropriate standards, training, or both were lacking. The strengths and weaknesses of each will be assessed.

The best way of rectifying the problems outlined in this paper is to foster interdisciplinary fieldwork and research. Archaeology and historic preservation are complimentary disciplines. Cooperative/collaborative ventures will strengthen efforts to establish standards whose application will become axiomatic.

Chicago Public Schools: Identifying Historic Schools and Creating Restoration Standards

Bill Latoza and Edward Torrez
Bauer Latoza Studio
Chicago, Illinois

Bauer Latoza Studio is working with the Chicago Public Schools for the 5 Year Capital Improvements Plan as Managing Architect and Architect of Record. This ambitious reconstruction of the existing 535 public schools is valued at a construction value of over \$650,000,000 over the next five years. The Bauer Latoza Studio is in charge of surveying and identifying the historically significant schools and developing the restoration standards for these schools. As of this date, 47 schools have been identified as historically significant. The schools date from 1874 to 1974, and were designed by such notable architects as William LeBaron Jenney, Dwight Perkins, and Arthur Hussander.

Our paper and lecture will discuss the following:

- Defining a methodology for the identification of historic schools
- Creating a survey form and data base for the historic schools, including:
 - architecturally significant schools
 - dates and architects of the schools
 - building materials of the schools
 - available historic drawings and specifications of the schools
- Identifying architecturally significant features
- Setting cost effective standards for their restoration
- Creating a methodology and timetable for a performance review of the products and materials used at one, three, five, ten, and fifteen years.

Field Grading of Structural Lumber and Timber

David C. Fischetti, P.E.
DCF Engineering, Inc.
Cary, North Carolina

Grading rules agencies are non-profit service organizations that supervise grading and manufacturing practices at subscriber plants for the protection of buyer, seller, and consumer of lumber products. Until the recent past, timber structures were not built with lumber graded in a formal manner. There is a great need to develop Preservation Standards that utilize grading principles for the evaluation of timber materials under field conditions to aid the structural engineer in assessing the condition and capacity of historic structures.

The intent of field grading rules would be to describe as accurately as possible the strength and stiffness of timber elements in an existing structure by evaluating major natural growth characteristics as to location, type, size, or number. Whereas grading rules limit characteristics which affect strength and stiffness in order to divide lumber into groups, thus establishing its suitability for a particular end-use, field grading would focus on material already in use for structural purposes.

Grades emphasized in this standard would be structural light framing, structural joists and planks, beams and stringers, and posts and timbers. Characteristics evaluated would include checks, knots, shakes, slope of grain, splits, wane, and rate of growth. Also included in the evaluation would be moisture content, hardness, density and species identification. Since the properties of timber in historic buildings will vary widely, the field grading process must accept wide variations. For field grading to be successful, it must be simple to apply and flexible in scope. Field grading must recognize the considerable strength of some slow growth timbers.

This paper will focus on non-destructive methods used for the evaluation of timber members applying a methodology which combines the spirit of the grading rules with a preservation philosophy of conservation. The development of Preservation Standards for the field grading of structural lumber and timber will require the efforts of preservationists working closely with members of the forest products industry and the structural engineering profession.

MANAGING AND USING COMPUTERS FOR DOCUMENTATION

The Electronic Documentation of Large Scale Buildings with Small Scale Budgets

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Large buildings make good subjects for illuminating the problems encountered in documenting historical structures because their scale puts extra pressure on time, accuracy, and financial resources in both the field measuring and drawing production phases of a project. Scale alone, especially in height, provides opportunities to investigate non-invasive documentation methods simply because many parts of a building may be physically unreachable. When one adds detail complexity with scale, all facets of documentation become stressed, thus providing an excellent arena in which to investigate more efficient and less invasive documentation strategies. This paper will present two large-scale projects in order to illuminate the documentation strategies developed to overcome the problems of scale and complexity on shoestring budgets. Both projects are thirteenth century religious buildings in southern France. The first project, completed in 1992, is the Cathedral of St. Just in Narbonne, France. It was from this project that much of the experience and methodology was developed to apply to the second project, the Cistercian Abbey of Valmagne near Montpellier, France.

The project to document the Cathedral St. Just was begun in 1984 with practically no budgeted funds and a small team. It quickly became evident that the scale of the building (60m x 60m x 50m) would pose great difficulty in attempts to generate accurate drawings by hand. In 1986, the decision was made to move all documentation to the computer and this decision impacted all subsequent development of strategies for solving both measuring and drawings problems. Strategies became more refined with increasing development in hardware and software so that by the end of the project in 1992, we felt we understood how to document any large structure with very little money.

Armed with years of experience, we set out to try these strategies on a new project, the Abbey of Valmagne. This project began in the summer of 1996 and is currently still underway. The strategies developed earlier in Narbonne are still quite effective, but new hardware and software have broadened the spectrum of possible solutions to earlier difficulties of scale. This project will illuminate the pros and cons of some of these options and our recent attempts to develop new methodologies in the 1990s.

*More with Less:
Managing Digital Project Information on a Laptop*

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Construction documentation for on-going rehabilitation work at Independence Hall, Congress Hall, Old City Hall, and the East and West Wings at Independence National Historical Park consists of 780 sheets of drawings and more than 1,000 pages of specifications. The work conforms to the Secretary of the Interior's *Standards for Rehabilitation* and involves removal and replacement of all existing mechanical, electrical, plumbing, communications, and security systems. The documentation was prepared within a 90 day period, the submittal list exceeds 2,600 items, and reviews must be completed in no more than five working days.

Maintaining the integrity of the buildings while assuring the progress of the project requires some unusual approaches to the design and construction process. As per the direction of the Owner (the National Park Service), all construction documentation, including drawings and written material, was prepared and distributed in electronic format as well as conventional hard copy. This approach was seen as the most feasible way to accommodate rapid dissemination of information among Architect, Owner, and Contractor and allow speedy responses and revisions, when required.

While the process does ensure rapid communication and response, management of three discrete sets of paperless data soon became a major aspect of the project. Beyond tracking overall progress, the problem was uniquely resolved for each, with the Architect concentrating on responses to information requests and submittal reviews, the Owner maintaining a dual emphasis on documentation and contract changes, and the Contractor mirroring the Architect's and Owner's concerns as well as subcontractor related issues. Additionally, storage of the electronic data varied by participant with the Architect relying on a central network with dial-up connections, the Owner using a local peer-to-peer network, and the Contractor using discrete local computers with data sent to a central office for backup.

*Three Dimensional Computer Modeling of Erosion to Historic Adobe Wall Ruins
at Fort Davis National Historic Site*

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Fort Davis in West Texas became a crucial military outpost in helping to protect America's westward expansion during the second half of the nineteenth century. Many of the buildings at Fort Davis are in a ruined condition and require constant preservation. The adobe wall ruins, in particular, suffer from erosion caused by the effects of wind and rain and past preservation treatments.

The National Park Service has the responsibility of preserving the adobe wall ruins at Fort Davis National Historic Site for the enjoyment of future generations. Monitoring of the condition of the walls has traditionally been based on subjective evaluations made by maintenance staff. By accurately measuring the walls using simple and economical measuring techniques, a large amount of quantitative data is obtained that reveals important information about the condition of the wall.

The site measurements of the wall are used to create three dimensional computer models using AutoCad. These models are used both as an historic record and for identifying areas where severe erosion has occurred and where preservation is required. Site measurements taken approximately four years after the original measurements reveal how much erosion has occurred during this period.

RECORDS OF THE PAST

Using Simple Databases to Compile Building Histories and Record As-Found Conditions in the Field

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Databases do not need to be expensive and difficult to use in order to provide gains in quality and productivity during research and field surveys. On the one hand, Historic Resources Group has designed large, complex databases which track hundreds of U.S. Section 106 compliance projects, have a variety of data fields, and can generate state and federal inventory forms. On the other hand, we have designed two databases which are small and easy to adapt to specific project requirements. Most PC and Mac platform users can use database programs with easy interfaces to write simple databases. Learning the software requires little investment of time, and the hardware requirements are minimal. The greatest productivity is gained by typing in information directly from a source to a notebook computer in the field.

The first format is a "Construction History" database into which information about a building and its elements can be recorded. The element is categorized, text description is typed, a date is assigned, and sources are recorded. The method provides an efficient way to record information directly from a research source. Reports weave together information and observations from disparate sources which are related by time and aspect. The reports may provide the basis for a narrative history or elements of a historic structure report.

The second format is an "As-Found Conditions" database which can be used to inventory, describe and record the physical condition of building elements. The nature and scale of the undertaking will determine the categories of elements. Recording rough dimensions during the field survey provides a basis for producing rehabilitation cost budgets.

These tools have been used for small projects, such as a rehabilitation study for a group of seven bungalows, large structures such as the Rose Bowl, and district surveys in Hollywood and the Hughes Aircraft Industrial Historic District at Playa Vista.

Documenting of Historic Buildings and Sites as a Permanent Process in the Field

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Today much time and energy is devoted to elaboration and making available information (management) which is useful and necessary for preservation of historic buildings and sites. The secondary sources (archives, publications, etc.) are exploited, the information gained in this way is digitalized, etc. However, the biggest responsibility, priority, and task of actual conservationists in the sphere of acquiring, and also managing, information is an activity in the field, with stress on historical art, historical architecture, historical structures, and to some extent, social, cultural, architectural, and urban knowledge. Just gaining knowledge from its primary sources, physical historic buildings and sites in the field, is insufficient. In addition, the way of single term or single way actions (a building or site is in one term recorded and analyzed, once and for always) is used. At the same time, the method of permanent monitoring, which corresponds with an essence of historic preservation and general protection of cultural heritage, is neglected. By permanent monitoring, I mean the capture of a partial knowledge and findings in the concrete building as they appear in the process of its growing older and interferences with it. It is a method of documenting which is linked to, or rather actualizes, the single term documenting.

In my presentation I would like to explain:

- Why I consider the permanent monitoring in the field as a principal in the documentation of historic buildings and sites.
- Who should ensure this work? What should be his necessary knowledge, experience, training, etc.
- Which methods can be applied in such a flexible field documentation.
- What form, written, graphical, photographic, etc., should resulting materials have.
- How could the process of the activity mentioned above be systematically organized, within governmental or non-governmental historic preservation, and its financing.

My approach to the documentation of historic buildings and sites and the process of obtaining permanent, undemanding, flexible and thoroughly substantial records is, in my opinion, a typical example of how less can bring more in the sphere of documenting.

I will present my study and analysis of the situation of documenting historic buildings and sites in the Czech Republic and Europe, especially the system of historic structure analyses and the analogy of historic structure reports, and I will present the results of my grant research work, Research Support Scheme 1996-97, "The Recording and Documentation of Historic Buildings and Sites in the Czech Republic and Europe - Analysis and Comparison." At the same time, I would like to impart some possible inspiration and application to the North American system of historic preservation with which I had the chance to become familiar during my study visit to the Ohio Historical Society; HABS/HAER, in Washington, D.C.; Parks Canada in Ottawa; and some other institutions, during November and December, 1996.

Louisiana Landmarks On Line

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In a research project designed to demonstrate how the Internet and the Web can facilitate distribution of information about Louisiana properties on the National Register of Historic Places, the LSU Office of Community Preservation (OCP) is developing a World Wide Web site called Louisiana Landmarks (<http://landmarks.lsu.edu>). The project is based on the premise that effective preservation strategies depend on the efficient flow of information, and that rapid access to relevant historical data establishes a sound foundation for informed management of our legacy of National Register properties.

For more than three decades, the Louisiana National Register Program has invested considerable time and money in accumulating a wealth of information about the state's historic buildings, structures, and sites. Unfortunately, a National Register designation, while an honor of academic significance to architectural historians, has not proven to be as useful in promoting social and economic development through heritage education or tourism. This is, in large part, because the files containing National Register data are invariably difficult to access and are often even more difficult to decipher.

The Louisiana Landmarks Web site, which has an intuitive user interface that is designed to be simple to operate, can be accessed using a Netscape 2.0 or Microsoft Internet Explorer 3.0 (or later) browser. By integrating the structure of an Internet-based hypertext system with that of a traditional database, the researchers were able to produce a user-friendly system that takes advantage of the attributes of each. The resulting design for Louisiana Landmarks employs a variety of data retrieval strategies to accommodate users with different levels of knowledge about Louisiana cultural heritage and with modest computer skills.

By making National Register data accessible through the Internet, the OCP is helping to promote practical applications for the under-utilized wealth of historical data that has been collected by the National Register Program. In addition, the Web-accessible National Register data of Louisiana Landmarks offers the potential to enhance tourism development efforts, heritage education programs, and cultural resource management practices in Louisiana communities.

MONITORING: TAKING A CLOSER LOOK

Electronic Monitoring of Historic Structures: Acquisition, Analysis and Archive

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Just as there is no single “perfect” building, so there is no single “perfect” monitoring system. This paper documents the process of specifying a monitoring system for a particular group of historic structures (four buildings at the Independence Hall site at the Independence National Historic Park, Philadelphia, Pennsylvania). The authors were confronted with an initial “wish list” of 304 sensors and four computers recording wind speed, wind direction, barometric pressure, structural movement, visible and ultra-violet light, soil moisture content, wall moisture content, wall infrared reflectivity, relative humidity, dew point, air temperature, surface temperature and occupancy. After a series of discussions and building walk-throughs with the prospective users of the data, National Park Service and City of Philadelphia, the authors whittled this list down to 110 sensors and one computer recording relative humidity, air temperature, surface temperature, window condensation, wood moisture content, and rainfall—the variables from which the condition of the buildings' response to exterior weather conditions and interior climate control could most clearly be deduced. Along the way, sensors for water level in guttering and interior/exterior pressure differential were proposed and ultimately rejected. The sensors for water level were rejected because of the difficulties of “false positives” from ice formation during the winter and the need to make penetrations in the eaves for cabling. The pressure differential sensors were rejected because of the complicating factor of exterior wind pressure and the difficulty of interpreting the results. The design process for the Independence Hall system serves as an object lesson in the difficulty of distinguishing between what it would be nice to measure in theory, and what can be meaningfully measured in practice.

In this paper, we outline the decisions that were taken during design in order to produce a satisfactory system, and the lessons from this process that are applicable to designing monitoring systems for historic structures in general. The following topics are considered:

- Defining the objective. We would draw a distinction between *investigative* monitoring (high sensor density, portable units, high data volume, short-term objective) to discover the source of a particular problem and generate appropriate solutions, and *confirmatory* monitoring (low sensor density, low data volume, permanently installed units, long-term objective) aimed at detecting whether the interior climate and building envelope are performing within acceptable norms. Confirmatory monitoring may detect a general problem (relative humidity too high, or condensation on windows), but additional investigative monitoring will usually be required to assign causes and generate appropriate solutions. Confirmatory monitoring is not a substitute for a regular program of careful visual inspection.

- Sensors and logging: what you can meaningfully measure and how accurately; specificity of sensors in time and space; appropriate sensor densities and logging intervals to minimize redundant data; the implications of excessive “data burden” on system maintenance, data analysis and data archive.
- Telemetry options: collecting data from sensors in a historic building; the pros and cons of stand-alone data logging, hardwiring, networking, and radio telemetry.
- Data into information: graphs as a building management tool; the problems of alarm modalities.

Getting the Most Out of Monitoring Data (Process Planning and Computer Use)

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Gathering data related to environmental conditions, movement, visitation, and many other factors in historic structures and museums is occurring with increasing frequency. As the advances in technology help provide new instruments for measuring conditions and storage devices that can save the ever increasing amounts of information, it becomes even more important for monitoring programs to be well thought out and managed.

The starting point of any monitoring program should be to outline why the monitoring program is necessary and how the information might be used. The assumption is that there is a real or perceived problem that needs to be addressed. Looking at the variables that may affect the problem, one needs to prioritize them, first by what is perceived to be the order of importance and influence, and second by the ability to gather data and the ease by which it is gathered. This prioritizing is the beginning of the planning process. Other areas that need to be considered include how readings will be made; frequency of readings; format of readings; how often is the data reviewed; what is the process for analysis of data that is accumulated; what is the process to be used as an alarm system to warn of unfavorable conditions; if used as a warning system, how frequently does system need to be queried; who will manage the collecting of the data; who will manage the analysis of the data; what method of reviewing data will be employed; what are the ranges that are considered acceptable; what are the deviations that are and are not acceptable; what are the actions that need to be taken when undesirable deviation levels are detected, etc.

These topics, along with case study examples, will be presented. Case studies will include viewing actual data that will be run through a diagnostic computer system and how the data was used in a beneficial way.

The Omnicam in Preservation: A Single Camera with Many Views

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This presentation demonstrates the use of a new computerized video camera, called an Omnicam, for documentation, monitoring, management, and interpretation of cultural heritage sites. The Omnicam sees in all directions using a single video lens projected into a parabolic mirror. A computer link transmits the image over the Internet in real-time to a computer or World Wide Web page. Because the camera uses a fixed lens there are no movable parts, which allows multiple users to view the same scene, or different parts of the scene, at the same time over the Web. Data also can be recorded on a computer and saved either on the computer or downloaded to a video tape. The Omnicam can show simultaneous views of an entire room or area in both hemispheric and linear perspective. The design of the Omnicam mimics a single viewpoint camera by using computer software to generate distortion free linear images.

Omnicam has many uses for preservation related work. Used in documentation and condition assessments, it can provide the conservator simultaneous access to all points of vision, something not accomplished with a standard camera and singular view point. Several conservators, in different parts of the world, can review a site together by moving a mouse around the field of view and stopping at questionable areas, or zooming in on interesting features. In the conservation of cultural tourism sites, the Omnicam can be used at locations that have little or no public access, providing a non-invasive means of visitor access. The Media Center for Art History with the World Monuments Fund are just beginning to explore the uses of the Omnicam that have been outlined here. Above all, this camera will provide the preservation community with a new technique for documentation and presentation.

INDOOR ENVIRONMENTS IN HISTORIC BUILDINGS

The Historic House Museum: Implications of Changes in Function for Changes in Climatic Comfort and Energy Consumption

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Historic house-museums are one of the common forms of preservation and represent a basic foundation of the preservation movement in the United States. According to the National Historic Trust, a house-museum is a museum whose structure itself is of historical significance and its interpretation relates primarily to the building's architecture, furnishings and history. A house-museum is a classic case of adaptive-use preservation projects since the building is being put to a different use than its original function. The adaptive use of an historic house as a museum can take different forms. It can preserve and exhibit the historic house as a museum in itself, and it can use the house to create an appropriate and authentic setting to display furniture and artifacts related to the building's and community's history. The changes in function of the house, the difference in the number of people using the building, the building's occupancy profile, and changes in its content, e.g., artifact collections, provoke the question of climate control and energy performance.

The objectives of this study are (a) to analyze the implications of the adaptive-use of a house-museum for climatic comfort and energy consumption; and (b) to identify energy strategies to accommodate the required micro-climate while maintaining the project preservation interpretation.

The study utilizes a rigorous methodology of computerized energy simulations to assess changes in comfort level and energy performance of a house that was transformed to a museum. Specifically, the study examines the Polasek House in Caldwell, Texas. This house was constructed in the late nineteenth century by one of the prominent Czech families in Texas, and is in the process of being turned into the Burleson County Czech Heritage Museum.

The analysis of the energy simulations focuses on the impact of people and exhibits on climate control in a house-museum. The study relates the functional changes to the new climatic demands both in terms of comfort level and energy conservation strategies. Finally, the study discusses the effect of different climate zones on the required micro-climate of a house-museum.

Fitting a New Environment Into an Old Building

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Proper archival storage conditions for book, art, and similar collections are difficult to achieve in historic structures. There are countless examples of ill-conceived retrofits that succeeded in preserving collections but caused severe deterioration to the buildings. These problems can be avoided through analysis of the various envelope systems and careful coordination between mechanical and envelope designers throughout design and construction.

This presentation will illustrate the retrofit of a university library that was originally constructed in the late 1920s. The exterior of the building is clad with thick masonry barrier walls and leaded glazing in bronze window frames. The owner established a main priority of maintaining an interior relative humidity of 40 percent, ± 5 percent, as well as requirements for preserving the building and maintaining a comfortable environment for the occupants. These design parameters created many challenges, including the paradox of preventing outward migration of moisture during the winter and inward migration during the summer. In addition, the new environment substantially changed the drying characteristics of the masonry barrier wall which, by definition, tends to retain a considerable amount of moisture during the rainy season.

The presentation will address the analysis of the effect of insulation and applying vapor barriers to the inboard sides of the walls, evaluate the effect of replacing the leaded glass, bronze-framed windows with other window types, and study options for minimizing the negative effects of the proposed interior environment on the performance of the wall and window systems.

What Price Climate Control?

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The need for climate control for preservation purposes is well recognized by preservation professionals. Climate control also has a reputation of sometimes being unaffordable. This session will demonstrate how to achieve a balance between the cost of climate control and the needs of preservation environments in historic buildings. Simple rules of improving project cost control will be presented and illustrated by examples of real case situations. The illustrations will include a multimillion dollar project, a medium sized project and a low cost project.

TRACK C: THE MATERIAL WORLD

CLEANING UP THE CITY

Deposition, Soiling, and Surface Rain Washing at the Cathedral of Learning

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The Cathedral of Learning is a 42 story limestone building on the University of Pittsburgh campus in Pittsburgh, Pennsylvania. Since its completion in 1938, the building has been subjected to soiling and deterioration by atmospheric pollutants. We have recently examined the possibility that soiling and deterioration patterns may be a result of variations in pollutant airborne concentrations and deposition rates at different locations on the building.

Experiments were conducted during four time periods over the course of one year, each lasting for four weeks. During each period, airborne concentrations of SO² gas, SO⁴² particles, carbon particles, and total NO³ (HNO³ gas and NO³ particles) were measured on the fifth, sixteenth, and forty-second floors. Simultaneously, flat deposition surfaces were used to measure SO² deposition rates at a total of nine locations on the fifth and sixteenth floors. The deposition surfaces were exposed for two-week intervals whereas airborne concentrations were measured in one-week intervals. Laser Particle Counters (LPC) were used to continuously measure airborne particle concentrations in two size ranges, >0.5 micrometer and >5 micrometer.

Airborne concentrations of the chemical species and >0.5 micrometer particles were found to be invariant

with height. Concentrations of >5 micrometer particles were, on average, 30 percent higher on the 16th floor than on the fifth floor. Particle concentrations in both size ranges were higher on weekdays than on weekends. Unlike the chemical species airborne concentrations, SO_2 deposition rates were spatially variable. Slightly higher deposition rates were measured on the sixteenth floor than on the fifth floor. On both the fifth and sixteenth floors, the highest deposition rates for each floor were found at the corners of the sampling patios. Among all nine sampling locations, these were also the areas that were the least soiled. The results suggest that deposition of SO_2 and surface soiling are not necessarily correlated.

Archival photographs of the Cathedral dating back to the late 1930s reveal that as air pollution in Pittsburgh has decreased, surface soiling patterns have receded. This observation, combined with the above experimental findings, suggests that in relation to damage to limestone buildings, SO_2 deposition, surface soiling, and surface rain washing must be considered as competing processes.

Investigation of Microabrasive Techniques Cleaning of Three Varieties of Sandstone

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The consequences of cleaning masonry using microabrasive techniques has not been well documented in the literature. Current restoration activities of the Parliament Buildings in Ottawa, Canada, has provided an opportunity to investigate the effect of cleaning three different sandstones using three different abrasion techniques.

The Nepean sandstone is an orthoquartzite composed of detrital quartz with a quartz cement. The porosity is low, nine percent, and is restricted of pores less than 10µm. The dirt on the surface is unevenly distributed and composed of carbon black and grit. The Ohio sandstone is composed of detrital quartz with patchy cement of quartz, clay and calcite. The weathering surface is crusted over with a gypsum surface. The porosity is high, 21 percent, with pores greater than 100µm. The Wallace sandstone is composed of detrital quartz and feldspar which is altered to clay. The cement is dominantly muscovite and clays with minor quartz. The porosity is moderate, 13 percent, with pores in the 0.1 to 10.0µm range. The surface dirt is honey-combed textured clumps in low relief areas of the stone surface.

The three cleaning techniques, to be referred to as A, B and C, each use there different abrasive products. Technique A uses dolomite and air as a propellant. Technique B uses olivine, and Technique C uses a glass slag. Both techniques B and C use air only as the propellant. The test samples were stone samples which had been removed from different buildings. All testing was conducted by each company's representative. The surfaces were divided into three zones: not cleaned, 50 percent cleaned, and 100 percent cleaned. The degree of cleaning was determined by the operator. The test surfaces were examined for degree of dirt removal, change in surface texture, and change in chemistry, using an electron microscope. In addition, the water absorption levels were determined.

Results indicated different responses to the different cleanings. The Nepean Sandstone was the most difficult to visually clean, but was least affected by the cleaning in terms of increased water absorption. The Ohio sandstone gypsum crust was easily removed by A and B, but this resulted in increased water absorption by the stone. The Wallace sandstone coarse pore structure tended to be either opened or clogged by A and B, respectively, and not significantly changed by C.

	Technique A (water propellant)	Technique B	Technique C
Nepean sandstone	- surface 50% visually clean - surface patina remains	- stone 100% visually clean - grit remains on surface	- surface 20% visually clean - surface patina remains
Ohio Sandstone	- stone 80% visually clean - removal of surface crust - increased water absorption	- stone 100% visually clean - removal of surface crust - increased water absorption	- surface 30% visually clean - thinning of surface crust - low increase of water absorption
Wallace Sandstone	- surface 80% visually clean - increased rate of absorption	- surface 100% visually clean - decreased water absorption - grit clogs pores	- surface 50% visually clean - no significant increase in water absorption

Recommendations were made for each stone. Technique A was considered appropriate for general cleaning applications for all the stone types, with the exception of cold weather cleaning. Technique B was appropriate for plain or rough faced Nepean sandstone, but would not be considered appropriate for either the Wallace or Ohio sandstones. Technique C is recommended to be used for highly damaged sandstone and carvings.

Cleaning Up City Hall: Lessons from a Monumental Task

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Philadelphia's City Hall is among the world's largest load-bearing masonry structures. Designed by John McArthur, Jr., and Thomas U. Walter, it took 30 years to construct and was out-of-fashion on completion. The building had also become extremely dirty due to pollution, which hastened the public's dislike of the building up to the 1980s. A Comprehensive Master Plan to restore City Hall was developed between 1992 and 1995. Concurrently, City Hall's East Center Pavilion was cleaned, which dramatically restored the facade's drab gray marble to a vivid white appearance.

The marble cleaning project is highly unique. Typically, professional journals report on single, isolated techniques. To insure masonry preservation, this study recorded and analyzed a broad range of cleaning methods giving insight on those techniques for careful and informed decision-making. The award-winning study linked controlled field tests for eight cleaning systems with a scientific study of those tests. Although the study was stone specific, it can serve as a model for other marble buildings, especially Berkshire Marble, in a temperate urban environment.

The design team identified four types of soiling conditions. The goal was to develop a masonry cleaning process that would remove the crusty pollution without harming the stone. The study desired to leave a stable surface that would best resist predictable weathering and soiling in the future since 'no cleaning' was an option the City desired. Looking for options involving low volumes of water led to a comprehensive study and evaluation in 1995 of methods currently in use or development in North America and Europe.

This presentation will describe the process used to compare traditional and proprietary masonry cleaning systems currently on the market. The strengths and drawbacks of eight methods will be discussed. Participants will gain insight into a highly focused selection process to identify the safest method to clean marble. With this data, practitioners will have a basis with which to evaluate these methods for other sites of similar material.

MASONRY: MAKING THE PIECES WHOLE

Repairing a Failed Restoration:

The Terra Cotta Walrus Heads at the Arctic Building, Seattle, Washington

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The Arctic Building was designed by architect A. Warren Gould and constructed in 1917. The terra cotta is an early use of multiple light colors in matte glaze. The ornamental terra cotta includes classical fluted columns and large cornices, with unique northwest motifs such as walrus heads. The Arctic Building is listed on the National Register.

There are 12 terra cotta walrus heads at the third floor level on the south elevation, 13 terra cotta walrus heads on the west elevation, and two heads on the east elevation. In December 1995, one tusk from one walrus head fell to a roof below. A survey of the other walruses revealed severe fracturing and deterioration in about one-third of the ornamental heads. Research into the background of the building discovered that the building was renovated in the early 1980s. Part of that renovation was the installation of replacement tusks into the existing, original terra cotta heads. However, the method of grouting and type of grouting material used to install the tusks into the heads ended up causing cracking in the heads within two years of installation. Repairs done at that time did not recognize the source of the cracking despite, as discovered, some severe fractures of a few of the heads. The repairs were incorrect, used inappropriate materials such as fiberglass putty, and failed to remedy the problem. Within about 13 years the cracking had advanced to the point where fracturing and failure of the terra cotta occurred in 13 of the heads. The damage was so extensive that the heads could not be salvaged and repaired, and had to be replaced.

In 1996, restoration documents for the terra cotta walrus heads were developed. Included was the replacement of the severely damaged heads with new terra cotta units. The remainder of the heads were to be pinned and repaired in place. As the restoration work progressed, previous repair work was uncovered and in some cases removed and replaced by appropriate methods and materials. Restoration work is scheduled to be complete in September 1997.

This presentation will focus on showing why the 1980s restoration was improper and led to the damage of the heads, why the first repair attempts were ineffective, and how the walrus heads were repaired and replaced in the spring and summer of 1997.

Stabilizing Nevada's Historic Pony Express Stations Using Low Pressure Injection Grouting

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This project consists of the stabilization of historic ruins located in the high desert east of Fallon, Nevada, on Interstate Highway 50, known as the "Loneliest Road in the Country." Three ruins were stabilized for this project: a Pony Express Station, an Overland Stagecoach Station, and a Telegraph station. These Nevada Historic Sites are listed on the National Register of Historic Places and were part of a larger system of stations across the United States that were built in the 1860s as Pony Express Mail Carrier Stations, Overland Stagecoach stations, or as Telegraph stations.

The walls of each structure are constructed of rubble masonry gathered from around the sites. The original masonry mortar for these three structures was local soil mixed with water to form a stiff adobe in which the stones were set. With time and the abandonment of the structures, the original adobe mortar was washed out of the joints, leaving the masonry walls in an unstable and sometimes precarious condition. The sites consist of low walls that define the original spaces. Doorways, windows, and fireplaces remained visible, but the structures were threatened by scavengers, vandals and by the continued loss of adobe mortar. Two of the sites were closed to the public as the unstable walls presented a safety hazard.

There were three goals for the stabilization project: 1) to provide minimal intervention of each site; 2) to remove safety hazards; and 3) to use original materials in the stabilization process. A low pressure injection adobe grouting technique was designed to replace the missing adobe mortar. The technique involves the use of an in-line pump, special hoses and nozzles, and site-specific amended mortar. Under low pressure, the in-line pump injects large quantities of adobe mortar into the wall cavity quickly and easily. This stabilization treatment halts further deterioration of the walls and minimizes safety hazards so that the sites may again be interpreted to the public. This grouting technique is a new approach that may have applicability to other similar archeological and architectural sites. Glenn David Mathews, Preservation Architect, and David P. Wessel, Project Conservator, will explain in detail the condition of the sites prior to commencing work, outline the testing procedures, and finally describe the construction phase of the work. The techniques represent minimal impact upon the historic fabric while achieving strengthening of the walls and thereby significantly reducing the chance of further loss. The client was the Carson City Director of the Bureau of Land Management and the project was funded by the ISTEAFund.

Saint Monica's Church Limestone Facade Restoration

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Saint Monica's Parish was formally established on June, 1887, and has been residing in Saint Monica's Church since 1925. One of the oldest Catholic churches in the area, Saint Monica's Church was designed by Albert C. Martin and Associates. Reportedly, Albert Martin, Sr., patterned his design after the Basilica of Saint Sabina in Rome. Prominently located to the north of Lincoln Park at the corner of Seventh Street and California Avenue, the church serves as distinctive visual landmark for the city of Santa Monica as well as home to over 5,000 parishioners. Throughout its history, the building has survived several earthquakes. In 1972 repairs to the church were made following the San Fernando earthquake. The church was severely damaged during the January 17, 1994, Northridge earthquake. The damage to the limestone facade was particularly severe.

The structure consists of a reinforced concrete frame, with brick masonry infill walls along the nave, aisles, and bell tower. The apse and east-west entry walls were unreinforced masonry. Unreinforced masonry extended approximately three feet above the concrete frame along the east and west facades. The north and south ends of the gable were also unreinforced masonry extending above the concrete frame.

The ashlar cladding consisted of four inch thick variegated Indiana limestone. The limestone was coursed in a random ashlar pattern. Larger limestone units were used for window surrounds, sills, arch voussoirs, cornices and brackets. The limestone was typically anchored to the masonry infill walls by use of steel, "Z" shaped anchorage straps or by "header" stones which extended back into the walls. The infill backing walls typically consisted of three wythes of brick.

The facade sustained extensive damage. The north and south ends of the gable collapsed out-of-plane. The seven thousand pound hoodstone located above the niche containing the statue of Saint Monica fell directly in front of the main church entrance. The stones at the apse suffered diagonal shear cracking and substantial displacement. Stones at the north end of the east and west elevations cracked vertically and were displaced away from concrete columns located at the corners. Several of the cornice "cap" and bracket stones were displaced. The arch stones at the western entry rotated so that the top of the arch was out-of-plane two inches. The tower also exhibited extensive diagonal shear cracking and displacement. Many mortar joints between stones cracked open.

All elevations of the church were photographed in order to document every limestone block remaining on the church. The photos were then converted into rectified photo mylars which were used by the inspection team to denote areas which needed to be removed and rebuilt, stones which needed replacement, stones which needed additional anchorage, spalls which needed patching, and joints which needed repointing. The inspection team conducted surveys with a metal detector at isolated areas to better determine the extent of metal anchorage. Inspection openings were made to determine extant conditions and displacement of the limestone relative to the brick back-up.

Repairs to the limestone facade were made in conjunction with structural and interior repairs. The structural repairs provided a sound substrate to anchor the limestone. An elaborate scaffolding system allowed the work to be done efficiently and effectively. The limestone was labeled, for re-installation at the same location, and removed from the gable ends, the tower, the west entrance, and the apse. At all of these areas, except the apse, the brick masonry infill was damaged and was replaced with reinforced concrete. Stainless steel dovetail slotted channels were placed in the concrete walls and dovetail anchors were used to provide anchorage of the limestone. At the apse, the inner wythe of brick was removed and steel reinforcing and shotcrete were placed to give lateral load resistance. Slots were chipped out of the outer wythe of brick and the dovetail slotted channels were placed with anchorage extending back into the shotcrete.

All serviceable existing stones were reinstalled. Some of the limestone was too severely cracked to be reinstalled, and the limestone that had collapsed to the ground during the Northridge earthquake had been discarded by crews performing emergency stabilization immediately after the earthquake. Replacement limestone was provided by the Evans quarry near Bedford, Indiana. The replacement stone matched the color and texture of the original Indiana limestone. Damaged stone was used for dutchman patches and plugs. Cracked joints were repointed with a sand, lime, and cement mortar to match the original, undamaged joints.

The "cap" and bracket stones making up the cornice above the concrete frame were anchored from behind with stainless steel threaded rods and a new concrete bond beam was poured around the anchorage at that level. Large stones such as window sills, arch voussoirs, and window surrounds were anchored through the face using stainless steel threaded rods epoxied into drilled holes. The drilled holes were capped with plugs made from original, damaged limestone and grouted into place. The face and sides of the hoodstone, which fell from the south elevation, were sawcut off and reattached to a new reinforced concrete substrate. A new precast concrete Celtic cross was installed at the apex of the south elevation, as the original had fallen in the San Fernando earthquake and had not been replaced until now. Following rebuilding, anchorage, and repointing, the entire facade was cleaned using a mild acidic cleaner and water rinse.

Due to the care, effort, and hard work of owner, the design team, the general contractor, the stone contractor, and the parish, the church was able to reopen for Palm Sunday, 1995, and once again is a landmark for the city of Santa Monica.

SOMETHING CONCRETE

The Merritt Parkway: A Methodology for Analysis and Replication of Historic Concrete

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This paper will describe the role of architectural conservators in the study, restoration and repair of four historic concrete bridges. Engaged by Swanke Hayden Connell, Ltd., to analyze historic concrete and develop concrete replication recommendations, our contribution can serve as a practical model for the simple study and cost efficient replication of historic material. The conservator's understanding of historic and current regional variations in materials, such as cement and aggregates, should have led to practically error proof and economical concrete replication. All too often claims of "it's no longer available," and "I don't have the time to find it" are accepted with disastrous aesthetic and physical results.

The Merritt Parkway was built during the 1930s to connect Connecticut and New York State as one of the first attempts to cope with the new American obsession, the automobile. Designed mainly in the Art Deco Style, it was proposed in the 1920s, with sixty-eight bridges completed by 1940. The parkway represents such a contribution to the built environment that it is now listed on the National Register of Historic Places.

Cores taken from four bridges were studied to determine their original composition and active deterioration processes. Two types of analyses, wet-chemical and petrographic microscopic, were executed. Concrete cores were analyzed by Jablonski Berkowitz via standard wet-chemical techniques. Four cores were examined petrographically by Stone Products Consultants, Inc. Components were identified, as well as damage from various factors including sulfate attack, freeze-thaw cycling, and alkali-aggregate reactivity. Together these analyses provided a basic characterization of the historic concrete types and aggregates originally used on the bridges, information required to formulate appropriate replication and patching mixes.

This paper will show that the combined analyses provided the information necessary to formulate aesthetically acceptable and physically compatible repair mixes for each bridge. Where possible original materials were located for use, with modern substitutions necessary in some instances. Much was learned about regional variations in raw materials, such as inherent cement color. We found that specifying a raw material from a particular region, Pennsylvania in this instance, helped to ensure proper replication of the historic material at no extra cost. This project raised the quality of concrete repairs and helped to safeguard the sixty-eight historic bridges.

*Historic Concrete Building Block:
Its Early Development, Performance, and Relevancy to
Contemporary Conservation Techniques*

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Sears, Roebuck & Co. has been accurately described as “a uniquely American institution” that has played an important role in the growth and development of Chicago. Its catalogue history serves as an accurate reflection of American trends and tastes. Within this heritage, Sears, Roebuck & Co., was instrumental in advancing the development and application of concrete building block. Their 1908 catalogue boldly portrays the numerous merits and advantages of The Wizard, a concrete building block machine. It is described in this catalogue as “the most rapid block maker on the market and it is strictly a one-man machine.” Woven within this advertisement is a treatise on the technology, design, production, aesthetic, material science, and versatile application of this emerging architectural, structural, and fire-proof building system deemed suitable for diverse agricultural, residential, and commercial buildings.

Through the combination of historical product research, a concrete building block preservation case study, and a brief technical review of the original materials and techniques used to produce this “new” building system, the premise will be presented that this “traditional material” has direct application to the future preservation of contemporary structures, current and emerging stone masonry restoration techniques, and the approaching contemporary conservation challenges associated with concrete masonry building systems.

The Fair Face of Concrete: Conserving More by Doing Less

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Concrete became emblematic for modern architecture in its heroic period in Europe. Early architectural applications involve experiments with mixtures, additives, granulates, reinforcement patterns, and the shapes of elements. Many early modern buildings therefore suffer from failures that are uncommon in older buildings but prevalent in more recent structures.

Consolidation of defective constructions through visible underpinnings would disturb the smooth and pure image of modern buildings. Also, a patina on their surface is inelegant, often contradicting its modern aesthetics in conceptual terms. Yet, the principle of material authenticity might be debatable with an architecture that favoured mass-produced parts. New approaches for survey, repair and maintenance are therefore required.

Present diagnostic methods often require destructive research. More sophisticated detection methods can now mostly be operated non-destructively. Traditional concrete repair either involves breaking out and replacing defective areas, and/or applying a fresh coat over damaged parts. Carbonation or chloride attack can now be countered with non-destructive electro-chemical treatments that reverse the chemical processes that caused the corrosion of rebar. Re-alkalisation arrests carbonation of concrete and restores its alkalinity to stop corrosion. Desalination involves a similar technology to extract chlorides. In many cases the durability of these treatments is high even without a protective coat, as often required after traditional repair. Therefore, the authentic surface of architectural exposed concrete can often be respected, which becomes increasingly relevant for postwar architectural heritage. Electrochemical repair offers new opportunities by keeping more authentic concrete by simply doing less.

The paper will briefly explain these methods, evaluate experiences with some noted buildings in Europe, such as Rudolf Steiner's *Goetheanum*, 1928, and will address the durability of these treatments, summarizing the results of a first European seminar on architectural preservation of exposed concrete.

Beauty and the Beast: Achieving Authenticity in the Conservation of Post-War Concrete Architecture

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Over the last decade much has already been said on the difficulties of reconciling the specific practical conservation problems posed by modern architecture, with current conservation philosophy. The retention of authenticity, which is the principal aim in any intervention, is the stumbling block. It is in attempts to define authenticity, and discussions on how we ensure we achieve this aim, that the ability of existing conservation philosophies and methodologies to accommodate the particular needs posed by our more recent heritage come into question and have caused such debate.

There are now beginning to be reasonably satisfactory means of resolving some of the technical problems of those buildings which belong to the vanguard of the Modern Movement, which are limited in number and have suffered in the past most frequently from a lack of technical knowledge to deal with the issues at hand. There is of course still much work to be done. However, now as more and more buildings from the second half of the century are beginning to be protected through conservation legislation, their conservation and the technical difficulties associated with their repairs are proving to be even more problematic. This is exacerbated by the fact that a huge proportion of much of the world's building stock dates from this period and so the scale of these problems should if nothing else urge solutions to be sought.

As we begin to be more knowledgeable about, and more experienced with preserving our twentieth century heritage, we have also begun to be less generalist about how we discuss it, an important breakthrough. To date there has been a tendency to lump together the vast array of architectural typologies which have emerged over the last century, which considering the richness and extraordinary differences in architectural expression can only serve to reduce the depth of discussion to a superficial level. To progress we must begin to generalise less and deal with the very different issues at hand in a more systematic and detailed way.

This paper concentrates on the specific difficulties of reconciling repair with authenticity for the post war exponents of modernism, in particular concrete buildings which became so widespread after the Second World War. With reference to a selection of case studies that practitioners in the United Kingdom are grappling with, an attempt will be made to illustrate how the importance of lateral thinking, perseverance and pushing forward technical barriers are essential if we are to move forward and secure the future of our recent past.

Of all the tremendous number of new materials and building systems introduced over the past century, reinforced concrete is by far the most dominant material, and as a result is causing the most urgent, the most common, and the largest scale problems in conservation terms. The use of concrete in its natural form (fair-faced concrete) which combined material honesty with economical construction techniques to define a new aesthetic, is at the moment causing technical problems which in conservation terms are extremely difficult to resolve. Surface finishes, be they precast or in situ, plain or decorative finishes to the surface of the structural material, or applied such as mosaic or tile, are fundamental to the appearance and character of these buildings. Current repair options do not accommodate the aim of retaining these buildings without radical visual alteration. What can we do to salvage these buildings, and how far must we accept change if they are to continue to function? Is the conservation adage of 'less is more' any less relevant for modern

buildings. These are questions which are being faced by anyone dealing with post-war buildings today, and which only over time and through shared experiences we will be able to come to terms with.

Lack of experience and undeveloped repair technology to meet the conservation challenge are the main causes of our current predicament. Recognition that there are some unsolvable difficulties resulting from inherent material problems as a result of the experimental or economic rationale behind the buildings, does not however mean we should give up. All too often buildings are being irreversibly damaged as a result of an acceptance that preservation means reconstruction for many post-war buildings. However, if we wish to authenticity to remain within the conservation vocabulary we need to stand firm and begin to meet these challenges.

METAL: ELEMENTS VERSUS THE ELEMENTS

Negative and Positive Aspects of Corrosion

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All of us have seen various kinds of corroding metals. The most prominent are corroded monuments and architectural elements. This paper will briefly discuss why metals corrode and which environmental factors accelerate corrosion.

In the case of sculpture, corrosion usually presents aesthetical changes, but very often it can also cause structural problems. In architectural structures, corroding metals present aesthetical and structural problems as well.

Very often, metals corrode as a result of galvanic reaction which can lead to complete destruction of very large objects. Visual changes in corroding metal can be attractive from an artistic point of view, but usually they are very expensive. One corrosion process, galvanic reaction, can be put into good use in preserving some of the corroding metals. This paper will discuss some of the situations where galvanic corrosion of one metal can be used to protect another.

The presenter works as a sculpture conservator, and he will briefly discuss monument conservation and presently used methods of corrosion prevention in the conservation of outdoor monuments.

*Environmental Corrosion of Copper and Lead-Coated Copper,
and Some Methods of Mitigation*

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The presenter has observed rapid corrosion of copper and lead-coated copper roofing and flashing materials over which rain water from other surfaces runs. He has observed this corrosion as far north as St. Johnsbury, Vermont, and St. John, New Brunswick, and as far south as Biltmore in Asheville, North Carolina. He has not observed it at the Robie House in Chicago or west of Chicago.

The probable cause of the corrosion is a non-volatile residue from acid rain which remains on roof surfaces as rain water dries. In addition, it is probable that acid aerosol is deposited directly on the roof. Dew or mist dissolves the acid but does not dilute it enough to render it harmless. When the concentrated acid residue runs over copper, it reacts with the copper, removes the patina, and erodes the surface. Evidence of the probable cause comes from measuring the pH of the first rain which drains from the roof and later rain. Further evidence comes from the lack of corrosion on all-copper roofs and copper gutters below marble roofs.

The presenter has tried several methods of reducing the corrosion on "fresh" and patinated copper, including zinc and marble chips. The zinc sacrificial anodes have been highly successful, and the marble chips have not. Other materials will be tried.

Fracture Critical Investigation of an Historic Wrought-Iron Truss Bridge

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The historic Faust Street Bridge is located in New Braunfels, Comal County, Texas. Built in 1887 by the King Iron Bridge and Manufacturing Company, the bridge features four spans for a total length of 640 feet. The Faust Street Bridge spans the Guadalupe River, one of Texas's main waterways, at the historic crossing of the El Camino Real. The Faust Street Bridge is one of less than 20 trusses in the state constructed prior to 1890 and is the longest, most complex and important of these examples. The Faust Street Bridge is one of a relatively small number of wrought-iron bridges ever constructed in the state, and survives as a rare example of this technology for Texas.

The bridge owner, Comal County, has been awarded ISTEAs funding to rehabilitate the bridge and open it to pedestrian traffic. As part of the engineering phase of the rehabilitation project, a Fracture Critical Investigation of the bridge was conducted. The goal of the investigation was to conduct visual assessment and ultrasonic testing of the bridge members identified as fracture critical. AASHTO guidelines define "fracture critical members" as structural members with zones of tension stresses whose failure would result in the collapse of the structure.

Significant Aspects of the Investigation:

- Literature search to collect available information on the structural behavior, assessment and rehabilitation of historic (1880 - 1930) metal truss bridges in the United States. Emphasis was on wrought-iron road bridges.
- Material samples tested to derive engineering properties for structural analysis. Only a small amount of material was removed from existing damaged members to minimize loss of historic fabric.
- Structural modeling and analysis to identify fracture critical members of the bridge trusses, and fracture mechanics analysis of the pins and eyebars to estimate critical flaw size.
- Development of specialized ultrasound procedures for testing of the wrought iron pins and eyebars.

Main Findings of the Investigation:

Ultrasonic testing was confirmed to be very useful in the structural assessment of historic wrought iron structures. Thanks to ultrasonic testing, determination of safe condition was possible without costly destructive testing and/or dismantling of the bridge. It is essential, however, to use testing equipment and procedures adapted to the historic material.

The laminated nature of the wrought iron material was shown to have a favorable impact on the fracture mechanics of the pins and eyebars. Consistent zones of inclusions, probably resulting from the manufacturing process, were found in the neck area of the eyebars.

Bridge design in the 1880s was sophisticated and resulted in a high degree of optimization of the structural members. Redundancy and resiliency were “engineered” into the lightweight structure and allowed it to survive damage from fire and from vehicular impact. Corrosion damage was limited, and the bridge was found to be in good structural condition.

SURFACE DECORATION: MOSAICS AND PAINT

Conservation of a Roof Mosaic: The Quapaw Bathhouse Dome

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The Dome Project is a structural and surface mosaic conservation project designed to reverse active deterioration, stabilize structural systems, and preserve elements of historic fabric. The mosaic clad Dome is a prominent decorative feature of the Quapaw Bathhouse, one of eight historic bathhouses in Hot Springs National Park, in Little Rock, Arkansas. Deterioration was recognized on exfoliating iron reinforcing on the underside of the dome, as well as on the surface with severe cracking and loss of mosaic tile. External and internal environmental conditions were in combination accelerating the deterioration. The repair program followed a thorough investigation including finite material analysis, engineering modeling, and conservation condition survey. A custom designed rolling scaffold mounted on a track provided full access to the surface for all activities. Driven by the survey findings, the treatment program included the acquisition and setting of replacement tesserae and injection grouting of voids and cracks using JAHN grout-M40. Structural analysis combining material testing and computer modeling indicated sufficient strength of the thin substrate due to inherent dome characteristics. The interventions will be limited to climate control and physical monitoring. There is the expectation that water infiltration can be controlled through external repairs and positive internal pressure. Thus, retarding egress through micro cracks will prevent damaging freeze/thaw potential. A water repellent treatment was applied after repair cure and surface cleaning. This project followed principles of thorough planning, minimal intervention focusing on continued maintenance, and monitoring in lieu of fabric alteration.

Team: Barry Welton, Rebecca Renaud, Engineers; Gary Smith, Master Mason; Anne Oliver, Bob Hartzler, Architectural Conservators; Ray Yunk, Park Project Coordinator.

*Surrealist Vision and Cold Reality:
Restoration of Marc Chagall's "Les Quatre Saisons"*

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The Marc Chagall mosaic "Les Quatre Saisons" was installed at the First National Bank Plaza in Chicago, Illinois, in 1974. The monument is constructed with a reinforced concrete vault clad with precast concrete panels and granite roof slabs. The Byzantine style mosaic was laid on precast concrete panels under Chagall's supervision in a studio in France. The panels were then installed on the concrete vault on site in Chicago. The mosaic is 70 feet long, 10 feet wide, and 14 feet high, and has visual elements of Chicago mixed with images of humanity and nature.

By 1993, after nearly 20 years of exposure to the environment, a number of distress conditions were present. A previous repair program in 1988 replaced nearly 15 percent of the mosaic face. Five years after those repairs were completed, isolated glass tesserae were missing or delaminated, with some areas numbering up to 50 or more tesserae. The Byzantine method of laying the tesserae had allowed moisture to collect between the tesserae and grout bed, leaving the mosaic vulnerable to deterioration from freeze-thaw conditions. Cracks had developed between the precast concrete panels and, besides being visible on the mosaic surface, allowed moisture to enter the mosaic. Select tesserae colors experienced an alkali-silica reaction between the grout bed and the glass tesserae, leading to delamination. Select precast concrete panels had been replaced in 1988 and additional deterioration in the remaining panels was likely to occur under the present environment conditions. In addition, the surfaces of the monument were stained by a bird repellent that required removal prior to assessing the full extent of these distress conditions.

This case study will review the cleaning, investigation, repair design, and restoration of the mosaic. Emphasis will be given to the materials of the monument and the types and causes of distress. Following the investigation, options were examined for the repair or relocation of the monument. Criteria were developed for protection of the monument. Specific repair procedures implemented during the restoration will be discussed. The restoration was performed in 1996 under the supervision of one of the original mosaicists for the monument. Concurrent with the restoration program, a glass canopy was erected over the monument to protect it from the elements.

Flake, Peel, and Powder: A Paint Failure Investigation

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This paper describes our investigation into a paint coating failure on the exterior masonry of a recently restored 1860 municipal building in New York City. In 1994, an extensive exterior restoration was undertaken on the building. The project included removal of the existing exterior paint finishes and application of a new paint system. Within months, the newly applied paint was failing on the exterior brickwork. Failure began on the brick piers, but quickly spread to other areas of the brick walls.

As the paint failure continued to worsen and complaints from the public rolled in, the restoration architect engaged the firm of Jablonski Berkowitz Conservation, Inc., to visually examine the painted finishes on the exterior masonry and to perform limited testing of the failing painted finishes. The visual examination indicated several failure conditions present including chalking or powdering of primer, cracking or breaks that extended through paint films to the substrate, and flaking or scaling off of paint layers. The integrity of paint film bonds to the masonry substrate were found to vary from good to totally failed or detached.

Limited testing was performed by Jablonski Berkowitz Conservation, Inc., to examine several characteristics of the brick substrate, primer, and finish coatings. Tests performed in the field were pH readings of paint and masonry substrates, moisture content of the brick substrate, paint adhesion according to ASTM D 3359-95a, and water absorption through brick surfaces using the RILEM tube. Testing performed in the laboratory included measurement of the paint film thickness, determining the pH of the paint stripper, and microscopic examination of paint films.

A second testing program for the project was undertaken after the results of the initial investigation were reported. This Phase II testing included water vapor permeability testing on cores of brick removed from the building and the application of test panels of a variety of paint coatings that were placed on the building for a prescribed period of time to serve as limited weathering tests.

This paper describes the paint failure investigation, its methodologies, examination methods, testing used, and the limitations of the project. The findings are discussed, as well as testing results and continuing treatments. One conclusion of this paper is the importance of a thorough understanding of all treatments involved in a restoration project.

GOOD WOOD AND BAD

Wood Structure of the Charles Arnold House at Lincoln Home National Historic Site: After 150 Years of Structural Modifications - Modifications for Restoration

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As the houses in the neighborhood of Abraham Lincoln's Home in Springfield, Illinois, have been altered with the changing demographics of the city, the changing needs of the occupants, the change in taste, and the advancement of technology, the wooden structures of these houses have been modified, often drastically, in the past 150 years. This history of structural modifications has presented some interesting restoration and preservation problems and opportunities as the neighborhood is returned to its appearance when Lincoln left Springfield in 1860.

In this presentation, these problems and opportunities will be explored through one case study structure: the Arnold House. The Arnold House shares some common conditions with other structures in the neighborhood but has conditions unique to itself. For instance each of the houses in the neighborhood is a mix of framing types, i.e., balloon, braced, and platform. However, the manner in which these methods intersect with each other has resulted in varying and unique problems at each house. The original story-and-a-half Arnold Cottage was constructed in circa 1840 near the front of its lot where it underwent several additions and renovations. Circa 1901 the additions were removed and the lumber salvaged, and the original cottage was rotated and relocated to the rear of the site. The salvaged lumber was re-used in new one-story additions at two sides of the original cottage. Soon after, an addition to a third side had essentially boxed-in the original balloon-framed cottage. Subsequent interior modifications, which created a multi-family dwelling, severed the bearing wall framing of the original cottage by as much as forty percent. Changes in door locations and window size and placement left the intact cottage with little structural integrity of its own. In effect, the one-story box around the cottage was acting as buttressing elements holding the taller walls of the cottage in place and creating a very weak structure. The structure necessarily had to be relocated and restored to its 1860 appearance. The restored building includes the intact remnants of cottage and several later additions which together constitute the "house."

This presentation will provide an overview of structural concerns and the analysis of the structural system of the Arnold House. The solutions to those problems will be reviewed and the final outcomes discussed in detail. This presentation will focus primarily on the wood framing but will also deal with the foundation components.

*Developing Hanta Virus Mitigation Procedures for Cultural Resources
in the National Park Service's Midwest Region*

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During the summer of 1996, the National Park Service (NPS) Midwest Region developed Hanta virus mitigation procedures for treating historic cultural resources during restoration work on the nationally significant Harold J. Cook Homestead Cabin at Agate Fossil Beds National Monument in western Nebraska. This presentation will discuss the procedures developed for Hanta virus mitigation of historic cultural resources, including documentation procedures, field testing of treated wood and fiber materials, decontamination, removal and storage of sample materials, stabilization, and selective demolition. It will conclude with a summary of findings one year after initial treatment. The restoration activity was precedent-setting in its ability to provide new, critical and complete information on the mitigation and conservation of cultural resources infected by the hazardous virus.

Hanta virus causes Hanta virus Pulmonary Syndrome, an often fatal infection of the lungs. The respiratory disease is carried primarily by the deer mouse in the western United States. Evidence of virus-positive mice in the region of Agate Fossil Beds resulted in an interdisciplinary restoration approach incorporating historic preservation and conservation measures to protect the integrity of the historic fabric, while complying with strict safety standards. Previous to this project, minimal written guidance was available involving mitigation treatment or conservation of historic resources infected with the virus.

The standard procedures and safety regulations required by the Center for Disease Control (CDC) and the NPS involve application of a caustic bleach and water solution. While portions of the cabin were treated with this solution, non-destructive procedures involving the use of a Lysol spray were employed to disinfect a collection of architectural samples and artifacts that were retained as part of a comparative collection. The Lysol spray treatment was developed in consultation with conservation professionals, the CDC, and the NPS. Periodic monitoring and future sample treatment will provide information to assess the long-term effects to both the cabin and to sample materials.

Non-Destructive Evaluation of Historic Structures - U.S.S. Constitution

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The U.S.S. Constitution is the oldest floating commissioned ship in the world and still a part of the U.S. Navy. Launched on October 21, 1797, the ship is currently in dry dock, preparing for the two-hundredth anniversary of her launching.

Personnel from the U.S. Navy responsible for maintaining the ship have investigated a variety of nondestructive testing techniques to assess the condition of the wood in the ship. Radiography and ultrasonic techniques were used to assess the condition of copper pins used as fasteners. Stress wave nondestructive evaluation (NDE) techniques were used to locate areas of degradation in the wood. The objective of this paper is to describe the stress wave techniques utilized and present results obtained from their use.

Stress wave NDE techniques have been researched and are utilized frequently to inspect large timber structures. A stress wave is induced by striking the member with an impact device that is instrumented with an accelerometer that in turn emits a start signal to a timer. A second accelerometer, which is coupled to the member, then responds to the leading edge of the propagating stress wave and sends a step signal to the timer. The elapsed time for the stress wave to propagate between the accelerometers is displayed on the timer. The underlying premise for use of this technique is that the speed, hence the transmission time at which a stress wave travels through a wood member, is indicative of the member's condition.

For example, it has been shown that a stress wave travels at speeds that are significantly slower in deteriorated wood when compared with sound wood. Consequently, this technique has proven to be an effective method for locating large, degraded areas in timbers. Previous efforts were aimed at locating degraded areas in softwood timbers. No information was found on use of these techniques for assessing degradation in hardwood timbers. In addition, limited baseline information exists on speed of stress wave transmission values for hardwood species.

Many timbers in the U.S.S. Constitution are from live oak, a hardwood species. Consequently, baseline information on speed of stress wave transmission in live oak was needed before we could proceed with using the stress wave technique on the member in the USS Constitution. Thus, we conducted a series of laboratory experiments to determine baseline speed of stress wave transmission values for live oak specimens prior to inspecting the ship.

To determine speed of stress wave transmission values parallel to the grain, we tested 80 0.5- by 0.375- by 12.0 in. (0.01- by 0.01- by 0.30-m) live oak specimens. All specimens were conditioned to approximately 12 percent equilibrium moisture content. An average value of 105 microsec/ft (9,524 ft/sec) was found. Values for these specimens ranged from 71 to 151 microsec/ft (6,622 to 14,085 ft/sec).

To determine speed of stress wave transmission values perpendicular to the grain, we tested 20 5- by 12- by 12-in. (0.1- by 0.3- by 0.3-m) live oak specimens. An average value of 278 microsec/ft (3,597 ft/sec) was found. Values for these specimens ranged from 210 to 476 microsec/ft (2,101 to 4,762 ft/sec).

All deck beams (four decks of approximately 32 beams each), various knees, stern post, stem keelson, and keel were examined. Baseline stress wave transmission times for sound live oak were calculated for the various thickness members. Significantly lengthy transmission times indicated the presence of deterioration. Significantly longer transmission times were indicative of deteriorated wood. Inspection of these members after they were removed from the ship revealed that the severity of degradation corresponded to increases in transmission times. This finding is in agreement with previously reported results.

Stress wave nondestructive evaluation techniques were used successfully to locate deteriorated wood in the U.S.S. Constitution. The technique that was utilized involved inducing a stress wave in the member in question and monitoring the time it takes to flow through the member, perpendicular to the grain. Significantly longer transmission times were observed when deteriorated wood was present.

LIME: SOME NEW TWISTS

A Lime Primer: Helping to Reduce the Confusion About Lime Terminology

Margaret Thomson
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The conservation of a historic masonry structure most likely requires the repair of a lime-based mortar. Descriptions of the masonry industry prior to the turn of the twentieth century indicate that much of the lime used in the industry was produced locally. Small lime kilns are located near most communities. For the most part, this is no longer the case, with larger lime producers capable of providing their product over much of the North American continent. It can be quite confusing to compare descriptions of lime products used in the original building of the structure with what is available today. The objective of this talk will be to discuss terminology and production techniques so as to aid the practitioner.

Type S, or special hydrate by ASTM C 110, designation is exclusively used in modern construction in North America. This is an unfortunate handle for the product as it often leads to confusion with Type S mortar as designated in ASTM C 270. Type S lime is typically derived from the rock and mineral dolomite. When calcined to quicklime, calcium oxide (CaO) and magnesium oxide (MgO) are formed. When slaked (water added to quicklime) the calcium oxide and magnesium oxide are converted to two hydroxides (Ca(OH)₂ and (Mg(OH)₂). This will form a lime putty which will vary in consistency from milk to thick cream, depending on the quality of the quicklime and the amount of water used. ASTM C 110 requires that lime putty has 50 percent by weight solids.

In an open vat, the magnesium oxide hydration to magnesium hydroxide may not be complete. This is a problem, especially if the product is used as a plaster. There is a 25 percent volume increase when the conversion occurs, which may result in the bulging or pocking of the wall. It is for this reason that the pressure hydration process was developed. In a pressure hydrator, just enough water is mixed with the quicklime to produce calcium and magnesium hydroxide crystals. The resulting product is a white powder consisting of fine crystals (less than 1 μm in diameter) and no more than one percent unconverted oxide. Lime putty can be made from hydrate by mixing 50 percent by weight of lime hydrate (powder) and water. This too is addressed in the ASTM C 110 standard.

Type N, lime hydrate or normal lime hydrate is typically derived from the mineral calcite or the rock limestone. When calcined, calcium oxide alone is produced, and when hydrated or slaked, calcium hydroxide is the product. Interestingly, calcite derived lime is exclusively used in Europe for masonry. It is this, which in part leads to considerable confusion about limes in the North American context. The image of lime putty stored for several years to ripen like a good cheese is appropriate for the calcite-derived lime, but not for dolomite derived Type S lime. The difference between the two lime products is in their degree of plasticity (determining how fat the mortar is) and the water retention. Type S lime hydrates have minimum values for these qualities to qualify.

*Factors Affecting the Performance of Lime-Based Mortars,
with Particular Reference to the Use of Pozzolanic and Air-Entraining Additives*

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The Smeaton Project, an English Heritage research project carried out in association with the Building Research Establishment, was begun in 1990 to address issues related to historic mortars in a systematic way through both laboratory and field research. The broad objective of the Smeaton Project is to contribute to the understanding of the characteristics and behavior of lime-based mortars by attempting to identify—and where possible, quantify—the material and practice parameters which affect their properties. Initial phases of the research have concentrated on the effects of set additives, particularly brick dust pozzolans, on lime-based mortars in terms of strength, durability and workability.

Results of Phase I (published in the *APT Bulletin*, September 1994) confirmed earlier indications that the addition of small quantities of cement to lime:sand mortars (less than a proportion of 1:3:12 of cement:lime:sand) is likely to have a detrimental effect on the strength and durability of the mortar.

Information was also gained regarding some of the properties affecting the behavior of lime mortars modified by the addition of crushed brick or tile. Low-fired brick dusts (fired at a temperature less than 900 degrees centigrade) seem to have the most positive effect on the strength and durability of lime:sand:brick dust mixes. Results indicated that brick dusts in the lower size particle range (particles < 300 microns) of brick in mortars seem to behave more as porous particulates or air entraining additives which again assist durability. The air content of the aggregate aids carbonation and improves resistance to frost and salt crystallization.

These hypotheses were tested in Phase II in a limited series of mixes utilizing low-fired brick dusts with particles in the extremes of the particle size range. A non-pozzolanic porous particulate was also tested in an attempt to distinguish between the two phenomena which seemed to improve performance in Phase I.

In Phase III, a refined group of lime:sand:brick dust mixes were compared to mixes employing other commercially available pozzolans and to mixes based on various hydraulic limes which have recently become available in the European marketplace.

All mixes were subjected to a range of laboratory tests including stiffening rate, water vapor permeability, porosity, compressive strength, salt crystallization, and freeze-thaw.

The proposed paper summarizes the results achieved in Phases II and III of the project, comments on the efficacy of testing procedures, assesses the implications of the results on field practice, and indicates future research directions.

Lime Putty: Mortar Returns to the Trowel

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Lime has been the primary ingredient in masonry mortars for thousands of years. The development of natural cement in 1824 and later the widespread use of portland cement in the 1880s profoundly changed historical mortar formulations which had been handed down for generations. What can be learned from these changes? How can we develop better repointing formulations by studying our own construction heritage? A detailed look at original mortar formulations from several significant historic properties including; The U.S. Capitol, The Empire State Building and Thomas Jefferson's Poplar Forest will be explored. A rare opportunity to observe a lime slaking demonstration will be offered by the presenter who is a fifth generation stone mason. An authentic lime putty mortar will be prepared from scratch. A historical overview on the production of lime, field slaking techniques from 1852, and the impact of masonry cements in 1932 will also be discussed.

TRACK D: THE ROAD AHEAD

PRESERVATION PUBLICATION NEEDS
(Sponsored by APT and the National Park Service)

Panelists:

Diana S. Waite
Editor, *APT Bulletin*
Mt. Ida Press
Albany, New York

Derek H. Trelstad
Friedman Structural Engineering, PC
New York, New York

Charles E. Fisher
Heritage Preservation Services
National Park Service
Washington, DC

Finding information on historic materials, appropriate conservation methods, suitable rehabilitation techniques, and options for meeting regulatory requirements can be particularly burdensome when dealing with historic preservation projects. This roundtable will examine various publication efforts in our field; identify topics of critical concern that need to be addressed; discuss options for expanding publishing activities; and suggest ways that current publications can be made more accessible to practitioners in the field.

*ARCHITECTURAL FRAGMENTS:
LESSONS LEARNED ON BOTH SIDES OF THE ATLANTIC*

Panelists:

Roberta Laynor
Colonial Williamsburg
Williamsburg, Virginia

Edward A. Johnson, Research Coordinator
Center for Historic Preservation
Middle Tennessee State University
Murfreesboro, Tennessee

The APT Architectural Fragments Committee promotes awareness and improved management of artifacts to help improve understanding of early building technology and material culture. Several members of the committee will conduct this forum exploring the theme *Less is More* as it relates to architectural fragments. The first presentation will examine current collections management practices for architectural fragments in Great Britain, showing how a minimal but thoughtful investment in time and funding can produce a well-organized collection. A second presentation will explore basic considerations involved in selecting a computerized database system for managing architectural fragments. A hands-on demonstration of architectural fragments from the United States and Great Britain will provide an opportunity to read ghost marks and other features that help to establish the significance of these artifacts.

Managing Information for Collections of Architectural Fragments

Edward A. Johnson, Research Coordinator
Center for Historic Preservation
Middle Tennessee State University
Murfreesboro, Tennessee

With increasing awareness of the importance of architectural fragments, many preservationists find that they need pragmatic ways of managing the information associated with their fragments collections. This presentation explores the basic considerations involved in establishing an efficient computerized database system for managing architectural fragments, emphasizing the kinds of information to be recorded and how that data can be incorporated into a practical automated database.

A great variety of parties (museums, government agencies, private firms, architects - even individuals) hold architectural fragments, and thus their information managing needs differ widely. Nevertheless, most would benefit by adopting some of the professional practices established by museum collections managers. Drawing on museum practices, the presenter describes database structure and fields appropriate to architectural fragments, with special emphasis on extraction location and other data fields which are uniquely tied to fragments.

The need for electronic information interchange, and the related issue of institutional size, strongly influence the information planning process. The presentation explains how to approach the selection of appropriate hardware and software to accommodate varying levels of data sharing needs. Larger institutions will likely require a highly centralized, formal approach to ensure effective information interchange, while smaller organizations may find an informal approach adequate.

Due to differences in organizations, several alternative approaches apply to the selection of collections management software: customized programming; commercial collections management packages; and adaptations of general-purpose database software. The presenter explores the pros and cons of these three alternative scenarios, and identifies helpful resources for each approach.

The presentation concludes with a discussion of potentially problematic implementation issues, including data migration from previous systems and data safeguards to counteract the fragility of electronic information.

ENVIRONMENTAL ISSUES IN PRESERVATION

Moderator:

Delph A. Gustitus
The Gustitus Group
Chicago, Illinois

Environmental issues are often overlooked during preservation projects. To increase awareness of environmental issues in preservation, the APT Environmental Issues Task Force is sponsoring a roundtable discussion on how environmental issues affect preservation, and how preservation affects the environment. The format for this roundtable will be an open discussion. Issues include the impact of hazardous materials (asbestos, lead based paint, PCBs) on preservation projects; indoor air quality; and exterior cleaning of buildings and associated waste collection/disposal. Is preservation good for the environment? Can preservation practices be more environmentally responsible? The roundtable is intended to stimulate discussion and ideas, and to develop an agenda for the task force to pursue over the next few years.

MUSEUMS IN HISTORIC BUILDINGS

Panelists:

Thomas H. Taylor, Jr., Ph.D.
Colonial Williamsburg
Williamsburg, Virginia

Andrew Powter
Public Works & Government Services Canada
Ottawa, Ontario

Paul R. Himmelstein
Appelbaum & Himmelstein
New York, New York

John A. Fidler
English Heritage
London, England

Following the endorsement of the New Orleans Charter by many national and international organizations, the Charter has been used to address the needs of collections in historic structures. This session will highlight areas where conflicts arise and where the Charter provides a framework for resolution. The first presentation will address the challenges of humidity levels for collections and buildings. A case study of the Library of Parliament in Ottawa will illustrate the development of an environmental and conservation standard. A third presentation will address meeting conservation needs while maintaining historic light levels. A fourth presentation will summarize activities planned at future symposia.

NETWORKING IN PRESERVATION

Moderator:

Ken Follett, Vice President
Apple Restoration and Waterproofing, Inc.
Brooklyn, New York

Panelists:

Walter S. Arnold
Sculptor
Chicago, Illinois

John Callan
Pennsylvania Historical and Museum Commission
Harrisburg, Pennsylvania

David Coe
Perry Dean Rogers & Partners, Architects
Boston, Massachusetts

Ilene Tyler
Quinn Evans/Architects
Ann Arbor, Michigan

Getting to know the other. Outreach. Making contact. Building relationships. Humor and pathos on the Internet. Exploration. Getting answers. Feeling like one of the group. Staying in the loop. Infinite preservation. News from nowhere. The focus of the session is the ongoing development of a virtual community of preservation via resources of the Internet. The topic is an outgrowth of APT website development. The Internet helps preservationists make contact efficiently and develop meaningful relationships beyond traditional limitations of geographic region, time, and transport. Internet communication tools considered include e-mail, preservation-l listserv, preservation oriented websites, and the APT website project. Emphasis will not be on hardware or software, but on communicating. Comparison will be made with strategies for local and geographic networking. Traditional networking tools and concepts such as business cards, rolodex, and telephone will be reviewed. Discussion will be led by individuals experienced in the direct use of the communication media.



Cover Design
Michael Ward

Cover Photography
Leslie Schwartz Photography, Chicago, Illinois

Printing
Crouse Printing, Champaign, Illinois

Less Is More