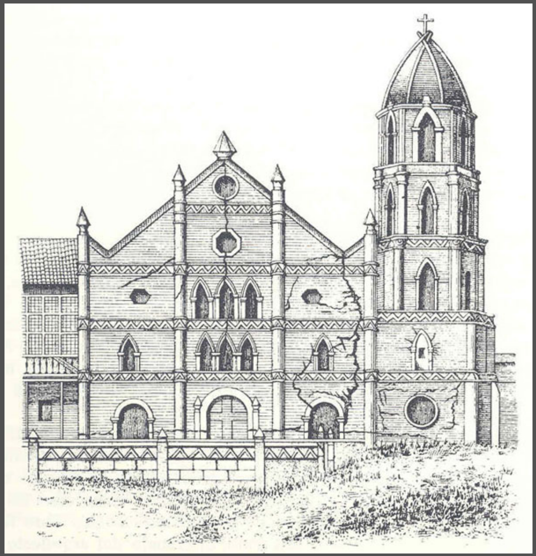
International Symposium on Seismic Retrofit of Unreinforced Masonry Churches in the Philippines
National Museum of the Philippines
14 January 14 2016

International Best Practices for Seismic Evaluation and Retrofit of Heritage Structures

Some Thoughts for the Philippines



Zach Watson Rice Architect
New York City, USA

OR

OPPORTUNITIES FOR HERITAGE RESILIENCE

WHAT IS RESILIENCE?

resilience

noun re·sil·ience \ri-ˈzil-yən(t)s\

1. The ability of a substance or object to spring back into shape; elasticity.
2. The capability to recover quickly from difficulties; toughness.

So, resilience refers to an engineering property, and a cultural trait.

The origin of the word resilience is Latin, but perhaps, given the manmade and natural disasters that the Filipino people have sprung back from over the centuries, that the origin of resilience must be Filipino.

INTERNATIONAL BEST PRACTICES: SOME THOUGHTS FOR THE PHILIPPINES

Over the last two days the expert speakers, local and international, have covered all the topics so thoroughly, that there is very little technical information that I can add to the symposium. So what I will do is review a few common threads that wove their way through all the presentations, and present a few additional thoughts that I hope will be useful for the conservation of heritage structures in the Philippines.

OUTLINE

- Common Approach
- Project Team
- Knowledge Opportunities
- Heritage Building Codes
- Heritage Documentation
- Monitoring, Inspections, and Maintenance

COMMON APPROACH

COMMON APPROACH

Though the international experts at this symposium have come from far flung countries, with very different types of heritage buildings, made of every possible archaic building material, the experts all approach the problem of how to work on heritage structures in a remarkably similar manner.

COMMON APPROACH

Learn the Building's History
Understand Past Behavior
Gather Data on Geometry, Construction Type, Materials, and Condition
Analyze Structural and Non-Structural Performance
Design the Conservation, Restoration, Retrofit, and Rehabilitation Work
Prepare Construction Documents (drawings and specifications)
Construction (or Implementation or Intervention)
Monitoring and Inspection after Construction
Maintenance after Construction
Document all Research, Design, Construction, Inspection, and Maintenance Work
Repeat

PROJECT TEAM

PROJECT TEAM

Heritage conservation projects are composed of a multi-disciplinary Project Team, beginning with the Owner, and the Owner's Representative or Project Manager, who works closely with the Design Team leader – an engineer, architect, or other design professional.

To be successful, heritage conservation projects must have a clear agreed upon approach, and common goals, objectives, and expectations.

PROJECT TEAM

Owner
Owner's Representative or Project Manager
Conservation Architect
Conservation Engineer
Geotechnical Engineer
Landscape Architect
Archaeologist
Historian
Non-destructive Testing Consultant
Architectural Conservator
Testing Laboratory
Contractor and Subcontractors
Building Code Official
Funding Agency
Review Agency
Peer Reviewers

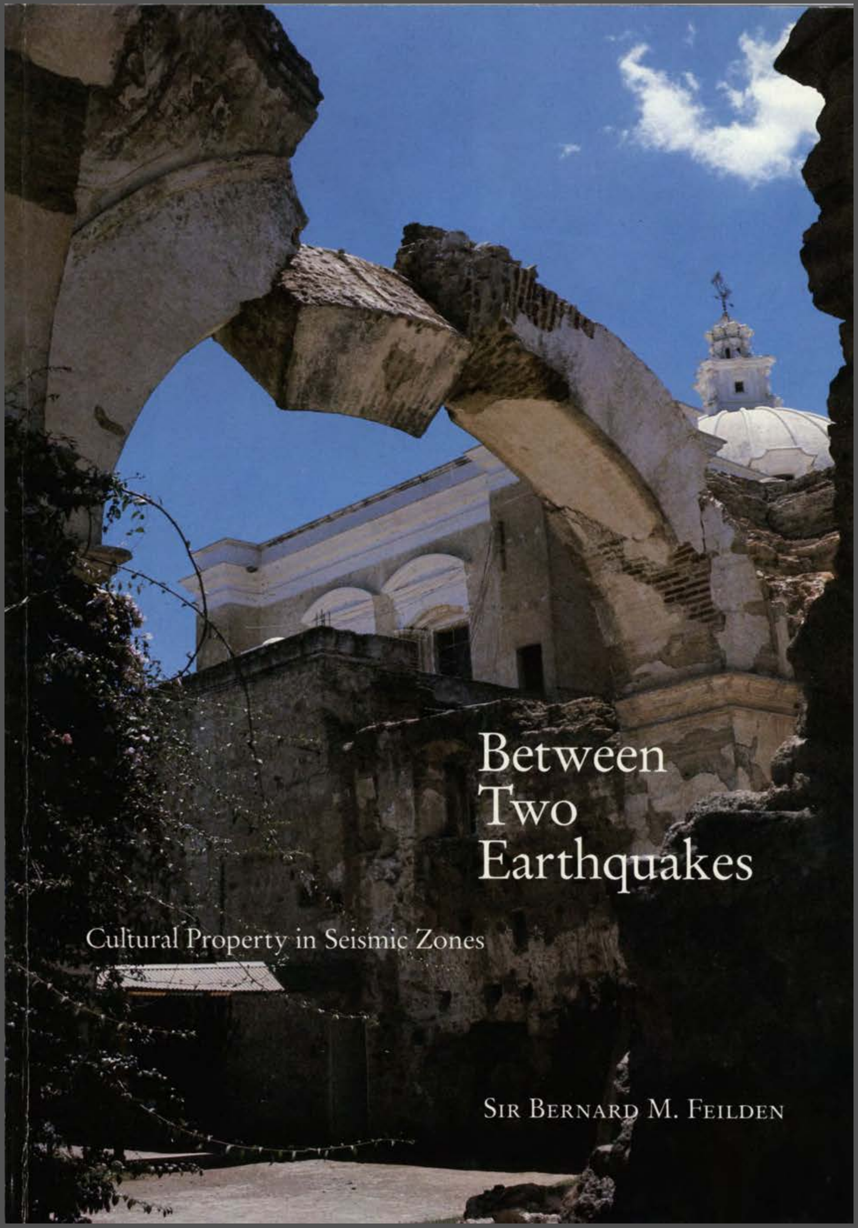
KNOWLEDGE OPPORTUNITES

RESEARCH OPPORTUNITIES

Historic Research
- Architectural and Engineering History
- A-seismic Engineering History
- Construction History

Technical Research
- Wall Characterizations
- Connection Types
- Truss Types
- Assembly Behavior
- Material Composition

Research and dissemination of each of these topics improves the ability of owners, design professionals, and stakeholders to conserve heritage structures.



READING LIST

Sir Bernard Feilden, *Between Two Earthquakes: Cultural Property in Seismic Zones*, 1987.

An excellent introduction to cultural heritage and earthquakes.

Available from as a PDF from www.getty.edu

READING LIST

Seismic Retrofitting, Conservation Perspectives: The GCI Newsletter, Spring 2015

Entire issue on seismic retrofitting of heritage structures. Includes articles by several symposium speakers.

Available from as a PDF from www.getty.edu

IN THE WAKE OF QUAKES

The Seismic

BY DANIEL TORREALVA AND CLAUDIA CANCINO

The seventeenth-century colonial Church of Kuño Tambo sits four thousand meters above sea level in the Peruvian Andes and is the most important building in its small town of five hundred inhabitants. Two hours' drive from the city of Cusco, the town's 150 or so earthen houses, together with the church, represent a historic rural settlement typical of the Andean region found from Colombia to Chile.

Built with thick adobe walls and a wooden truss roof covered with clay tiles, the church has preserved most of its original architectural features, including its three-hundred-year-old mural paintings. Nevertheless, during its history the church has suffered from a series of earthquakes and a lack of maintenance. These factors have resulted in the structure's partial collapse and, sadly, the cessation of its ecclesiastical use.

Four hundred kilometers northwest of Kuño Tambo, near the Peruvian coast, is the city of Ica, founded by the Spanish in 1563. Fronting the city's main square is the Cathedral of Ica, originally built in 1759 by the Jesuits. Throughout its history, the cathedral has hosted the city's important religious events and has been Ica's central place of worship. Its design follows the Jesuit typology established by the Church of the Gesù in Rome—a rectangular base plan consisting of a central nave, two side aisles, a transept crowned by an impressive dome, and an altar—and is thus typical of many cathedrals found on the west coast of South America. Its facade, probably from a later period, has two towers. On August 15, 2007, a 7.9–8.0 magnitude earthquake with an epicenter eighty kilometers northwest of Ica caused widespread damage to the cathedral, which suffered partial collapse of the vaulted roof and the main dome, as well as extensive loss to its adobe walls, wattle and daub pillars, and other architectural elements, including its towers and facade. In 2009 another earthquake led to the total collapse of the dome.

Earthen buildings such as the Church of Kuño Tambo and the Cathedral of Ica are typically classified as unreinforced masonry structures, which are extremely vulnerable to earthquakes and subject to sudden collapse during seismic events—especially if a

The village of Kuño Tambo in the Peruvian Andes. The large building on the far left is the Church of Kuño Tambo, where the GCI is involved in a collaborative seismic retrofitting project. Photo: Wilfredo Carazas.

READING LIST

Daniel Torrealva and Claudia Cancino, "In The Wake Of Quakes: The Seismic Retrofitting Project in Peru."

Article co-authored by symposium speaker Daniel Torrealva on research and retrofitting Spanish-era buildings in Peru.

READING LIST

Stephen Kelley and Rohit Jigyasu, "Between Two Earthquakes: From Recovery To Mitigation And Preparedness."

Article co-authored by symposium speaker Stephen Kelley on pre- and post-earthquake prevention of damage to heritage structures.

BETWEEN TWO EARTHQUAKES

From Recovery to Mitigation and Preparedness

BY STEPHEN KELLEY AND ROHIT JIGYASU

IN THE IRANIAN CITY OF BAM IN 2003, BAM CITADEL—ONE of the world's largest adobe forts and a UNESCO World Heritage Site—was devastated by an earthquake. Not only was the citadel almost leveled, but more than 85 percent of the adobe brick houses in Bam were damaged. There are, of course, other vivid examples of heritage loss in recent years: the L'Aquila, Italy, earthquake of 2009; Haiti's 2010 earthquake near Port-au-Prince; the 2011 Christchurch, New Zealand, earthquake with the loss of its namesake cathedral; monasteries and pagodas in Myanmar destroyed by the 2012 Shwebo earthquake; and severe damage to Spanish-era churches on the Philippine island of Bohol in 2013. Earthquakes continue to cause immense damage to built cultural heritage.

Built heritage is exposed to various natural hazards, but seismic events are unique in that—unlike floods, storms, and fires—there is no warning, and thus the loss of life can be staggering. And earthquakes cause damage not just from shaking but also from related hazards. During the 1964 Alaska earthquake there was significant damage from soil liquefaction. The Erwang Temple in Dujiangyan, China, was extensively damaged by a landslide caused by the 2008 Wenchuan earthquake. A tsunami following the Great East Japan earthquake of 2011 swept away entire villages. The fire that devastated historic neighborhoods of wooden houses following the 1995 Kobe earthquake, also in Japan, illustrates the increased vulnerability of cultural heritage due to the interruption of essential services following a major seismic event.

An overlay of World Heritage Sites on a map of earthquake hot spots of the world reveals that many of these sites are vulnerable to earthquakes. Therefore, effective measures must be taken to reduce seismic risks. The importance of thorough methodologies for assessing earthquake damage and of appropriate measures for their mitigation, preparedness, and recovery is recognized, but these measures have been insufficiently developed and implemented.

The Santisima Trinidad Parish Church in Loay, Bohol, in the Philippines. The church, a National Cultural Treasure, suffered enormous damage as a result of an October 2013 earthquake. Its concrete neoclassical facade collapsed during the event. Photo: Stephen Kelley.

REDUCING SEISMIC VULNERABILITY

Retrofitting Historic Buildings

BY PAULO B. LOURENÇO

THE VALUE OF PRESERVING HISTORIC BUILDINGS IS INCREASINGLY accepted by society, which not only recognizes built cultural heritage as a part of its identity but is also more cognizant of its economic value. In Europe, for example, tourism accounts for 10 percent of the GDP in the EU and 12 percent of employment.[1] Built cultural heritage is a fundamental element of what draws tourists to European destinations.

To a great extent, the value of historic buildings rests in the integrity of their components as unique products of the technology of their time and place. Unfortunately, cultural heritage buildings are particularly vulnerable to disasters, for a variety of reasons. They are often damaged or in a state of deterioration; they were built with materials with low resistance; they are heavy; and the connections among their various structural components are frequently insufficient. The main causes of damage are lack of maintenance, water-induced deterioration (from rain or rising damp), soil settlement, and extreme events such as earthquakes. Earthquakes have caused hundreds of thousands of deaths in the last decade, in addition to the tremendous losses in built cultural heritage.

A METHODOLOGY FOR INTERVENTION

Studies indicate that investment in measures to reduce the vulnerability of buildings yields an average value of four times the amount invested.[2] Retrofitting of buildings to increase earthquake resilience offers a cost-benefit of up to eight times the value of the investment. In the case of built cultural heritage, the structures are invaluable and cannot be reconstituted by post-disaster measures. Earthquakes occur randomly, and they can be larger than those anticipated in safety regulations; it is therefore necessary to take steps, in advance, that can reduce the risk of damage and promote subsequent recovery.

Modern conservation respects the authenticity of a building's historic materials and structure. In practice, interventions must be based on understanding the nature of the building and the actual causes of damage or change. The goal is a minimum of interventions and an incremental approach; much importance is attributed to diagnostic studies of historical, material, and structural issues. In 2003 these considerations were summarized in recommendations issued by the International Council on Monuments and Sites,[3] recognizing that conventional techniques and legal codes oriented to the design of new buildings may be difficult to apply, or even inapplicable, to heritage buildings. These recommendations

The interior of the Church of Santa Maria Assunta in Paganica, Italy, badly damaged by the 2009 L'Aquila earthquake. Photo: Paulo B. Lourenço.

READING LIST

Paulo B. Lourenço, "Reducing Seismic Vulnerability by Retrofitting Historic Buildings."

Article by symposium speaker Paulo B. Lourenço on methodologies, research, and practice of seismic retrofitting heritage structures.

MASTERING THE MECHANICS OF THE PAST

A Discussion about Preservation Engineering

ANDRONIKI MILTIADOU-FEZANS, a structural engineer specializing in historic structures, is director of the Directorate Special for the Promotion and Enhancement of Cultural Heritage and Contemporary Creation at the Ministry of Culture, Education, and Religious Affairs of the Hellenic Republic. She has been responsible for many structural restoration projects in Greece and teaches at the Raymond Lemaire International Centre for Conservation in Belgium and at the postgraduate conservation program of the National Technical University of Athens.

CLAUDIO MODENA is a professor of structural engineering at the University of Padua. He has served on a number of research and scientific committees related to earthquake engineering and seismic risk and has done extensive consulting internationally, focusing generally on the conservation of historic masonry structures.

JOHN OCHSENDORF is a structural engineer specializing in the analysis and design of masonry structures and is a professor at the Massachusetts Institute of Technology, holding a joint appointment in the departments of Architecture and Civil and Environmental Engineering. He is a founding partner of Ochsendorf DeJong and Block Engineering.

They spoke with **CLAUDIA CANCINO**, a senior project specialist at the Getty Conservation Institute, and **JEFFREY LEVIN**, editor of *Conservation Perspectives, The GCI Newsletter.*

CLAUDIA CANCINO In recent decades, structural interventions on historic structures, appropriate or not, have sparked a series of discussions about the role an engineer should play in a conservation project. What do you think is the role of a preservation engineer?

ANDRONIKI MILTIADOU-FEZANS Structural intervention on historic structures is a matter that cannot be dealt with only by a structural engineer—it is a project for a multidisciplinary team. Of course within the team, an engineer plays a very important role. His or her main duty is to document a structure's bearing system, to design and supervise the necessary investigations, to assess the structure in its current state, and to design the necessary interventions in collaboration with architects, archaeologists, and others—all in order to ensure as much as possible the survival of the structure from damage or even collapse. Of course, the engineer has the responsibility of ensuring that human life is protected, but at the same time, together with safety, has to propose interventions that take into account all the other values—such as historical, architectural, and aesthetic—in an effort to limit their possible alterations due to intervention. He or she needs to elaborate on alternative solutions and to put them on the table to be debated with other professionals on the team to reach an optimum solution. Consequently, the engineer should have the ability to communicate these structural matters to the team, so the team can discuss them and reach the optimum compromise.

CLAUDIO MODENA I agree that the role of the engineer is to consult with the team and to bring to the team his knowledge about the structural performance of different types of material and the ways to evaluate them.

JOHN OCHSENDORF For me, the first responsibility of an engineer is to work closely with the other disciplines—historians to learn the history of a monument, architects to learn the design intent for future use, conservators to understand the challenges in terms of material conservation, and also the property owner to understand the owner's needs and challenges. Engineers must then offer a range of solutions that can be debated on their merits. Engineering problems never have just one solution. Furthermore, every solution has pros and cons in terms of cost, authenticity, durability, and reversibility. The primary role of the preservation engineer is to put on the table a range of solutions. In many cases, doing nothing should be on the table. Too often, it is not.

CANCINO I also agree that engineers should be part of a team in a conservation project, but I was wondering about their capabilities to intervene in historic structures. Do engineers in general,

READING LIST

"Mastering the Mechanics of the Past: A Discussion About Preservation Engineering."

Discussion between three structural engineers, including symposium speaker Claudio Modena, on heritage engineering.

TOWARD A PHILOSOPHY OF PRESERVATION ENGINEERING

JOHN OCHSENDORF

Introduction

Structural engineers are increasingly called upon to assess the safety of historical buildings, bridges, walls, dams, and other structures. However, a preindustrial timber truss, a rubble-masonry wall, or a cracked concrete slab may present significant challenges to the conventional structural engineer. Even more, when faced with a highly deformed Gothic stone vault, a brittle glass-and-iron dome, or a leaning stone tower, an engineer may quickly assume that such a structure does not satisfy current building codes and is therefore unsafe. In such cases, the obvious path for the engineer is to add new structural elements, which are easier to calculate and which allow for greater peace of mind. The more difficult path is to prove that the structure is safe and that it does not require additional support. If a structure has been standing for centuries, or even decades, then the structure is able to find a load path to support itself. It is the engineer's challenge to find at least one possible load path and to prove the safety of the structure under reasonable expected loadings. To maintain historical authenticity, to practice with integrity, and to save scarce resources, a preservation engineer should avoid intervening in a historic structure if at all possible.

For a consulting engineer, strengthening a historic structure is an easy path to take. It is much more difficult to prove that the structure is safe and that it does not require an intervention. According to Prof. Santiago Huerta of the Polytechnic University of Madrid, there are three primary motivations that can lead to unnecessary structural interventions:

- **Fear**. If the structure collapses and people are killed, the engineer may be held responsible. This is a valid concern, and it may be justified in some cases.
- **Inexperience**. Many engineers lack a fundamental understanding of the mechanics of even simple historic structural elements, such as a brick arch. This is understandable, since engineers are trained almost exclusively in the elastic design of steel and concrete beams, columns, and frames. Moreover, the techniques and software that serve admirably for the design of new framed buildings are wholly unsuited for most historical structures. Since most universities do not attempt to teach courses on the theory and analysis of historical structures, engineers are expected to learn from experience and to rely heavily on intuition, rather than on a deep understanding of the theory of historic structures.
- **Money**. Consulting fees are often based on a percentage of the overall cost of a project. If an engineer decides that a structure is safe and requires no intervention, the project will be much less lucrative than if a major intervention is required. Furthermore, some clients prefer to spend money on repairs, rather than on additional studies to prove that the repairs are unnecessary. Financial incentives can lead to unnecessary strengthening.

Thus it is important to understand the motivations that lead engineers to intervene in historical structures and to consider ways in which preservation-minded engineers can avoid unnecessary interventions. Of course in some cases, it is essential for engineers to intervene, as in the case of the Leaning Tower of Pisa, where increasing displacements were clearly leading towards collapse. In such cases, it is essential to identify best practice and to agree on principles to guide the intervention.

Principles of Preservation Engineering

In assessing a historic building, it is essential to approach the structure with humility. The aim of the preservation engineer is to pass the structure on to future generations, and, therefore, the structure will likely be standing long after the engineer is no longer alive. If a computer model predicts that the structure does not stand up despite the fact that it has been standing for a century, then that model is likely incorrect. Current software packages are not capable of analyzing many historic structures, but it is not easy to admit the limitations of sophisticated finite-element programs. Finally, the builders of historic structures likely had greater knowledge of the materials and construction systems than today's engineer. How many twenty-first-century engineers have built a masonry vault? These considerations point to the need for humility when assessing historic structures.

Preservation engineers must work in an interdisciplinary team. The history of the structure; its construction, materials, systems; and its context can only be fully understood from different viewpoints. Archaeologists, preservationists, conservators, craftsmen, materials scientists, historians, architects, and others can provide essential perspective to inform the possible courses of action. No engineering problem has only one solution; preservation engineers should propose a range of solutions and should debate the merits and drawbacks of each with the rest of the preservation team. For monuments of national and international importance, professional peer review from other engineers can enrich the dialogue and sharpen the decision making.

Some structures are not safe and will require an intervention. When interventions are required, engineers should follow basic principles of preservation. Any new intervention should be reversible, allowing future engineers to undo the work if necessary. New work should be compatible, both chemically and mechanically, with traditional materials. In general, it is often best to repair with traditional materials. Following the principles of reversibility and compatibility would have prevented the indis-

READING LIST

John Ochsendorf, "Toward A Philosophy of Preservation Engineering," APT Bulletin, Special Issue On Preservation-Engineering Education, 2013.

Email zwr@earthlink.net for a copy.

From the *Bulletin* of The Association for Preserva-tion Technology Interna-tional, an international organization of engineers, architects, contractors, and preservation professionals.

Join at www.apti.org and begin a Philippines chapter.

NIKER NEW INTEGRATED KNOWLEDGE BASED APPROACHES TO THE PROTECTION OF CULTURAL HERITAGE FROM EARTHQUAKE-INDUCED RISK

NIKER Grant Agreement n° 244123

Deliverable 3.1

Inventory of earthquake-induced failure mechanisms related to construction types, structural elements, and materials

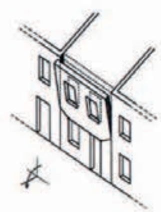
Due date: April 2010
Submission date: September 2010
Issued by: POLIMI

WORKPACKAGE 3: Damage based selection of technologies

Leader: POLIMI

PROJECT N°: 244123
ACRONYM: NIKER
TITLE: **New integrated knowledge based approaches to the protection of cultural heritage from earthquake-induced risk**
COORDINATOR: Università di Padova (Italy)
START DATE: 01 January 2010   START DATE: 01 January 2010
INSTRUMENT: Collaborative Project
Small or medium scale focused research project
THEME: Environment (including Climate Change)





Dissemination level: PU   Rev: FIN

READING LIST

NIKER

European research project on improvement of seismic behavior of cultural heritage structures and artistic assets, includes research and practice on heritage materials and assemblies, technologies, methodologies, structural modeling, design, implementation, and monitoring

Research downloads available as PDFs from www.niker.eu/downloads/

PERPETUATE

PERformance-based aPproach to Earthquake proTection of cUlturAl heriTage in European and mediterranean countries

FP7 - Theme ENV.2009.3.2.1.1 - ENVIRONMENT
Grant agreement n° 244229

DELIVERABLE D22

Definition of confidence factors for the safety verification

Delivery date:	30 December, 2011
Date of approval:	.........., 2012

READING LIST

PERPETUATE

Research project to develop European guidelines for the evaluation and mitigation of seismic risk to cultural heritage assets, exploring traditional and modern techniques for seismic strengthening of heritage buildings and the conservation of immovable artworks.

Research downloads available as PDFs from www.perpetuate.eu/final-results/reports/

Bull Earthquake Eng (2015) 13:5–12
DOI 10.1007/s10518-014-9710-1

EDITORIAL

Performance-based assessment of cultural heritage assets: outcomes of the European FP7 PERPETUATE project

Dina D'Ayala · Sergio Lagomarsino

Received: 24 November 2014 / Accepted: 25 November 2014 / Published online: 11 December 2014

The damage assessment to cultural heritage assets after recent earthquakes, in particular in Italy (Umbria and Marche, 1997; L'Aquila, 2009; Emilia, 2012), showed the high vulnerability of some types of historical structures (palaces, churches, towers etc.). Earthquakes also proved that strengthening interventions adopted in the last decades are often invasive, ineffective and might also increase the vulnerability. Thus, there is an urgent need for developing reliable assessment procedures and promoting effective strategies for the seismic risk mitigation of cultural heritage .

The preservation of cultural heritage assets must guarantee their capacity to last over time against decay, natural hazards and extreme events, without losing their authenticity and use.

A strong engineering contribution on assessment and strengthening methods for historic and heritage buildings was developed in the latter part of the twentieth century in Europe and the Mediterranean Region. In particular, ICOMOS and ICCROM have promoted an important campaign to raise awareness on structural conservation through the writings of Sir Bernard Feilden (1987) and the constitution of an ICOMOS International Scientific Committee for the Analysis and Restoration of Structures of Architectural Heritage (ISCARSAH) in 1996, which led to the adoption of the ISCARSAH Principles in 2003.

The growing attention to this topic is demonstrated by the European Commission's funding of two large consortia that had submitted a research proposal under the call FP7-ENV-2009-1, on the effect of natural hazards on the cultural heritage, specifically earthquake.

The PERPETUATE project (Performance Based Approach to Earthquake protection of Cultural Heritage in European and Mediterranean Countries) had as main objective to produce European Guidelines for the evaluation and mitigation of seismic risk to cultural heritage assets, useful to support the design of strengthening interventions for the preservation of the architectural building and the contained unmovable artworks. The ambition was to develop

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S. Lagomarsino
University of Genoa, Genoa, Italy

READING LIST

PERPETUATE

The PERPETUATE project results are presented in a Special Issue of the *Bulletin of Earthquake Engineering*, 2015, including articles by symposium speaker Sergio Lagomarsino.

HERITAGE BUILDING CODES

HERITAGE BUILDING CODES

Building codes are laws or regulations that describe the minimum requirements for building safety.

Heritage building codes protect life safety *and* heritage values.

Disaster is the origin of building codes.

Building codes are tools of resilience.

What type of building code provides for heritage resilience?

HERITAGE BUILDING CODES

After all disasters, natural and manmade, that affect our lives and property, humans assess the damage done – what caused the damage, what worked to resist that damage, and what did not. Filipinos have been doing this for generations.

In the beginning as a Spanish city, Manila was a city of wood, bamboo, and nipa. Following the great 1583 fire that flattened Manila, Governor-General Santiago de Vera required all new buildings to be built of stone. On the 30th of November 1645, at 8 in the evening Luzon was severely shaken by what is now estimated to be a 7.9M_w earthquake, and most of Manila's stone buildings fell.

1645 MANILA EARTHQUAKE

“The stone walls were shaken and bent like sheets of paper or parchment fluttered by the wind; the towers swayed and bent like trees; and the largest trees [broke] like the mast of a ship in the midst of a fierce hurricane. Nothing could be heard but the crash of buildings mingled with the clamour of voices entreating heaven for mercy.”

Chaplain Joseph Fayol, 1645

Thus began the Spanish understanding of the true power of the earth in the Philippines.

Seismologists believe that between the years 1600 and 1900 seventeen earthquakes either reduced entire towns to ruin or devastated whole districts throughout the Philippines.

FILIPINO BUILDING CODES

With each new disaster, whether fire, typhoon, or earthquake, new building laws were passed, to provide for a more resilient building stock, and thus leading to the creation of two of the most significant building types in the Philippines: “Earthquake Baroque” churches and *bahay na bato*, or the stone house, both intended to be earthquake resistant, or a-seismic construction.

BUILDING REGULATIONS FOR MANILA;

DRAWN UP IN CONSEQUENCE OF THE EARTHQUAKES OF 18TH AND 20TH JULY, 1880.

Government-General of the Philippine Islands, Civil Administration, Public Works Branch.

In accordance with the orders of His Majesty's Government, contained in the official telegraphic despatch of the 21st of last month, relating to the plans and technical conditions to which public and private buildings in these provinces are subjected;

Considering the opinion expressed by the Consulting Committee of Public Works and by the General Meeting of the Administrative Council;

Considering the law 4, title 23, part 7 of the last official volume of laws which applied the law 7, title 19, part 3, of the same Code to all the dominions of his Majesty;

Considering that the Administration has the incontestable right and the unavoidable duty of looking after the security of the inhabitants, greatly threatened by the falling of stone-buildings during the earthquakes which so frequently disturb this soil;

Considering that the serious losses sustained by house owners render it necessary to harmonize as far as possible the interests of the public with those of the respectable class (the house-owners), unfortunately now, so worthy of commiseration, and to which class the greatest guarantees must be given that

Building Regulations for Manila: Drawn Up in Consequence of the Earthquakes of 18th and 20th July, 1880.

The 1880 Manila building code regulated foundations, stone walls, buttresses, mortar, trusses, balconies, and roofing.

Building Regulations for Manila: Drawn Up in Consequence of the Earthquakes of 18th and 20th July, 1880.

7.—The height of stone walls of public buildings must be in accordance with their use and disposition, but in private buildings they must be limited to a height corresponding to the ground-floor of such buildings; but they can also have a basement store in addition.

8.—The length of stone walls cannot be more than double their height without their being supported by cross walls or strengthened by exterior or interior buttresses.

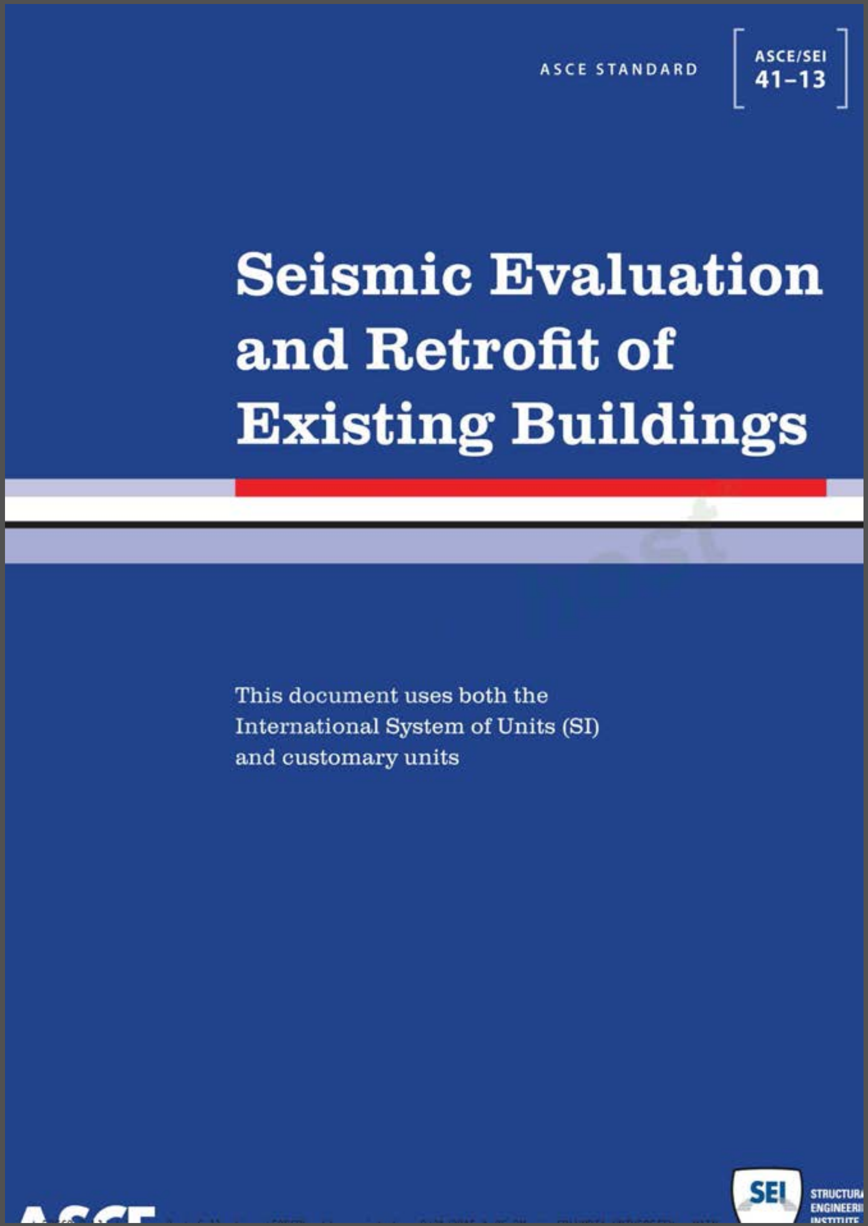
9.—The thickness of stone walls must be at least one-fifth of their height. In this thickness is not included the stone facings or brick linings of walls, which are not of the same construction throughout.

The thickness of transverse walls can be reduced a little according to the span of the floors which they support, but it must never be less than one eighth of the height.

10.—The angles of the building must be strengthened by means of exterior and interior buttresses, whichever is most suited to the character of the building.

11.—The exterior walls must be perfectly united with the transverse walls and with the buttresses, and the whole construction must be executed carefully and uniformly.

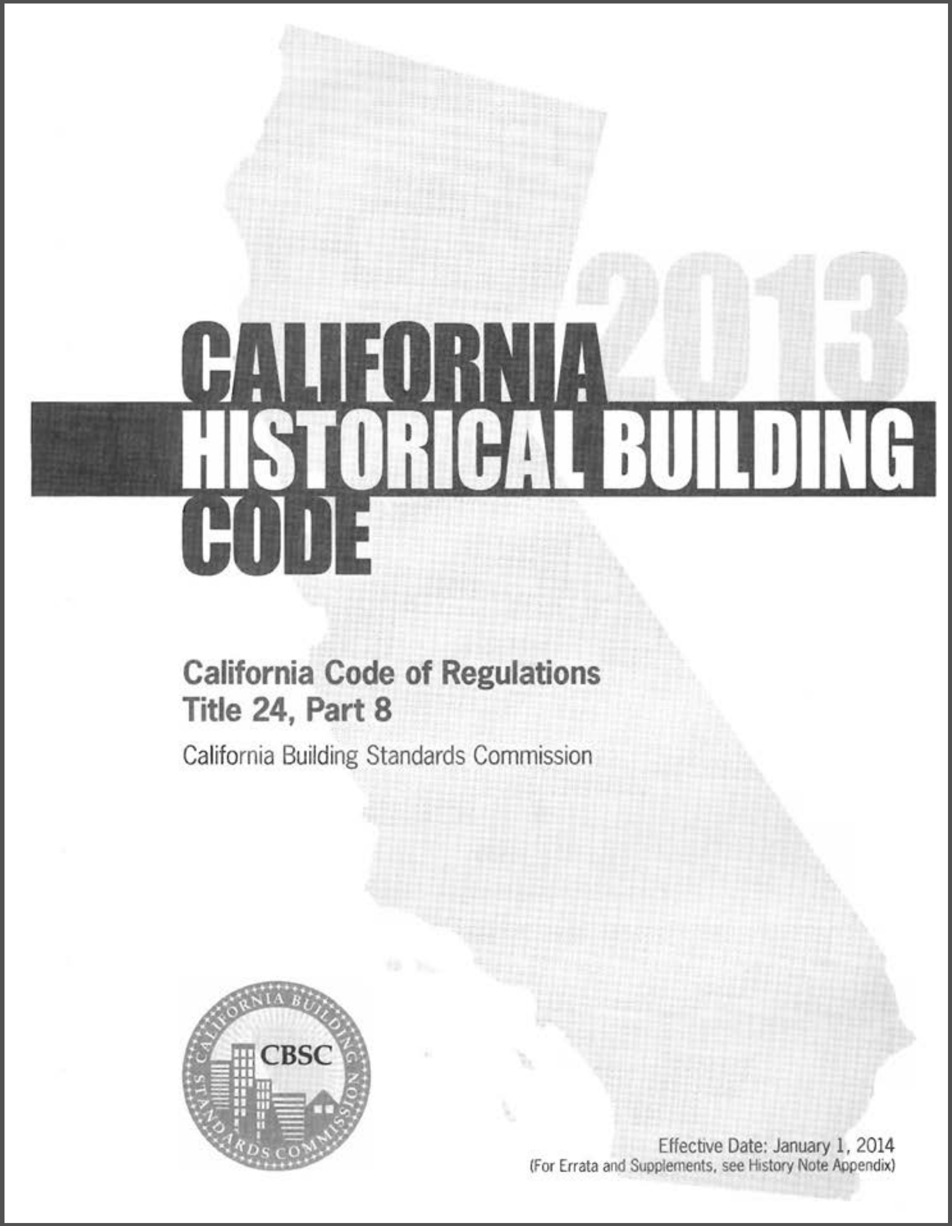
The 1880 building code was based on commonly known “rule of art” standards for properly constructing masonry walls in seismic zones.



ASCE/SEI 41-13: Seismic Evaluation and Retrofit of Existing Buildings, 2014

The most up-to-date international seismic standard for existing buildings, which is being considered by reference to the NSCP, and is applicable to heritage structures for both structural and non-structural evaluation and retrofit, with limitations.

See also the PERPETUATE project and California Historical Building Code for other heritage codes.



California Historical Building Code, 2014

A comprehensive heritage building code that may be an appropriate model for the Philippine Heritage Code.

Available as a PDF from ohp.parks.ca.gov/pages/1074/files/2013%20CHBC.pdf

TABLE OF CONTENTS

California Historical Building Code, 2014

For all types of structures, includes administrative requirements, use and occupancy, fire protection, means of egress, accessibility, structural, materials and construction types, and mechanical systems.

HERITAGE DOCUMENTATION

HERITAGE DOCUMENTATION

WHY DOCUMENT?

Record the building for posterity
Make the knowledge accessible for:

- Scholars
- Disaster recovery teams
- Architects for evaluation
- Engineers for analysis
- Reconstruction if destroyed
- The next restoration or retrofit project
- The public for enjoyment

Heritage documentation should be publically accessible at libraries and archives and online, such as the US Library of Congress - www.loc.gov/collections/architecture-design-and-engineering-drawings/about-this-collection/

HERITAGE DOCUMENTATION

Documentation Standards are required for uniformity of records, and include :

- Recording Methods
- Hand Measuring
- Laser Scanning
- Drawings
- Photography
- History
- Storage
- Dissemination

HERITAGE DOCUMENTATION

An example are the US National Park Service Standards & Guidelines of the Heritage Documentation Programs - HABS/ HAER/HALS:

Historic American Building Survey
Historic American Engineering Record
Historic American Landscape Survey

See www.nps.gov/hdp/standards/index.htm/

Types of heritage documentation include:

Narrative History
Large Format Photographs
Measured Drawings
Historic Structure Reports

HABS
TEX
15-SANT.V,
SE—

HISTORIC AMERICAN BUILDINGS SURVEY

MISSION SAN JOSE Y SAN MIGUEL
DE AGUAYO, CHURCH — HABS No. TX-333-A

Location: 6539 San Jose Road, San Antonio, Bexar County, Texas.

Present Owner: Roman Catholic Archdiocese of San Antonio.

Present Use: Public museum.

Significance: The church is a typical component of a Spanish mission complex built during the period of Texas frontier.

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Date of erection: 1768.

2. Original and subsequent owners: See History section of Mission San Jose y San Miguel de Aguayo, HABS No. TX-333.

3. Builder: Father Pedro Ramirez de Arellano.

4. Original plans and construction: Before the 1794 partial secularization of the Spanish missions, the church and the chapel were a beautiful feature. Father Jose Francisco Lopez wrote in 1789 that the entire church building and its furnishings were valued at thirty thousand pesos and eight or ten thousand pesos respectively. Ornaments, some of silver, included a frontal, a throne and a baldaquin.

B. Historical Context: See Mission San Jose y San Miguel de Aguayo, HABS No. TX-333.

PART II. ARCHITECTURAL INFORMATION

A. General Statement:

1. Architectural character: The church is of a large cruciform type with two front towers. A vaulted roof and dome, an ornate frontispiece and buttresses give the church more architectural flavor.

2. Condition of fabric: The walls are sound and the building is currently well maintained.

B. Description of Exterior:

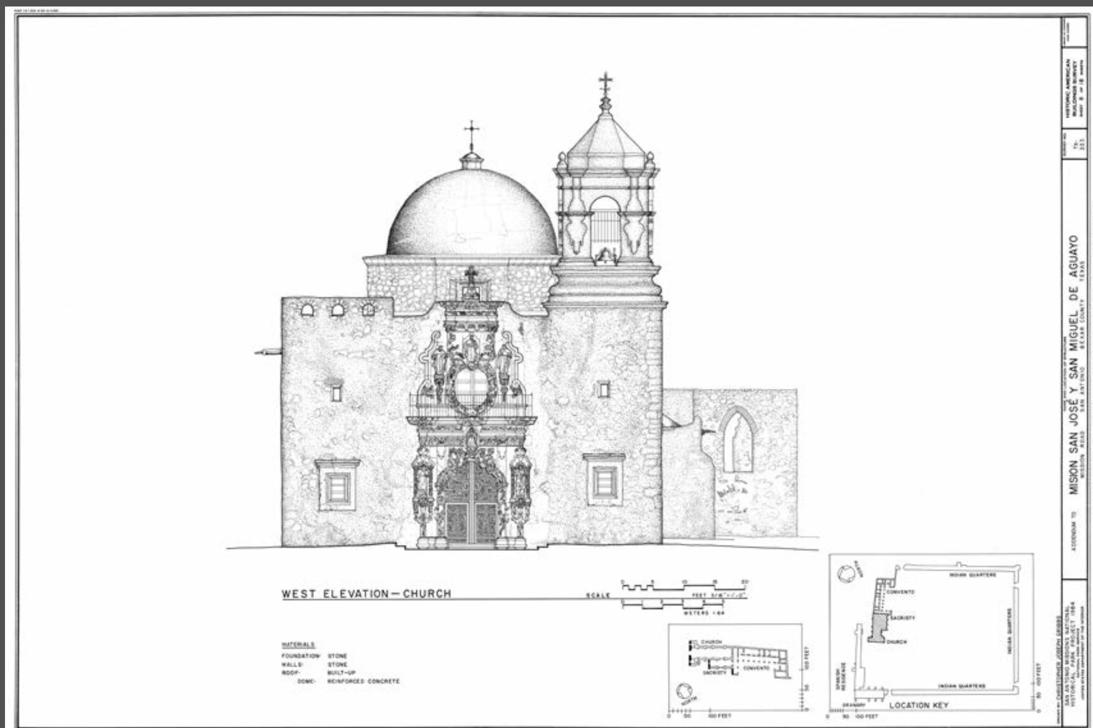
1. Overall dimensions: The church is approximately twenty feet wide and eight feet long. The front facade is approximately forty feet wide.

HERITAGE DOCUMENTATION
Narrative History

Includes basic information on location, dates, owners, engineers, architects, builders, and significance.

HERITAGE DOCUMENTATION
Large Format Photographs

Usually black & white large format negatives and prints, but may be color and digital if printed in an approved archival format



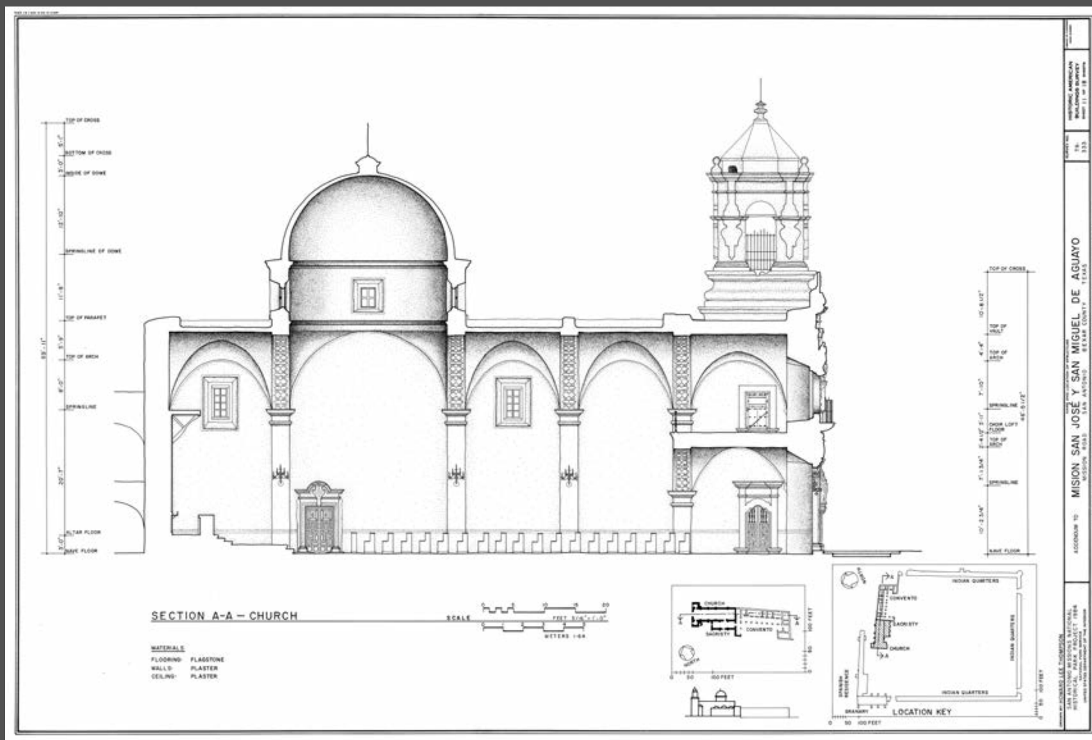
HERITAGE DOCUMENTATION

Measured Drawings

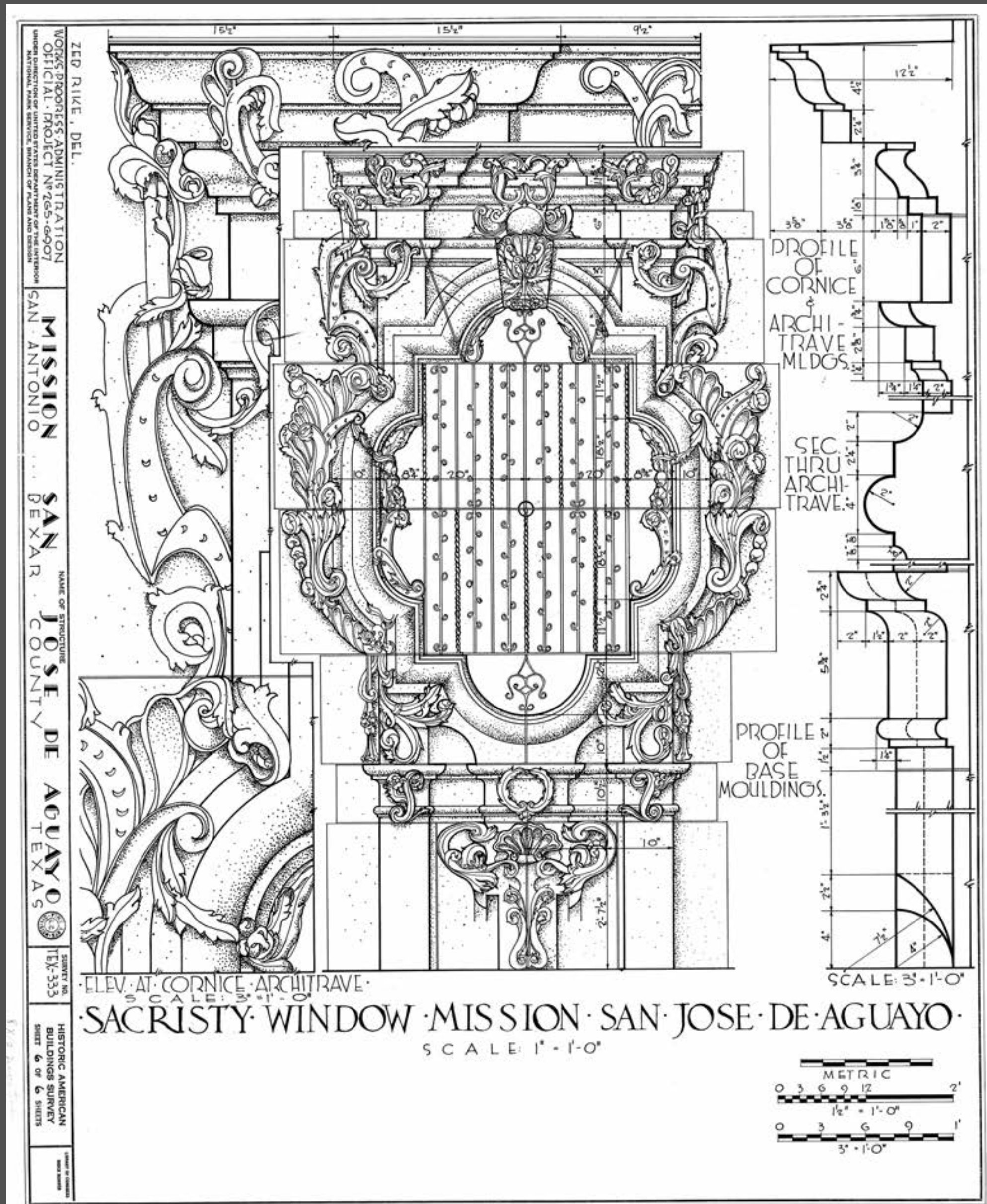
Site plan, plans, sections, elevations, and details, with materials and dimensions shown.

HERITAGE DOCUMENTATION

Measured Drawings



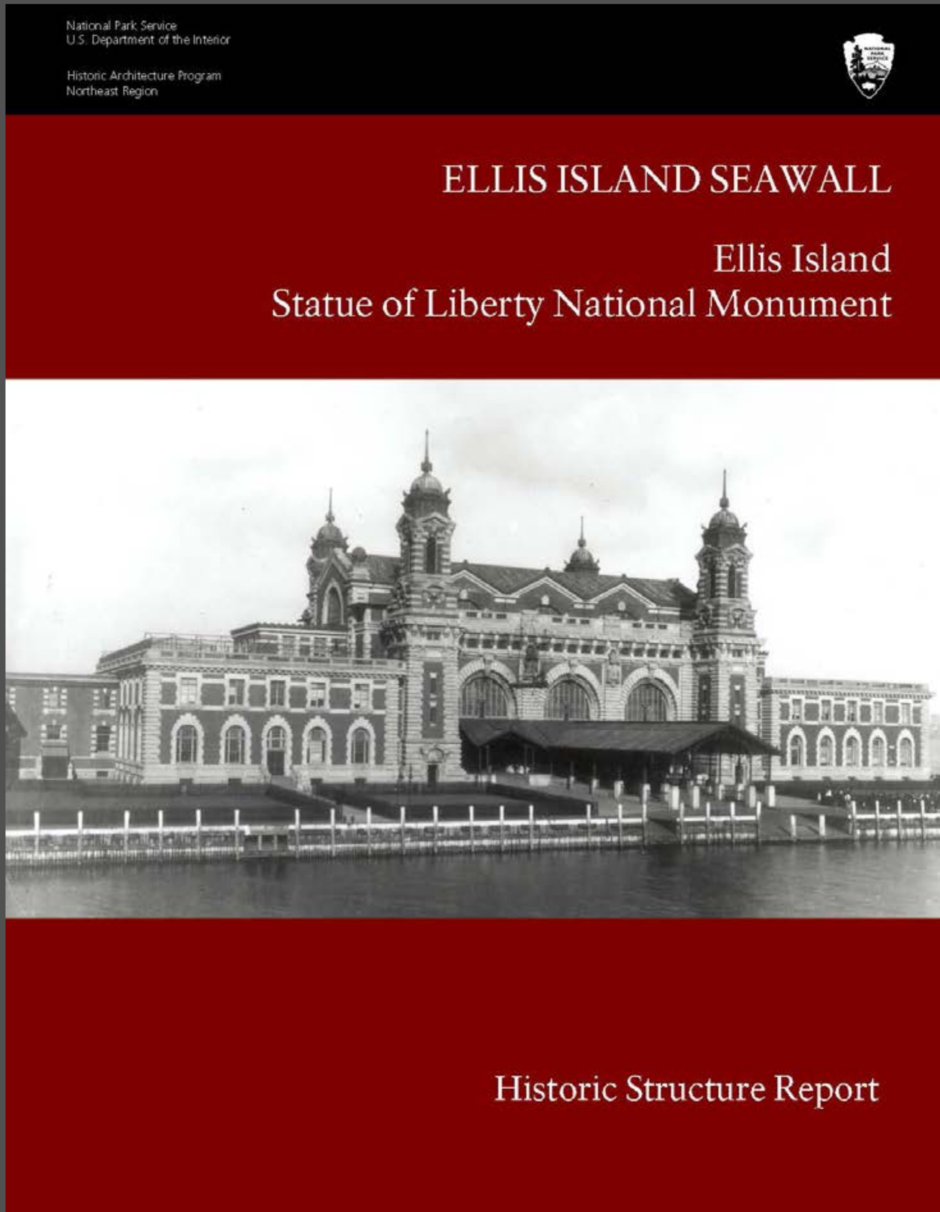
May be hand drawn of CAD, but must meet documentation standards, and final drawings must be printed on archival paper for permanent archival.



HERITAGE DOCUMENTATION

Measured Drawings

Significant details may be documented, with profiles of moldings and other elements shown, with dimensions included.



HERITAGE DOCUMENTATION
Historic Structure Report

The most detailed form of heritage documentation is known as an HSR – Historic Structure Report.

See *Historic Structure Reports & Preservation Plans:*

A Preparation Guide -

www.nj.gov/dep/hpo/4sustain/preparehsr_2015_11_02.pdf

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HERITAGE DOCUMENTATION

Historic Structure Report

An HSR provides a statement of significance, architectural structural, and site descrip - tion, and a detailed history of design, construction, and alteration.

HERITAGE DOCUMENTATION

Historic Structure Report

An HSR also includes a detailed technical chronology of construction and altera - tions, recommendations for work, a glossary, and bibliography of sources cited.

VII. APPENDICES

HERITAGE DOCUMENTATION

Historic Structure Report

The appendices of an HSR contain copies of the historic technical specifications, drawings, reports, and photographs of the structure and site.

Historic Photographs

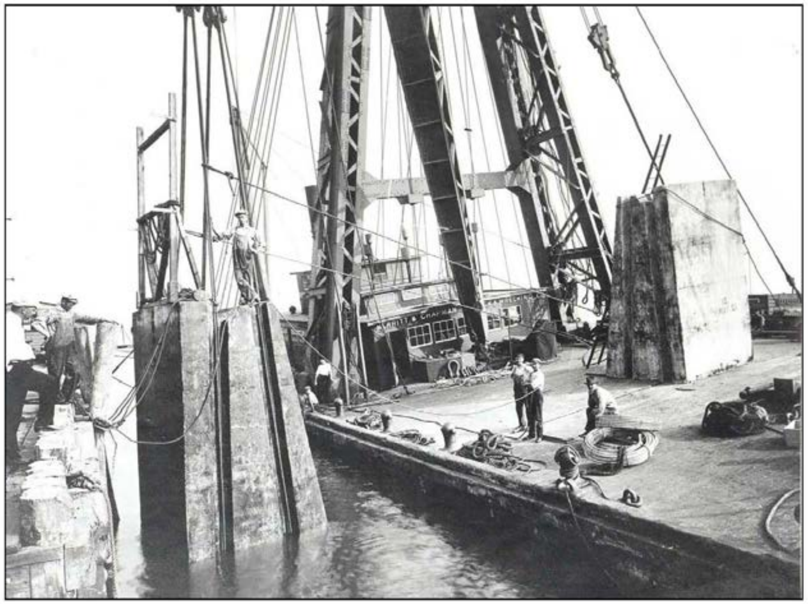

Figure 27. Setting of underwater concrete blocks for Contract 1, July 19, 1913.

HERITAGE DOCUMENTATION

Historic Structure Report

Historic Drawings

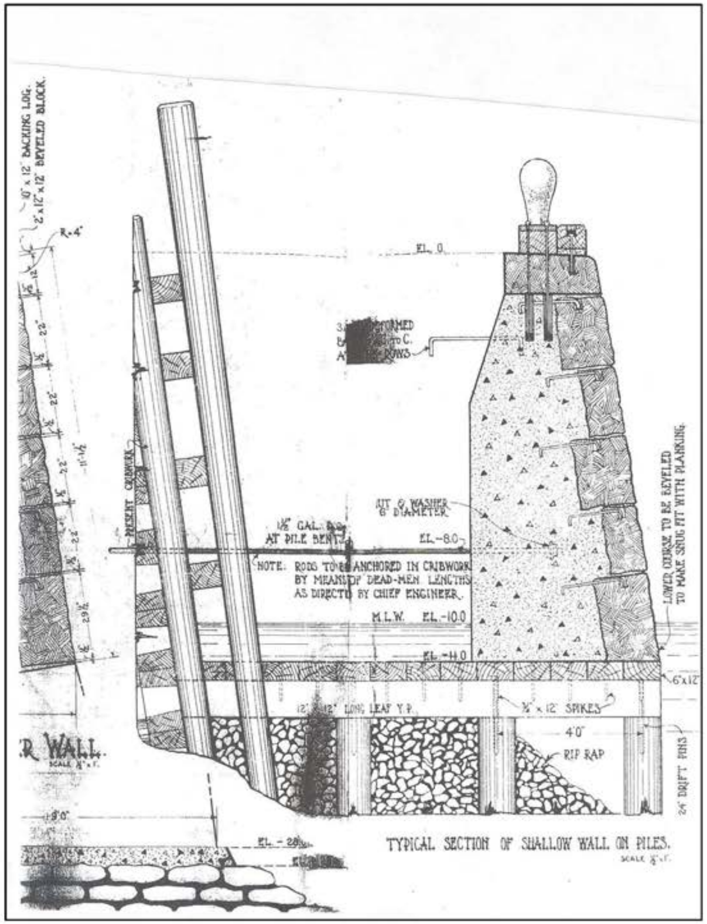

Figure 31. Lower left detail of Contract 2 drawing, December 3, 1914.

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Historic Specifications

S P E C I F I C A T I O N

For Building Cribs for United States Government at Ellis Island, New York Harbor.

Plans to be seen at the Office of

Superintendent of Repairs,
United States Public Buildings,
Room 104 Court House and P.O.Building,
New York, June 5th, 1890.

The amount of work to be done, the size of different Cribs, and the lines that they are to be built on, will be entirely in accord with the plans accompanying these Specifications.

Bidders must satisfy themselves by personal examination of the locality, or whatever means they may prefer as to the accuracy of the soundings and shall not at any time after the submission of their estimate, dispute or complain of any misunderstanding of the Specification or Plans.

The Contractor will be obliged to complete the work to the entire satisfaction of the Superintendent of Construction, and it is to be expressly understood, that no deviation from the Plans or Specification will be allowed in any respect whatever, except by written consent from the Superintendent, when he deems such alteration necessary for the best interest of the Government.

The Superintendent of Construction shall have the

(2)

MONITORING, MANTENANCE, AND INSPECTIONS

PROVIDE SAFE ACCESS FOR MONITORING, INSPECTIONS, AND MAINTENANCE

DESIGN AND CONSTRUCT FOR ACCESS

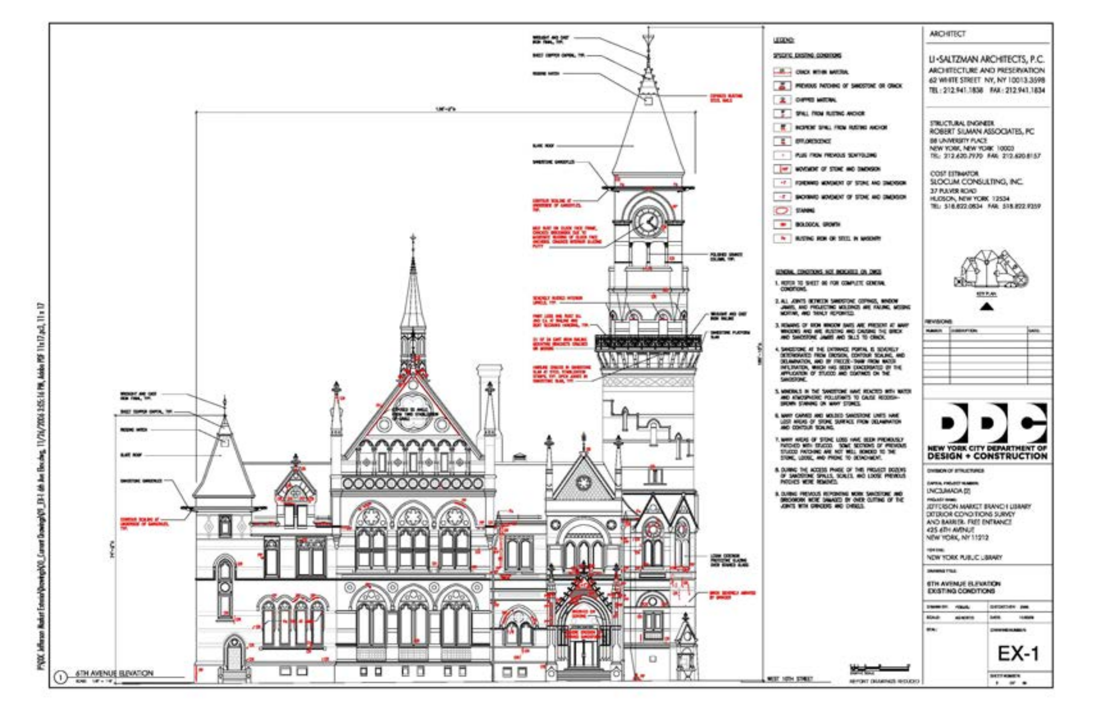
- Fixed Ladders
- Walkways
- Handrails
- Safety Lines and Access Points
- Access Openings

And provide Personal Protective Equipment – Safety Harness and Lifeline for Each Worker

PROVIDE SAFE ACCESS FOR MONITORING, MAINTENANCE, AND INSPECTION

Jefferson Market Library, New York City, 1877

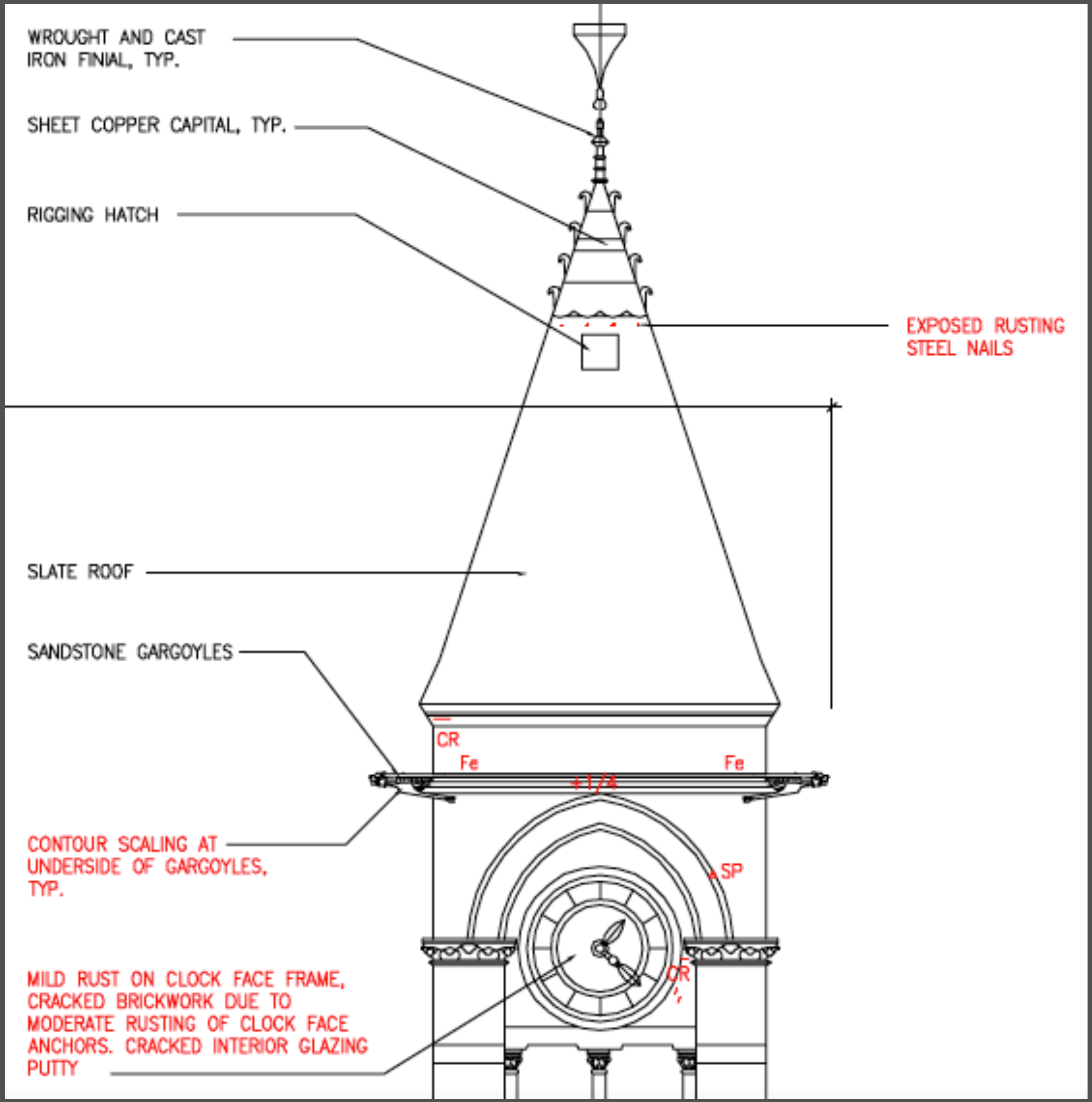
A difficult building to inspect, monitor, and maintain, due to extreme heights, steep roofs, and urban location.



PROVIDE SAFE ACCESS FOR MONITORING, MAINTENANCE, AND INSPECTION

Sample condition assessment drawing, based on hands-on inspection of the entire structure.

The drawings prepared by two Filipino architects, Filomena Barcelona and Jason Jeanjaquet, working for Li-Saltzman Architects.



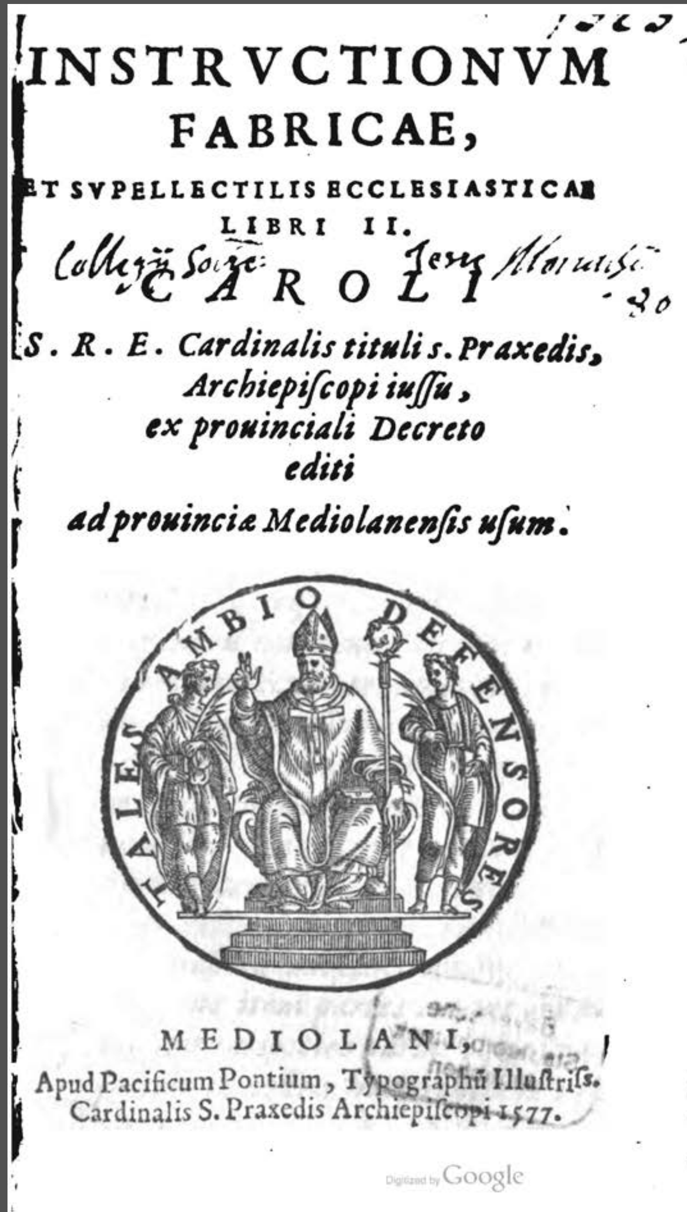
PROVIDE SAFE ACCESS FOR MONITORING, MAINTENANCE, AND INSPECTION

Detail of upper part of the tower, showing one of four rigging hatches used for industrial rope access for inspections and maintenance of the tower.

The rigging hatches were installed during a 1967 renovation and were used during the 2006 condition assessment inspections.

PROVIDE SAFE ACCESS FOR MONITORING, MAINTENANCE, AND INSPECTION

Detailed hands-on inspection of the Jefferson Market Library tower, by Vertical Access LLC, using TPAS®, direct to digital documentation Tablet PC Annotation System, **integrating condition assessments on drawings with photographs.**


INSTRVCTIONVM
FABRICAE,
ET SVPELLECTILIS ECCLESIASTICAE
LIBRI II.
CAROLI
S. R. E. Cardinalis tituli s. Praxedis,
Archiepiscopi iussu,
ex prouinciali Decreto
editi
ad prouinciæ Mediolanensis usum.

TALES AMBIO DEFENSORES

MEDIOLANI,
Apud Pacificum Pontium, Typographũ Illustriss.
Cardinalis S. Praxedis Archiepiscopi 1577.

Carlo Borromeo, *Instructionum Fabricæ Ecclesiasticæ et Supellectilis Ecclesiasticæ* (Instructions on Ecclesiastical Building), 1577

Includes instructions for church maintenance.

International Symposium on Seismic Retrofit of Unreinforced Masonry Churches in the Philippines
National Museum of the Philippines
14 January 14 2016

International Best Practices for Seismic Evaluation and Retrofit of Heritage Structures

Some Thoughts for the Philippines

Zach Watson Rice Architect
New York City, USA